ANNUAL REPORT - 2001

THE TEA RESEARCH INSTITUTE OF SRI LANKA

THE TEA RESEARCH INSTITUTE
OF
SRI LANKA

ANNUAL REPORT
FOR THE YEAR
2001

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REPORT OF THE CHAIRMAN
TEA RESEARCH BOARD

The year under review saw a name change in the TRI shear harvester that won a gold medal at the 28^{th} International Exhibition of Inventions held in Geneva in April 2000. It is now called the TRI Selective Tea Harvester as the previous name did not adequately describe its selectivity in harvesting leaf. Outmigration of workers from tea estates has led to labour shortages making plucking a difficult proposition particularly during the rush crop periods. In mitigation TRI continues in its efforts to develop simple and more efficient harvesting machines and to test those developed elsewhere.

Up until now tea fields which vary widely in respect to soil type, soil fertility, slope and terrain of land have been managed by and large, with a uniform package of inputs. For maximising production and optimising input use precision agriculture needs to be practiced where management zones are identified within a field. TRI has initiated studies on precision agriculture in tea fields.

TRI has continually been faced with staff losses due to internal and external brain drain. Various approaches adopted to stem these losses have failed. Most recently the assistance of the Ministry of Foreign Affairs was sought with no tangible results. TRI continues to suffer being unable to amass a critical mass of trained scientists essential for quality research.

TRI's corporate plan from 1999 to 2003 has been upgraded annually with new research thrusts replacing those completed.

In clonal development notable progress has been made in identifying new clones with resistance to nematodes, canker and shot hole borer through the use of newly developed rapid screening techniques. The validity of these findings have been subsequently corroborated through field assessments.

In the field of soils and fertilizers, the characterization of soils of the wet-zone tea lands was completed in collaboration with the Soil Science Society of Sri Lanka. Studies on the effects of macro elements on colour and strength of tea liquor was completed. The laboratory at Walahanduwa now has the analytical capability for samples of soil, leaf and fertilizer. A computer programme for interpreting soil, plant and fertilizer data was developed.

In the field of entomology, soil solarization enhanced by urea supplementation, and tea waste in layer arrangement (1:1 with soil) have been shown to be good alternatives to methyl bromide for nematode control in tea nurseries. Mechanical uprooting of tea was shown to lower P. loosi infestation in the soil by reducing residual root matter and decreasing the P. loosi: free living nematode ratio. A laboratory for nematode analysis (80 samples per day vs. 10 at present) equipped with new processing technology is under construction.

In organic tea culture it was found that microorganisms produced during decomposition of organic matter cause stress conditions in the tea rhizosphere when ordinary compost is used. To circumvent this deleterious effect a dual purpose compost, having both nutritional and pesticidal properties, was formulated to IFOAM standards. Also a coir dust – rubber latex combination block as developed as an alternative to the use of soil in nursery bags. This should serve as a useful rooting medium in instances where suitable soil for establishing tea nurseries is limiting.

In factory technology a simple computer model to draw a rolling program in black tea processing was developed. A prototype of a machine for bulking tea was designed and tested prior to fabricating a commercial unit.

The services of the consultant in plant breeding from the Commonwealth Secretariat was extended for a period of one year till end of year 2001. His services were used in up-grading the breeding programme and in training staff engaged in plant breeding activities.

Yield decline in tea, first observed at the High Forest Estate, is now observed to spread elsewhere and a somewhat similar yield decline in tea is reported from the Deniyaya region. TRI scientists have been grappling with this phenomenon for some years but a satisfactory outcome has not been forthcoming. A redoubling of their efforts, pursuing a multidisciplinary approach, is deemed necessary.

Scientific staff of TRI participated in scientific conferences, meetings, workshops, training programmes and seminars both locally and abroad. The scholarship programme for higher studies of TRI scientists was also continued.

TRI Staff participated in short-term training programmes under the MOA (Memorandum of Agreement) between ICAR (Indian Council for Agricultural Research) and CARP (Council for Agricultural Research Policy) Sri Lanka conducted at IARI (Indian Agricultural Research Institute) New Delhi, India on technology transfer; at the National Academy for Agricultural Research Management, Hyderabad, India in the international training programme for administrators and accountants and in an M Sc programme at Govind Ballah Pant University of Agriculture and Technology, Pantnagar, India.

An M Sc in remote sensing and GIS was also undertaken at the Asian Institute of Technology, Bangkok, Thailand.

TRI staff also participated in a 3 months full-time residential basic course in tea plantation management at Kothari Agricultural Management Centre, Tamil Nadu, Coonor, India and in an International Workshop on practice oriented results in the use of plant extracts and pheromones in integrated and biological pest control in Egypt.

International Conferences attended by TRI staff were on Nature and Ecological Balance at Haryana Agricultural University, India; on Tea Science at the International Symposium of the Plantinum Jubilee, UPASI Tea Research Foundation, Chennai, India; on Tea Research and Development in the new millenium, Johart, India; on Remote Sensing in Taipei, Taiwan; at the International Tea Conference in China; and at the International Conference on Tea Culture and Science, Shizuoka City, Japan.

Symposia attended by TRI staff were at Chennai on Tea Science and at the Tocklai Conference in Johart, India; and at the Indian Convention of Food Scientists and Technologists.

A Session of the IGG (Inter Governmental Group) on tea organized by the FAO was held in New Delhi, India. At these sessions important decisions are taken on international issues related to tea. TRI was not represented at some previous meetings and the need for TRI to be represented at these IGG sessions needs no overemphasis. Further, the local apex bodies responsible for coordinating representation at these IGG sessions should endeavour to follow up decisions taken to ensure that Sri Lankan interests are not vitiated.

Dr. S. D. I. E. Gunawardena
CHAIRMAN, TEA RESEARCH BOARD

REVIEW OF THE DIRECTOR
TEA RESEARCH INSTITUTE

Corporate Plan and Cess Allocation

As in the previous years, scientists and extensionists continued to work in a transdisciplinary mind-set. The thrusts and projects listed under the Corporate Plan were revised to suit the allocation of funds while considering the staff strength.

The Tea Research Institute's share of the cess remained at 25% for the year under review.

Achievements and highlights

Major achievements during the year under review could be summarized as follows. The project notation used in the TRI Corporate Plan, 1999 - 2003, is given in parenthesis.

* Breeding for Crop Improvement

Nine out of 36 selections in a Phase II trial at St Coombs Estate was found to be performing as high quality clones (Project A.1.1.). Nineteen old tea seedling bushes were released as potential mother bushes from an area of 7 ha which showed tolerance to blister blight and satisfactory general growth habits (Project A.1.2.).

In tea breeding research, the method of colchicine treatment for apical buds was perfected for inducing tea polyploids.

Thirty-one tea accessions conserved in an *ex-situ* field gene bank were characterized using 12 morphological descriptors. Of the 12 descriptors studied, 11 of them were identified as useful morphological descriptors for characterizing tea germplasm.

The research work on inter-specific hybridisation between *Camellia sasanqua* and *C. sinensis* showed that irrespective of the tea clone used, fruit abscission caused between 4 – 4.5 months after pollination. These results suggest that it is necessary to rescue inter-specific hybrids 4 months prior to the date of pollination (Project D.1).

An experimental protocol was worked out to recover plants *in vitro* from immature zygotic embryos obtained from fruits developed at very early stages. This study confirmed that there is a possibility of using this protocol for rescuing embryos from inter-specific hybrids.

Data from the polymerase chain reaction (PCR) using 20 selected primers on 39 clones were analysed and dendrogrammes were constructed using the results. The dendrogrammes will be useful in future plant breeding programmes to select genetically diverse parents in crossing (Project B18).

*** Improvement of Land Productivity**

A field survey was conducted in Uva and low country estates, where tea is grown using urea as the sole source of nitrogen fertiliser. It was found that the leaf sulphur concentration remained within the acceptable range and did not show any sulphur deficiency symptoms. This finding was supported by the results of a long-term (20 year) field trial testing use of urea and ammonium sulphate with increasing levels of nitrogen (Project A.15.2.).

*** Crop Management**

A mechanical hand pruner was developed to prune 1000 bushes day$^{-1.}$ This invention was patented (Thrust A21).

The efficiency of different harvesting systems was assessed. The use of the recently-developed TRI Selective Tea Harvester (TSTH) and conventional manual harvesting, and different systems of leaf collection (the conventional urea bag with cane basket/cloth bag), and the weighment procedures were compared at Great Western Estate (Project B8).

Assessments were made in terms of plucker productivity (intake rate), quality of made tea, workers' preference in regard to the innovations, and economic benefits. The results indicated that *in situ* weighment alone, or with the TSTH and the new Great Western/TRI basket, improved plucker productivity and reduced the cost of production by Rs 7-10 per kg.

Out of 29 plant species tested, *Eupatorium inulifolium* (Fam. Compositae) was found to be the only diversionary host to shot-hole borer. *Flemingea congesta* was found to be a very good host and should not be encouraged in tea lands. The beetle was totally repelled by *Tithonia diversifolia* which will be tested for use as an active agent for use in bio-traps (Project A22.3).

Stem cuttings of *Montonova bipinnafida* attract the shot-hole borer. Two major volatile compounds present in the bark of *Montonova bipinnafida* were identified using GC-MS with a view to use these compounds as trapping agents for SHB (Project A22.6).

*** Organic Tea**

The TRI is dedicating tea plots at its' St Coombs estate for more research into organic way of production. With the growing global, consumer demand for organically produced food, the market for bio-tea is enlarging, and the TRI is in the process of researching and formulating recommendations for Sri Lankan producers who may be interested in bio-tea production.

*** Pest and disease control**

Three potentially beneficial fungi were isolated locally, viz. *Trichoderma pseudokoningii. Aspergillus niger* and *Penicillium aurantiogriseum. T. pseudokoningi* proved to be the best in the control of fungi causing both red- and white root diseases. *T.pseudokoningii* was also found to be the most efficient of the three in helping bio-conversion of organic-material (Project A23.1).

Six-week solarization of soil treated with urea at the rate of 1-2 kg per cube of soil (1-2 g per plant) is recommended for eradication of nematodes. Urea in excess of 2 g per plant can cause phytotoxicity. Tea waste (refuse tea), coir dust and paddy husk are nematicidal in nature. They can be used as partial soil substitutes in tea nurseries in place of fumigation of soil with methyl bromide. Metam sodium at the rate of 600 ml per cubic meter of soil is the best chemical substitute for methyl bromide (Project D17).

By using the biochemical methods of clonal screening, eight of the prospective TRI 5000 series clones were identified as resistant to *Glyptotermes dilatatus,* the low-country live-wood termite. By the conventional method, this would have taken ten years to obtain the results (Project D19).

*** Post Harvest Technology**

A simple computer model for drawing a rolling programme for black tea processing (pure orthodox type or orthodox-rotorvane type) was designed using Microsoft Excel Software.

A method was developed to classify leafy grades of tea according to either oversize or undersize fractions retained on standard meshes when a grade is subjected to sieve separation/analysis. Results were presented at the International Organization for Standardization (ISO) Technical Committee on Tea (ISO/TC 34/SC 8) meeting held in Mombasa, Kenya. Based on the presentation, leafy grades of tea produced in Sri Lanka were exempted from classification of grades by particle size (ISO 11286) (Project B49).

Trials were carried out to determine the nett outturn of made tea to green leaf, achievable in the Up country. The results indicated a linear relationship between the nett outturn and moisture content in green leaf. The relationship is given in the following equation:

N. O = 111.75 - 1.17 (M.C)
where N.O - Nett outturn, and M.C - moisture content in the green leaf.

* Health benefits of tea

Increased populations of the fungus *Candida* in the human oral cavity could cause candidasis (oral thrush). It was established that all polyphenolic fractions in the tea brew has inhibitory actions against *Candida albicans,* thereby establishing that tea drinking could improve oral health (Project B19).

In addition to this, the fluoride content of teas from different tea growing areas of Sri Lanka was also established. Based on these results, it can be concluded that drinking 4-5 cups of Sri Lankan tea will provide 38-57% of the recommended daily allowance of fluoride.

* Monitoring Residues in Made Tea

The establishment of the pesticide-residue laboratory was completed with the installation of a Mass Selective Detector. The TRI is now in a position to assist in assessing new pesticides developed for tea by analysing the residue levels in the manufactured tea (Project D30). Tea factories interested in obtaining HACCP certification could request the TRI for residue analysis of their teas.

Facilities to determine Polycyclic Aromatic Hydrocarbon (PAHs) in made teas were established at the TRI. The PAH levels in some Sri Lankan teas were established.

* Publications and Theses

A total of 33 publications, four Advisory Circulars and two theses were produced during the year under review.

Dr M T Ziyad Mohamed
Deputy Director Research (Technology)
For Director

THE TEA RESEARCH INSTITUTE OF SRI LANKA
REPORT FOR THE YEAR 2001

1.1. Introduction

The Tea Research Board of Sri Lanka was established on 12th November 1993 under the provisions of the Tea Research Board Act No. 52 of 1993.

According to the above Act, which came into operation on 7th March 1994, the functions of the Tea Research Board shall be to engage in, and to encourage, foster and facilitate, research into the planting and manufacturing of tea.

1.2 Functions of the Tea Research Board

The specific functions of the Tea Research Board are:

(a) to conduct, assist and encourage scientific and technological research into, and investigations, of all problems and matters affecting the production and manufacture of tea, including the prevention and control of pests affecting tea, the prevention and control of diseases affecting tea and the improvement of the quality of tea, as well as the diversification of products manufactures from tea; and to disseminate and publish at its direction, results of such research.

(b) to conduct, assist and encourage research into the economic viability of the tea industry in Sri Lanka, including future economic trends in such industry

(c) to establish and maintain relations with research institutions in Sri Lanka and abroad

(d) to conduct, in the discharge of its functions, joint study programme, seminars or symposia, with foreign research institutions and research institutions in Sri Lanka.

1.3 Tea Research Institute Head Office at Talawakelle

The Head Office at Talawakelle is responsible for the maintenance, administration, overall planning and execution of research and extension and advisory programmes of its main centre at Talawakelle and five substations located in the different tea growing districts.

1.4 Members of the Tea Research Board as at 27th November

1.	Dr S D I E Gunawardena	-	Chairman, TRB
2.	Dr W W D.Modder	-	Director, TRI
3.	Mr M J C Amarasuriya	-	Member
4.	Mr Clifford Ratwatte	-	Member
5.	Dr (Ms) Damitha de Zoysa	-	Member
6.	Prof H P M Gunasena	-	Member
7.	Mr K P Govindaraj	-	Member
8.	Mr Nimal K. Bandara	-	Member
9.	Mr K.G.B.Obeysekera	-	Member
10.	Mr K M Opananda	-	Member
11.	Mr S K L Obeysekera	-	Member
12.	Mr J S Ratwatte	-	Member
13.	Mr M. Sundaralingam	-	Member
14	Dr U Vidanapathirana	-	Member
	Secretary to the Board	-	Mr. C C Mawilmada

1.5 Consultative Committee on Estates & Advisory Services

1.	Mr J P M Y Ratnayeke	-	Chairman
2.	Dr S D I E Gunawardena	-	Member
3.	Dr W W D Modder	-	Member
4.	Mr J S Ratwatte	-	Member
5.	Mr S.C.Imbuldeniya	-	Member
6.	Mr Asoka Somaratne	-	Member
7.	Dr (Ms) Damitha de Zoysa	-	Member
8.	Mr Nihal Bopearachchi	-	Member
9.	Dr M T Ziyad Mohamed	-	Member
	Convenor/Secretary:	-	Ms S I Vitharana

1.6 Consultative Committee on Research

1.	Dr S D I E Gunawardena	-	Chairman
2.	Dr W W D Modder	-	Member
3.	Mr Camillus Silva	-	Member
4.	Prof Y D A Senanayake	-	Member
5.	Mr N F G P Athukorala	-	Member
6.	Dr D T Wettasinghe	-	Member
7.	Mr R K Nathaniel	-	Member
8.	Mr Amal Perera	-	Member
9.	Dr D Kirtisinghe	-	Member
	Convenor/Secretary:	-	Dr M T Ziyad Mohamed

1.7 Audit & Management Committee

1.	Dr(Ms) Damitha de Zoysa	-	Chairperson
2.	Dr W W D Modder	-	Member
3.	Dr U Vidanapathirana	-	Member
4.	Mr Asoka Somaratne	-	Member
5.	Mr S K L Obeyesekera	-	Member
	Convenor/Secretary:	-	W.B. Herath

1.8 Senior Management Staff as at 31st December

1.	Director	-	Dr. W W D Modder
2.	Deputy Director Research (Technology)	-	Dr. M T Ziyad Mohamed
3.	Deputy Director (Administration)	-	Mr. C C Mawilmada

1.9 Executive Staff (Grade I & II) as at 31st December.

Administration Division

Mr C C Mawilmada - Deput Director (Administration)
Ms A Sabanathan - Administrative Officer
Mr K G Piyasena - Public Relations Officer

Finance Division

Mr W B Herath - Senior Accountant (served up to 17th December)
Mr M Bowatta - Accountant
Mr M F Y Arafath - Accountant

Internal Audit Division

Mr R Kariyawasam - Internal Auditor

Engineering Division

Ms D W Manawadu - Resident Engineer

Library

Ms R W M W K Illanganthillake - Librarian

Publication Unit

Vacant - Publication/Publicity Officer

Advisory & Extension Services Division

Mr S Wimaladharma - Head, Advisory & Extension Services
Mr B A D Samansiri - Acting Officer-in-Charge/ Advisory Officer
Mr V S Sidhakaran - Advisory Officer

Agronomy Division
Ms. M S D L de Silva - Research Officer

Agricultural Economics Unit
Ms. J A A M Jayakody - Research Officer/Officer-in-Charge
Mr. D P B Herath - Research Assistant (on overseas studies)
Mr. G Ganewatte - Research Assistant (on overseas studies)

Bio-Chemistry Division
Dr. I S B Abeysinghe - Actg. Head /Senior Research Officer
Dr. (Ms.) A C Liyanage - Senior Research Officer
Dr. A M T Amarakoon - Senior Research Officer
Mr. P A N Punyasiri - Research Officer
Ms. J Jayasundera - Research Officer

Entomology Division
Ms. S I Vitharana - Actg. Head /Senior Research Officer
Dr. Keerthi Mohotti - Senior Research Officer
Mr. R S Walgama - Research Assistant

Plant Physiology Division
Dr. A Anandacoomaraswamy - Actg. Head/Senior Research Officer
Dr.(Ms) A J Mohotti - Senior Research Officer

Plant Pathology Division
Dr. A Balasooriya - Actg. Head/Senior Research Officer
Mr. T A S.Gunasekera - Research Assistant
Ms. N H L Pradeepa - Research Assistant (on overseas studies)
Ms. B A P Cooray - Research Assistant

Plant Propagation & Breeding Division
Mr. V Shanmugarajah - Actg. Officer-in-Charge/ Snr. Research Officer
Dr.(Ms.) M T K Amarakoon - Senior Research Officer
Mr. M Ratnayake - Research Officer
Mr. M A B Ranatunghe - Research Assistant

Soils & Plant Nutrition Division
Dr. L S K Hettiarachchi - Actg. Head/Senior Research Officer
Dr. A K N Zoysa - Senior Research Officer
Ms. S Anandacumaraswamy - Research Officer
Mr. G P Gunaratne - Research Officer
Mr. P S Munasinghe - Research Assistant

Technology Division
Mr. W S Botheju - Research Officer
Mr. K Raveedran - Chemical Engineer (on overseas study leave)
Mr. S Koneshwaramoorthy - Mechanical Engineer

TRI Sub-Station Deniyaya

Mr. J A S K V Jayasinghe	- Actg. Officer-in-Charge/Advisory Officer

TRI Low Country Station, Ratnapura

Ms. S I Vitharana	- Officer-in-Charge
Dr. M A Wijeratne	- Senior Research Officer
Dr. K G Premathilake	- Senior Research Officer
Mr. G L C Galahitiyawa	- Research Officer
Mr. N P S N Bandara	- Research Assistant
Ms. S M Samarasinghe	- Research Officer
Mr. K M S L D Amaratunga	- Advisory Officer

TRI Sub-Station, Hantane

Mr. P B Ekanayake	- Officer-in-Charge/Senior Research Officer
Mr. S T Yatawatta	- Advisory Officer
Ms. R M D T Pallemulla	- Research Officer

TRI Sub-Station, Kottawa

Mr. K D Dahanayake	- Officer-in-Charge/Advisory Officer

TRI Sub-Station, Passara

Mr. J C K Rajasinghe	- Acting Officer-in-Charge/Advisory Officer

1.10 Other Administrative, Scientific, and Advisory Staff (Grades III-V) as at 31st December.

Administration Division

Ms. S.M Jeyasingham	- Secretary to the Director
Ms. S Shanmuganathan	- Stenographer (English)
Ms. Devika Ratnayake	- Stenographer (English)
Ms. P Marapana	- Stenographer (English)
Ms. D H Kalikotuwa	- Stenographer (English)
Ms. A P V Kalyani	- Stenographer (English)
Ms. C S K Kiribathgoda	- Stenographer (English)
Mr. B Tilakeratne	- Purchasing Officer
Mr. M L H Perera	- Transport Officer
Mr. P D S L De Silva	- Clerk/Typist
Mr. R Nadarajah	- Clerk/Typist
Ms. I Jayawickrama	- Clerk/Typist
Mr. K R M Priyantha	- Clerk/Typist
Ms. R Jayasinghe	- Clerk/Typist
Ms. Ramani De Silva	- Clerk/Typist
Ms. R Wanasinghe	- Clerk/Typist
Mr. D H Jayatilake	- Clerk/Typist
Ms. Chandrika Jeyaram	- Clerk/Typist
Mr. S H Chandrasena	- Clerk/Typist

Mr. P T Perera	- Clerk/Typist
Mr. G G E H Gamage	- Chief Motor Mechanic
Mr. U A Wickramasinghe	- Electrical Foreman
Mr. J M R K Bandara	- Electrician
Mr. R W Rengasamy	- Electrician
Mr. K M Seneviratne Banda	- Telephone Operator
Ms. P K N Damayanthi	- Telephone Operator
Mr. S Karuppiah	- Telephone Linesman
Mr. D V D Vithanage	- Clerk of Works
Mr. W P A N Jayasinghe	- General Clerk
Mr. V Shanmuganathan	- Clerk/typist (on 'No Pay' overseas leave)
Mr. C J B Abeykoon	- Works Supervisor
Mr. W C K Fernando	- Chief Plumber Mechanic (on 'No Pay' overseas leave)
Mr. J G Gamage	- Filter Plant Assistant
Mr. S N W M Premaratne	- Tinker/Welder
Mr. K Palathanthrige	- Works Supervisor

Finance Division

Mr. K D H Pathirana	- Chief Store Keeper
Mr. S G Punchibanda	- Accounting Assistant
Mr. C B Koswatte	- Accounting Assistant
Ms. D M R Dissanayake	- Accounting Assistant
Mr. B G D Premadasa	- Clerk/Typist
Ms. N Saparamadu	- Stenographer(English)
M. V Pahalage	- Accounts Clerk
Ms. G A S Gunasekera	- Accounts Clerk
Ms. W G Piyaseeli	- Accounts Clerk
Mr. Saman Hewasiliyan	- Accounts Clerk
Mr. K T U Kulatunga	- Asst. Store Keeper
Mr. W A Nishantha	- Data Entry Operator
Ms. R Godage	- Clerk/Typist
Mr. H P W Gunasekera	- Stores Assistant
Mr. H B Talgahagoda	- Cashier/Cum Accounts Clerk
Ms. A P Amaratunga	- Accounts Clerk
Ms. P V D Chandrakanthi	- Accounts Clerk
Ms. H K Seetha	- Accounts Clerk

Internal Audit Unit

Mr. P S Wickramasinghe	- Internal Audit Officer
Ms. L N K Udumulla	- Internal Audit Clerk
Ms. N C Jayaweera	- Internal Audit Clerk
Ms. W N K I Ariyaratna	- Audit Clerk

Library

Ms. R W M S K Amunugama - Library Assistant

Advisory & Extension Services Division

Mr. L A M R C Liyanarachchi - Extension Officer
Mr. M J A S Fernando - Extension Officer
Ms. M A H Nishanthi - Extension Officer
Mr. R. Rajendrakumar - Clerk/Typist
Mr. K G R Niroshan - Photographer
Mr. J T Thevadasan - Photography/Dark Room Attendant
Mr. N S Ekanayake - Audio Visual Attendant

Agronomy Division

Mr. A R Amarasekera - Experimental Officer
Mr. U P Abeysekera - Experimental Officer

Agricultural Economics Unit

Ms. R M S S Rajapakse - Experimental officer
Ms. H W Shyamalie - Experimental Officer
Mr. W M J C Bandara - Technical Assistant

Biochemistry Division

Mr. M D L P Gunatilaka - Experimental Officer
Mr. K M Mewan - Experimental Officer
Mr. G A A R Perera - Experimental Officer
Mr. P B Chandradasa - Technical Assistant
Ms. J M D Abeysinghe - Technical assistant
Ms. A D M Damayanthi - Technical Assistant
Ms. R W T Dharshani - Technical Assistant
Mr. M W Silva - Skilled Mechanic

Entomology Division

Mr. D D Liyanage - Experimental Officer
Mr. N Nawaratne - Experimental Officer
Ms. P V A R Abeysekera - Experimental Officer
Ms. R D P Dharmalatha - Experimental Officer
Mr. G P Udumulla - Experimental Officer
Mr. M M Jayatillake - Technical Assistant
Ms. S S C J De Seram - Technical Assistant
Mr. P G C Priyantha - Technical Assistant

Plant Physiology Division

Ms. V. Sidhakaran - Experimental Officer
Ms. D M S Navaratne - Experimental Officer
Mr. H P Baddage - Technical Assistant

Plant Pathology Division

Mr. J W K Jayasundera - Experimental Officer
Mr. R M A Ratnayake - Experimental Officer
Ms. W G N Udayangani - Technical Assistant
Mr. E M C S Edirisinghe - Technical Assistant

Plant Propagation & Plant Breeding Division

Mr. R Paskaradevan - Experimental Officer
Mr. B A Rathnagoda - Technical Assistant
Mr. A K Mudalige - Technical Assistant
Mr. J D Kottawa Arachchige - Technical Assistant

Soils & Plant Nutrition Division

Mr. R G A Wijayawardana - Experimental Officer
Mr. H A P Warnasiri - Experimental Officer (on 'No Pay' leave)
Mr. T C N Pieris - Technical Assistant
Mr. O G K A Gunaratne - Technical Assistant
Mr. D H B N Dissanayake - Technical Assistant

Technology Division

Ms. S H P Waduge - Experimental Officer
Mr. D L D H Dahanayake - Experimental Officer
Mr. L Jayasinghe - Technical Assistant
Mr. A M M V Abeykoon - Technical Assistant
Mr. U D Alagiyawadu - Technical Assistant
Mr. C B Herath - Technical Assistant (Electronics)

Mechanical Workshop

Mr. A Nandasiri - Workshop Mechanic

TRI Sub-Station, Deniyaya

Mr. K K P Katulanda - Extension Officer
Mr. O W Jayawardana - Station Assistant

TRI Low-Country Station, Ratnapura

Mr. H S N Peiris - Experimental Officer
Mr. E R Perera - Experimental Officer
Mr. C Gunasekera - Experimental Officer
Mr. P D Upali - Experimental Officer
Mr. W M U A B Marapana - Experimental Officer
Mr. D S E Weerasooriya - Chief Clerk
Mr. A K Prematunga - Experimental Officer
Mr. D W Vithana - Experimental Officer
Mr. A G Gamage - Experimental Officer
Mr. K G J P Mahindapala - Extension Officer
Mr. D.G.N. Mahinda - Extension Officer
Mr. A K M Jayasena - Technical Assistant
Mr. K A D Mervin - Accounting Assistant
Mr. R Nandasena - Station Assistant

Ms.	P V G Karunanayake	- Stenographer(English)
Mr.	K A S Kumarapperuma	- Clerk/Typist
Mr.	J S K de Silva	- Electrician
Ms.	B S N Vithana	- Experimental Officer
Mr.	K Gunawardena	- Work Supervisor
Mr.	J H N Piyasundera	- Technical Assistant
Ms.	E W D P Prematunga	- Technical Assistant
Ms.	P I Jayawardena	- Telephone Operator/Receptionist
Mr.	M A B De Silva	- General Mechanic
Mr.	M A Chamindra	- Technical Assistant

TRI Mid-Country Station, Hantana

Mr.	H J M de Silva	- Extension Officer
Mr.	T M Sarathchandra	- Experimental Officer
Mr.	K R W B Kahandawa	- Extension Officer
Mr.	A P D A Jayasekera	- Experimental Officer
Mr.	U B Herath	- Experimental Officer
Ms.	B Sureshkumar	- Experimental Officer
Mr.	Saman Wijetunga	- Experimental Officer
Mr.	A H M L S Abeysinghe	- Experimental Officer
Ms.	U Sridaran	- Experimental Officer
Ms.	S N Wijesekera	- Experimental Officer
Ms.	K Sarathchandra	- Experimental Officer
Mr.	H Jayaweera	- Experimental Officer
Mr.	K R W B Kahandawa	- Extension Officer
Mr.	K M N K Ratnamalala	- Experimental Officer
Ms.	P L K Tennekoon	- Experimental Officer
Mr	C S K A Ratnayake	- Experimental Officer
Ms.	C N K Edirisinghe	- Clerk/Typist
Ms.	B K S Herath	- Accounts Clerk

TRI Sub-Station, Kottawa

Mr.	P K Jayawickrama	- Experimental Officer
Mr.	E K Somapala	- Station Assistant
Mr.	S P Ratnayake	- Extension Officer

TRI Sub-Station, Passara

Mr.	R M A C Rajakaruna	- Extension Officer

Walahanduwa Laboratory Complex

Mr.	M A Wijedasa	- Experimental Officer
Mr.	W T B Priyantha	- Experimental Officer
Mr.	J R Y Abeywardana	- Technical Assistant

Estate

Mr.	S G Ekanayake	- Superintendent (St. Coombs)
Mr.	M S E Perera	- Superintendent (St. Joachim)

1.11 Retirement during the year

(a) Mr. C. Gunasekera Experimental Officer, retired after years of service on 25th October.

1.12 Resignations during the year

(a) Mr. R U N Udagamage, Technical Assistant , resigned on 31st May

(b) Mr. D G I S Nishantha, Driver, resigned on 23rd June

(c) Ms. H K M D J Kumarasinghe , Technical Assistant, resigned on 26th June

(d) Mr. H K Shantha , Legal Officer, resigned on 31st August

(e) Mr. M B A Perera, Advisory Officer, resigned on 01st September

(f) Mr. M W D P K de Silva, Asst. Store keeper, resigned on 02nd September

(g) Dr. (Ms.) L D Amarasinghe, Senior Research Officer, resigned on 29th November

(h) Mr W.B. Herath, Senior Accountant, resigned on 17th December.

1.13 Overseas Training / Seminars / Conferences

Mr S. Wimaladharma, Acting Head, Advisory & Extension Services, Mr B A D Samansiri, Acting OIC, Advisory & Extension Services Division, Mr G P Gunaratne, Research Officer, Soils & Plant Nutrition Division, Mr. V Shanmugarajah, Senior Research Officer, Plant Propagation & Plant Breeding Division, Dr A Balasooriya, Acting. Head, Plant Pathology Division and Mr S G Ekanayake, Superintendent, St Coombs Estate,followed an Advance Course on Tea Plantation Management at Kothari Agricultural Management Centre, Coonoor, India from 3rd to 31st January.

Mr K Raveendran, Chemical Engineer, Technology Division, commenced his Masters Degree on Energy Technology at the Asian Institute of Technology, Thailand on 3rd January for a period of 20 months.

Ms Pradeepa Liyanage, Research Assistant, Plant Pathology Division, commenced her M.Sc. in Agriculture, Plant Pathology at Govinda Ballah Plant University of Agriculture and Technology, Pantnagar, India for a period of 2 years from 5th January.

Mr C C Mawilmada, Deputy Director (Administration) attended a short term training for Administrators and Accountants at the National Academy of Agricultural Research Management, Hyderabad, India from 22nd to 27th January.

Dr A Balasooriya, Senior Research Officer/Actg. Head Plant Pathology Division, proceeded to Chennai, India to make a presentation at the Symposium on Tea Science from 5th to 6th February.

Dr W W D Modder, Director, TRI, proceeded to India to participate and make presentations at the Symposium on Tea Science from 5th to 6th February and to attend the 33rd Tocklai Conference from 12th & 13th February in Jorhat, Assam, India.

Ms S I Vitharana, Entomologist/ Acting Head, Entomology Division, made a presentation on Practices Oriented Results on Use of Plant Extracts and Pheromones in Integrated & Biological Pest Control at the Workshop in Cairo, Egypt from 10th to 11th February.

Ms S I Vitharana, Entomologist/Acting Head, Entomology Division, followed a short term training in the Field of Research Management on the Work Plan for 2000 – 2001 under the MOA between ICAR & CARP, National Academy of Agricultural Research Management, Hyderabad, India, from 21st February to 7th March.

Dr A K N Zoysa, Senior Research Officer, Soils & Plant Nutrition Division, participated in the International Conference on Nature and Ecological Balances at Haryana Agricultural University, India, from 7th to 14th March.

Dr W W D Modder, Director, TRI, participated in the National Tea Conference, Wuhu City, China, from 29th to 30th April.

Mr W A N Punyasiri, Research Officer, Biochemistry Division underwent a training on the Use of Waters Alliance – HPLC in India from 25th to 29th June.

Dr L S K Hettiarachchi, Senior. Research Officer/Acting Head, Soils & Plant Nutrition Division participated at the 7th International Symposium on Soil and Plant Analysis in Edmonton, Canada, from 21st to 27th July.

Dr I S B Abeysinghe, Senior Research Officer/Acting Head, Biochemistry Division, proceeded to Beijing, China for a training workshop on Use of Nuclear Techniques in studies of Transport and Fate of Pesticides in Eco-environment from 10th to 21st September.

Dr I.S.B. Abeysinghe, Senior Research Officer/Acting Head Biochemistry Division and Dr (Ms) A C Liyanage, Senior Research Officer, Biochemistry Division participated and presented papers at the International Conference on O–CHA Tea Culture and Science at Shizuoka, Japan from 5th to 8th October.

Dr W W D Modder, Director, TRI and Dr M T Ziyad Mohamed, Deputy Director Research (Technology), proceeded to Mombasa, Kenya to attend the Technical Committee Meeting of the International Organization for Standardization from 11th to 13th October.

1.14 Staff Recruitments

The following staff were recruited during the year

(a) Resident Engineer	-	01
(b) Research Assistants	-	03
(c) Experimental Officers	-	03
(d) Legal Officer	-	01
(e) Administrative Officer	-	01
(f) Drivers	-	08
(g) Technical Assistants	-	09
(h) Accountant	-	01

1.15 Telephones

Following work have been completed in addition to day to day maintenance work at Head Office , Talawakelle, during the year

(a) 09 New extensions were given.

(b) Internet connection was given to Library from the Main Telephone Exchange

1.16 Vehicles

The following vehicles were purchased during the year:

Car	-	01 No.
Ambulance	-	01 No.(St. Coombs Estate)
Motor Cycles	-	02 Nos.

1.17 Maintenance Division

Buildings:

Major repairs, renovations and construction work at TRI Head Office and sub stations

TRI, Head Office, Talawakelle

a) Construction of Rubble retaining wall	-	Work in progress.
b) Improvements of the approaching Road	-	Entire road surfacing work completed.
c) Replacing main water line	-	Job completed.
d) Construction of water tank	-	– do –

Sub-station, Kottawa.

a) Construction of Twin Labour cottages	-	Job completed
b) Roof repairs in seminar hall	-	– do –
c) Construction of Watcher Hut	-	– do –

Sub-station, Deniyaya

a) New road construction	-	Work in progress.
b) Construction of Leader drain	-	Job completed

Sub-station, Hantane

Improvements to Internal Roads	-	Job completed

1.18 Electrical

The Electrical Division completed the following work during the year:

335 jobs at laboratories and bungalows

i.	Maintenance of TRI Bungalows	-	196
ii.	Maintenance of Laboratory, Office buildings etc.	-	81
iii.	Maintenance of Sub-station	-	08
iv.	Maintenance of street lights, security lights etc.	-	50

Completed the following at Head Office, Talawakelle

i. Re-wiring of A 1 Hostel and C 54, D 12, D 24, D 32, & D 40 bungalows

ii. Installed heavy electrical equipment including wiring etc. in the Soils & Plant Nutrition Division

iii. Installed electrical equipment including wiring etc. in the Bio-chemistry Division

iv. Fixed 02 Nos. Split Type air-conditioners at the Auditorium

v. Wiring, repairs etc. in the Plant Pathology Division. Completed the following at Sub-stations

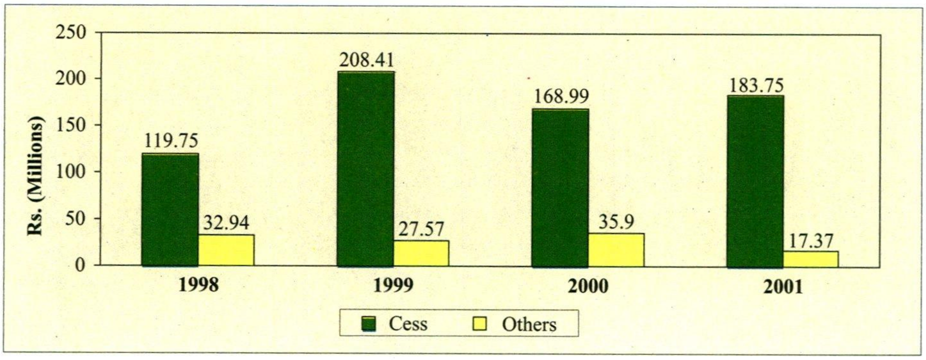
i. Completed wiring repairs etc. at Deniyaya station.

ii. Completed wiring, repairs etc. at the new office building at Passara station.

FINANCIAL PERFORMANCE REPORT

In a complex economic, social and political environment, allocation and utilization of financial resources in a more effective and constructive manner for the acheivement of organizational objectives is very important. Therefore it is believed that a proper financial strategy is of paramount important for any organization attempting to cope up with existing trends.

The Tea Research Institute's prime income comes from the Cess and its secondary income generations are from Estates (St Joachim and St Coombs), interest on investments, and analytical services etc. The following graph shows the income generation of the Institute, during the last four years.



Reserves in the form of seven days call deposits and treasury bills, as at 31st December 2001 was Rs 62.99Million, which has fallen from Rs 150Million and Rs 78Mn in years 1999 and 2000 respectively.

This contraction in reserves was the main reasons leading to the decline in the interest income from Rs 12.774Mn in year 2000 to Rs8.179Mn in Year 2001. Reduction in the TRI Cess proportion from 32% to 25% caused further erosion of reserves.

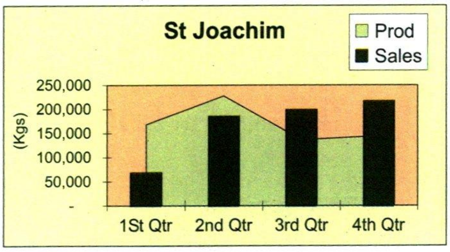
Production,Sales and Profitability Trend-Estates

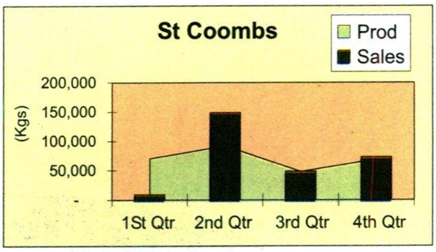
The two Estates are considered as separate revenue units for accounting purposes even though they are being used for field & factory experimentation, adaptive trials and as testing ground for TRI recommendations. The reduction in sales and the increase in overhead cost caused the negative profit in both estates in year 2001.

Estates	Profit(000)			
	1998	1999	2000	2001
St Coombs	3,893	(1,657)	6,182	(971)
St Joachim	16,166	7,338	7,799	(1,097)
Total	20,059	5,681	13,981	(2,068)

St Joachim Estate's main input comes from bought leaf. Therefore the price level prevailing in the domestic market also can affect the profitability.

Estates	Production and Sales (Kgs)					
	Kgs	1St Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
St Joachim	Prod	168,269	227,711	136,344	143,867	676,191
	Sales	68,520	185,640	199,430	217,121	670,711
St Coombs	Prod	70,702	92,098	48,228	69,401	280,429
	Sales	9,417	148,757	48,935	73,320	280,429

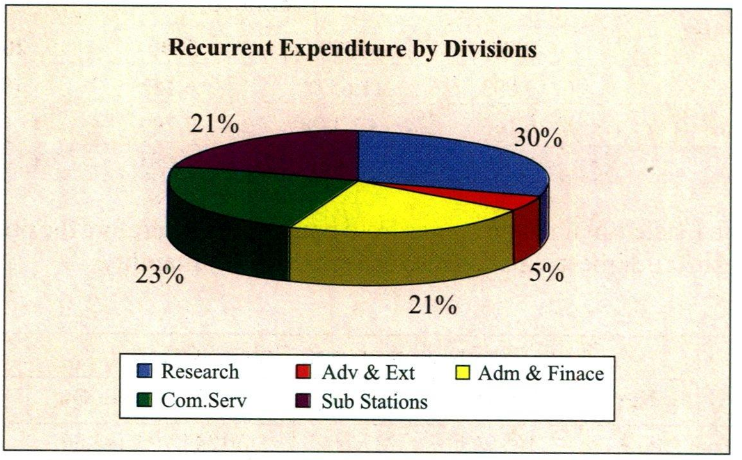




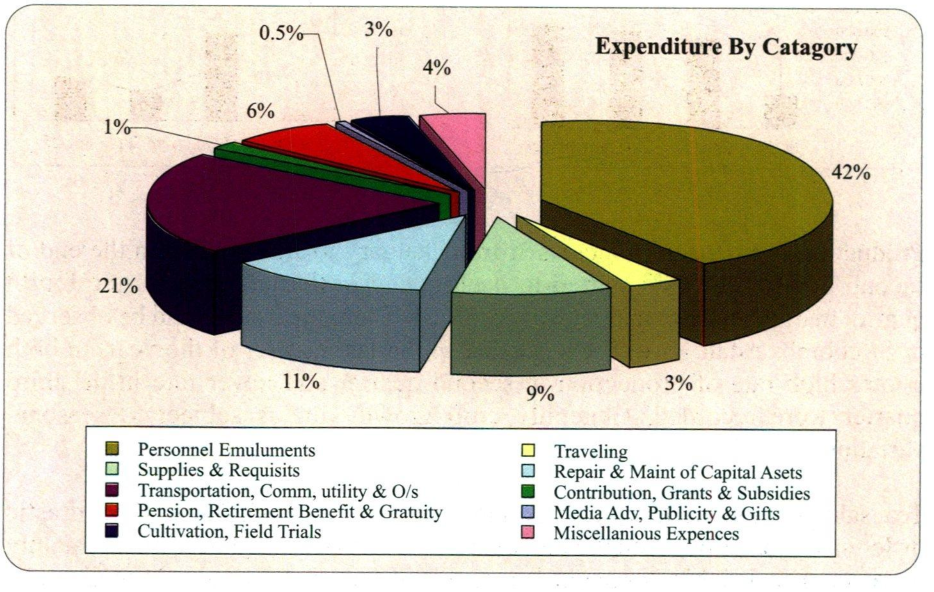
Production in St Joachim increased from January to June and from the end of second quarter onwards started to decline and in the later part of the fourth quarter marginal improvement was recorded. The same trend could be observed in St coombs estate as well except that in the last quarter of the year. In both estates high rate of production in second quarter and lower rate in the third quarter were recorded. Generally crop growth rate is subject to seasonal variations.

Tea sale is another dependent variable with production.There is no drastic difference in sales between the four quarters at St Joachim estate,which is mainly because of St Joachim's bought leaves operations. But the sales at St Coombs Estate shows wide fluctuations due to hundred percent dependence on its own production which is subject to seasonal variations.

The factory Capacities are 14,600 kgs green leaf/month and 12,000 kgs GL/month at St Joachim and St Coombs respectively.



Significant portion of the common services have been absorbed by research and it includes Transportation, Engineeering and Internal Audit divisions. Substation and Advisory & Extention cost also could be attributed to research since these cost units directly function as dissemination centers of research findings.



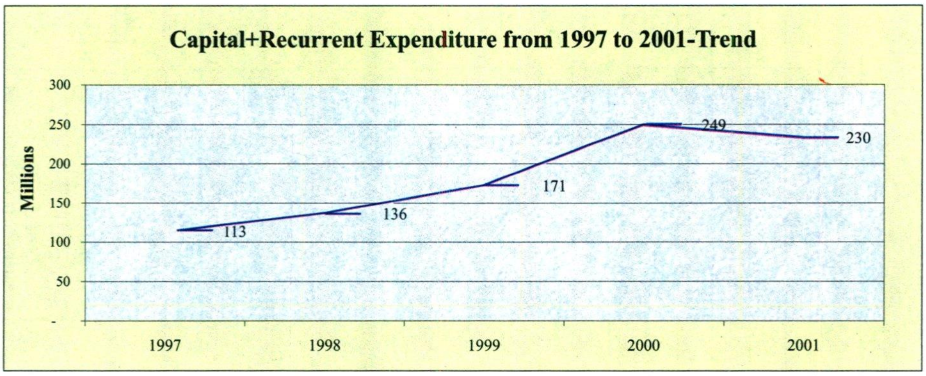
Personnel Emoluments constituted 42 % of total recurrent expenditure and exceeded the budgeted figure by 18%. This was mainly due to implementation of two Public Administration Circulars. Arrears payments according to the PA 2/97(111) and 2/97(V) and Interim Allowances of Rs 1,200 as per PA Circular 24/2001.

The budgeted amount for traveling was Rs 8,361,161,but actual expenditure was only Rs 4,681,142. This resulted in a saving of 44% of budgeted expenditure. The instructions from Presidential Secretariat dated 21st June 2001(Ref CPA/6/1/1) curtailed all the foreign trips.

There are drastic reductions shown in Supplies & Requisits, Media Advertising, Publicity & Gifts, Cultivation, Field Trials and Miscellaneous expenditures. Total saving from these cost units is Rs 19.965Mn. Again this has been done based on the Budget Circular No-91 dated 4th April 2001.

Repair & Maintenance of Capital Assets and Transportation, Communication, utility & other services have exceeded budgetary figures by 27% and 8% respectively. This was because of the fact that the general inflationary situation of the country in year 2001 was approximately 15%. Prices of Crude oil in international market and fuel cost in the domestic market were the obvious reasons. Price hike in Telephone and Electricity bills and high rate of tax on import of spare parts also must be taken into consideration.

Unfavorable variance of total capital expenditure at 85% is not because of the excessive expenditure over budget but because of the capitalization of goods in transit as on 31st December 2000. Delays in approving the capital budget and natural bottlenecks in importation items caused this situation. Therefore the Budget-Actual comparative analysis for capital expenditure is very much subjective.



Total expenditure (Capital and Recurrent) shows a steady upward trend over the last four years. Uncontrollable variables such as Inflation, Government Policies, industrial and economic growth and international recession could be the reasons for the above situation. Severe financial curtailments in year 2001 brought down expenditure from Rs 249Mn in year 2000 to Rs 230Mn.

FINANCIAL PERFORMANCE REPORT

Recurrent Expenditure

Year - 2000	Expenditure Type	Research			Advisory & Extentions			Administration & Finance			Common Services			Substation		
		Budget	**Actual**	**Var %**	**Budget**	**Actual**	**Var %**	**Budget**	**Actual**	**Var %**	**Budget**	**Actual**	**Var %**	**Budget**	**Actual**	**Var %**
54,051,387	Personnel Emoluments	25,924,527	29,099,462	(12)	2,993,447	4,176,548	(40)	12,094,988	15,129,345	(25)	8,733,686	8,759,821	(0.3)	5,830,478	8,149,329	(40)
4,410,846	Travelling	5,469,167	2,133,681	61	387,112	499,243	(29)	1,651,500	1,051,256	36	283,118	260,819	8	570,264	736,143	(29)
16,413,252	Supplies & Requisites	15,355,775	6,773,994	56	2,194,290	2,096,587	4	1,908,283	2,877,059	(51)	1,151,604	994,246	14	1,347,470	1,988,356	(48)
13,342,157	Repair & Maint of Capital Assets	3,726,000	1,132,113	70	580,500	109,157	81	451,800	279,110	38	5,614,200	10,252,205	(83)	4,008,600	6,482,004	(62)
28,450,700	Transportation, Comm, Utility & O/Ser	350,100	499,160	(43)	13,500	750	94	7,623,500	6,808,066	11	15,479,458	15,905,164	(3)	7,835,760	10,683,486	(36)
2,074,379	Contributions, Grants & Subsidies	251,776	204,517	19	35,190	51,792	(47)	1,697,670	1,925,812	(13)	120,014	58,057	52	140,400	142,994	(2)
7,258,033	Pensions, Retirement Benefit & Gratuity	3,064,822	3,225,136	(5)	470,428	556,572	(18)	3,409,184	4,206,141	(23)	692,748	795,024	(15)	671,103	695,179	(4)
433,328	Media Adv. Publicity & Gifts	99,000	64,057	35	1,260,000	415,748	67	310,500	187,969	39	-	-	-	221,400	100,498	55
5,717,141	Cultivation, Field Trials	3,858,409	1,148,616	70	256,500	73,846	71	-	-	-	-	-	-	3,922,043	4,176,416	(6)
5,514,111	Miscellaneous Expenses	9,889,166	3,830,513	61	1,089,000	135,146	88	3,207,967	1,518,082	53	127,800	24,625	81	301,500	129,801	57
137,665,334	**Total Recurrent Expenditure**	**67,988,742**	**48,111,249**	**29**	**9,279,967**	**8,115,388**	**13**	**32,355,392**	**33,982,840**	**(5)**	**32,202,628**	**37,049,961**	**(15)**	**24,849,018**	**33,284,206**	**(34)**

Year 2000	**Capital Expenditure**	**Budget**	**Actual**	**Var %**
5,467,581	Building	1,277,280	3,208,494	(151)
38,818,779	Plant, Machinery & Lab Equipment	12,648,000	23,127,112	(83)
7,920,672	Office Equipment	929,500	3,624,348	(290)
2,903,336	Furniture & Fittings	831,200	1,635,775	(97)
14,278,994	Motor Vehicles	336,000	4,599,125	(1,269)
6,872,635	Roads, W/Supply, Electricity & Phones	1,995,000	843,966	58
499,312	Workshop Tools and Equipment	415,000	188,460	55
3,980,048	Other Fixed Assets	3,409,500	3,219,196	6
80,741,357	**Total Capital Expenditure**	**21,841,480**	**40,446,476**	**(85)**

Total Fund Generation	
Cess Income	183,750,000
Sale of Green Leaf	5,430,913
Interest on Investment	8,179,866
Disposal of Fixed Assets	161,600
Miscellaneous	3,601,790
Total	**201,124,169**

(Note-01) Depreciation is excluded from the above expenditure analysis
(Depreciation for Year 2000 is Rs. 30.289 Mn and Rs. 31.802 Mn for Year 2001)

(Note-02) All figures are Prior to Audit

TEA RESEARCH BOARD

BALANCE SHEET AS AT 31ST DECEMBER - 2001

2000 Rs.			Tea Research Institute 2001 Rs. Cts.	St. Coombs Estate 2001 Rs. Cts.	St. Joachim Estate 2001 Rs. Cts.	Total 2001 Rs. Cts.
	FIXED ASSETS					
416,676,694	Property, Plant, Equipment etc.		464,598,859.06			464,598,859.06
(206,974,220)	Less: Accumulated Depreciation	(Anx. I)	(242,663,672.30)			(242,663,672.30)
209,702,474			221,935,186.76			221,935,186.76
13,597,874	Capital Work in Progress	(Anx. II)	24,461,552.80	365,442.00		24,826,994.80
223,300,348			246,396,739.56	365,442.00	0.00	246,762,181.56
	CURRENT ASSETS					
10,466,386	Stocks	(Anx. III)	7,797,021.90	1,479,534.70	913,419.68	10,189,976.28
124,453,990	Debtors and Other Debit Balances	(Anx. IV)	191,926,982.11	5,930,776.15	543,294.27	198,401,052.53
39,934,915	Deposits,Pre-Payments & Purchase Advances	(Anx. V)	35,324,898.51	83,992.83	1,224,811.29	36,633,702.63
20,260,768	Loans and Advances to Staff & employees	(Anx. VI)	19,342,239.55	3,255,395.77	851,458.60	23,449,093.92
10,300	Other Current Assets-Patents		15,550.00			15,550.00
78,000,000	Short Term Investments-7 day Call Deposits	(Anx. VII)	62,994,015.88			62,994,015.88
2,871,005	Cash and Bank Balances	(Anx. VIII)	5,147,949.58	3,088.08	80,706.87	5,231,744.53
275,997,364			322,548,657.53	10,752,787.53	3,613,690.71	336,915,135.77
500,558	Identified Losses	(Anx. IX)	500,557.87	–	–	500,557.87
52,337	Excess & Shortages	(Anx. X)	281,889.40	–	–	281,889.40
276,550,259			323,331,104.80	10,752,787.53	3,613,690.71	337,697,583.04
	CURRENT LIABILITIES					
(41,233,248)	Creditors and Provisions	(Anx. XI)	(23,205,764.84)	(5,838,404.94)	(7,739,070.60)	(36,783,240.38)
235,317,011	Net Current Assets		300,125,339.96	4,914,382.59	(4,125,379.89)	300,914,342.66
458,617,359	**TOTAL ASSETS LESS CURRENT LIABILITIES**		546,522,079.52	5,279,824.59	(4,125,379.89)	547,676,524.22
	REPRESENTED BY					
53,063,187	Grants and Reserves	(Anx. XII)	59,683,059.42	–	–	59,683,059.42
372,945,155	Tea Research Fund		452,705,231.81			452,705,231.81
–	A/C Current St.Coombs Estate		7,574,744.10	(7,574,744.10)		0.00
–	A/C Current St.Joachim Estate		9,264,307.69		(9,264,307.69)	0.00
754,670	Long Term Liabilities-Land Reform Commission		754,670.00			754,670.00
31,843,546	Provision for Gratuity	(Anx. XIII)	16,528,266.50	12,854,568.69	5,138,927.80	34,521,762.99
10,800	Petrol Deposit Refundable	(Anx. XIV)	11,800.00			11,800.00
458,617,359			546,522,079.52	5,279,824.59	(4,125,379.89)	547,676,524.22

Note:- 1. Negative figures are shown within brackets

Actg.Senior Accountant
T.R.I.

Director
T.R.I.

Chairman
T.R.B.

AGRONOMY DIVISION

A. Anandacoomaraswamy
Acting Head of Division

Research activities

1. Thrust: A9- Development of an economically viable system to eliminate /reduce soil rehabilitation period prior to replanting in the up-country

Project A9.1: Evaluating soil rehabilitation techniques

9.1. Effect of direct planting vis-a- vis planting after soil reconditioning on yield, Concordia Estate (1991)

The objective of this study is compare the effect of soil reconditioning before replanting in very high altitude (>1800m AMSL) where soil fertility is not limiting the establishment of tea. Five clones (PK2, TRI 2024, DT1, NAY3, TRI 2025) are used in this study. This experiment is in the first year of the second cycle. The yield for the period September 2000 to August 2001 is presented in Table 1.

TABLE 1 - *Yield of tea (kg MT ha^{-1})*

	Yield		
Treatments	*Reconditioning*	*Direct Planting*	*Mean*
Clone			
TRI 2025	2390	2442	2416
TRI 2024	1699	1562	1630
NAY3	3015	2696	2855
DT1	2941	2322	2632
PK 2	1630	1394	1512
Mean	2335	2083	
LSD(P=0.05) for reconditioning	115		
LSD(P=0.05) for Clones	220		
SE for reconditioning	112.4		
SE for Clone	67.2		
SE for reconditioning x Clone	131.1		
CV(%)	12.8		

Benefits of soil reconditioning was evident during the first year of the second cycle too.

A.R.Amerasekera and U.P.Abeysekera

2. Thrust: A10- Development of an economically viable system to eliminate /reduce the soil rehabilitation period prior to replanting in the mid-country

Project A 10.1: Evaluating soil rehabilitation

10.1.1 Effect of alternate methods of soil reconditioning compared with soil reconditioning by grass on the establishment and Yield

a. New Peacock Estate (1991) —TRI 3013

The objective of this experiment is to test the available alternate methods with traditional methods to reduce the soil reconditioning period of two years. Compost, coir dust with and without T200 (young tea mixture) were incorporated at the time of planing (July 1997). Further *Flemingia congesta* was used as another treatment for *in-situ* soil reconditioning after planting tea. The control for this comparison was two years of soil reconditioning with Mana. The experimental plots which were pruned in November 2000 were brought into plucking in September 2001. There were causalities and the plots were infilled with the same clone in May 2001. The percentage of casualties and tipping is given in Table 2.

TABLE 2 - *Percentage casualties and Tipping weight*

Treatments		*Casualties (%)*	*Tipping weight kg ha^{-1})*
T1	- Tea Planted in Soil reconditioned with Mana	14.0	831.9
T2	- Direct Planting with compost (3kg per hole)	45.1	241.3
T3	- Direct Planting with Compost (1.5 kg at the bottom of the hole + T200 -20g per hole)	37.5	255.6
T4	- Direct planting with coir dust 1.5 kg at the bottom of the hole and compost 1.5 kg on the top	23.6	361.5
T5	- Direct planting with coir dust (3 kg per hole and T200 -20g per hole)	22.2	303.0
T6	- Direct planting with coir dust (3 kg per hole)	20.1	315.9
T7	- Direct plsnting of tea with interplanting *Flemingia congesta* as a cover crop In the inter rows after planting tea	34.0	188.0
T8	- Direct planting without any soil amendments + T200 - 20g per hole	41.3	264.1
LSD(P=0.05)		8.1	155.5
CV(%)		11.5	22.9

Casualties were higher in the directly planted area with soil amendments (Treatments T2-T8) compared to soil reconditioning with grass (T1). Tipping weight, taken in August before the commencement of second cycle, indicated that two years soil reconditioning with grass is superior to other treatments.

A.R.Amerasekera and U.P.Abeysekera

b. Ratwatte Estate, Ukuwela (2000) – TRI 2025

The objective of this experiment is to compare the available alternative methods with traditional methods to reduce soil reconditioning period. The girth and height were measured in September 2001 is presented in Table 2b. The first centering weight was taken in October is also presented in Table 3.

TABLE 3 - *Growth Measurements*

Treatments		*Height (cm)*	*Girth (cm)*	*Tipping weight (kg ha^{-1})*
T1	– Control (Direct Planting)	63.3	0.99	708
T2	– Rehabilitation with Mana for 2 years	86.5	1.45	1625
T3	– Rehabilitation with Mana for 2 years + Cowpea in between tea rows	91.6	1.47	1575
T4	– Compost + Trochoderma 3kg per hole	76.4	1.11	683
T5	– Coir dust 2 kg per hole	95.4	1.35	1008
T6	– Coir dust 4 kg per hole	84.3	1.24	1108
T7	– Refuse tea 2 kg per hole	76.7	1.08	933
T8	– Refuse tea 4 kg per hole	66.9	0.82	750
T9	– Coir dust 2 kg per hole + Refuse tea 4 kg per hole	77.9	1.08	758
T10	– Mana *insitu* every row	60.4	0.76	241
T11	– Maize *insitu* every row	67.9	0.99	650
T12	– 'Turdhal' *insitu* every row	64.0	0.76	200
LSD (P=0.05)		11.1	0.25	152
CV(%)		16.2	17.5	42.3

The result clearly demonstrates the benefits of 2 years soil rehabilitation prior to planting tea. Planting an economic crop like Cowpea with tea in the rehabilitated soil also gave the similar results.

A.P.D.A.Jayasekara, S.N.Wijesekara and P.B.Ekanayake

3. Thrust: A11 - Development of an economically viable system to eliminate /reduce the soil rehabilitation period prior to replanting in the low country

Project A 11.1: Evaluating soil rehabilitation techniques

a. Balangoda Estate

This study was started in 1999. Planting of tea was done in September, 1999 with TRI 2026. Plants were centered in December 2000 and the second cut was given in April 2001.

TABLE 4 - *Growth performance of tea plants in relation soil rehabilitation and soil amendments.*

Treatments (g plant^{-1})	*Girth (cm)*	*Weight of cut branches*
Planting after Rehabilitation	2.35	175
Direct planting (planting hole)	1.96	100
Planting with Compost (planting hole)	2.02	118
Planting with Compost (trenches)	1.92	111
LSD (p=0.05)	0.29	43.1

Girth and weight of cut branches presented above (Table 4) showed that the performances of tea planted after rehabilitation was superior to direct planting even with addition of other soil amendments.

M.A.Wijeratne, N.P.S.N.Bandara, D.W.Vithana

b. St. Joachim Estate(2000)

The tea plants were cut (centering) at a height of 30 cm in November 2001 and the weight of cut shoots were weighed. Bulk density of soil, plant height (6 months after planting) and fresh weight (FW) of cut shoots were also determined and as given below (Table 5):

TABLE 5 - *Bulk density of soil and growth of tea plant affected by soil improvements*

	Bulk density (gcm^{-3})	*Plant height (cm)*	*Weight of cut shoots (FW g plant^{-1})*
Rehabilitation with mana,	1.51	74	161
Compost in trenches	1.54	71	161
Compost in planting holes	1.54	79	176
Interplanting tea with Mana	1.60	76	142
Interplanting tea with 'Turdhal'	1.52	66	140
Interplanting tea with Sweet Corn *	1.62	65	136
Direct planting	1.64	66	135
LSD (p=0.05)	0.07	9.7	22.1
CV (%)	3.6	15.2	10.9

* The treatment of planting sweet corn was not successful as these plants were completely destroyed by cattle. Harvesting of 'turdhal' was completed by April 2001 and the total yield of 'Turdhal' was 1500 kg/ha. Results showed that the bulk density of rehabilitated soils (except interplanting mana and sweet corn with tea) were lower than that of unrehabilitated soil (direct planting). Plant growth assessments also showed that the growth of tea plants in rehabilitated plots was superior to that in unrehabilitated plots. However, interplanting of mana and sweet corn with tea has not significantly contributed to increase the growth of tea. The experiment is in progress.

M.A.Wijeratne, H.S.N.Pieris

c. Handford Estate – Deniyaya

The objective of this experiment is to investigate available alternate methods compared to traditional methods to reduce the soil reconditioning period. Compost with tricodama, refuse tea, coir dust with and without refuse tea were incorporated at the time of planting (August 2000). Further, mana, maize and turdhal was used as other treatments of in situ soil reconditioning after planting tea. Other treatments are rehabilitation with Mana grass for 2 years and planting tea with and without cowpea. The control for these comparisons was direct planting of tea after uprooting old seedling tea. The height and girth measured at 1cm above the ground level is presented Table 6

TABLE 6 - *Height and Girth*

Treatments:		*Height (cm)*	*Girth (cm)*
T1	- Rehabilitation with mana grass for two years	168.7	8.25
T2	- Rehabilitation with mana grass for two years + Green gram	168.3	8.71
T3	- Direct planting of tea with mana in between the tea rows (*Insitu* rehabilitation)	65.5	4.32
T4	- Direct planting of tea with vettiver in between the tea rows (*Insitu* rehabilitation)	81.9	4.95
T5	- Direct planting of tea with 'turdhal' in between the tea rows (*Insitu* rehabilitation)	69.7	5.33
T6	- Direct planting of tea with green gram in between the tea rows (*Insitu* rehabilitation)	83.7	4.80
T7	- Direct Planting with T200 with no forking	75.0	4.87
T8	- Direct planting with T200 with forking up to 18"	61.5	4.52
T9	- Direct Planting with compost (3kg per hole)	91.6	5.28
T10	- Direct Planting with coir dust (3kg per hole)	113.2	7.10
T11	- Direct planting of tea with 'tricoderma'	67.7	5.13
T12	- Direct Planting with refuse tea (3kg per hole)	88.9	5.72
T13	- Direct Planting with compost (1.5kg per hole) and coir dust (1.5kg per hole)	69.3	4.39
LSD (P=0.05)		36.0	1.58
CV(%)		23.2	16.7

Traditional soil reconditioning with grass for two years gave the highest growth in terms of height and girth. Addition of coir dust (T10) and Compost (T9) improved the growth rate of tea compared to the other treatments.

A.R.Amerasekara, U.P.Abeysekara

Project 11.2: Minimum period required for soil rehabilitation

a. St.Joachim Estate

Mana and Citronella grasses were planted in two large blocks of field No. 1, St. Joachim estate in August, 2001 for soil rehabilitation. Grasses were lopped three times in 2001 and the total weight of loppings are given below:

TABLE 7 - *Fresh Weight of Loppings*

	Fresh Weight of Lopping (tons ha^{-1})		
Grass species.	1st	2nd	3rd
Citronella	11 ± 2.1	41 ± 4.8	29 ± 2.3
Mana	30 ± 3.3	52 ± 7.3	38 ± 2.2

M.A.Wijeratne, N.P.S.N.Bandara

4. Thrust A12 – Development of intercropping systems (with pepper and coffee) for marginal tea lands in mid country small holder sector

Project 12.1: Evaluating the most compatible crop combinations.

12.1.1. Effect of intercropping minor export crops in a mid country small holding in Manikdewela (2000)

This trial was initiated to study the compatibility of the crops and their effect on yield of young tea.

Treatments: T1. Tea alone
T2. Tea x pepper (Pepper spacing 4 m x 4 m)
T3. Tea x Coffee (Coffee spacing 4 m x 4 m)
T4. Tea x Pepper x Coffee (Intercrops planted alternately)

Design: Observation blocks

The first year yield of the first cycle is presented in Table 8

TABLE 8 - *Yield of tea in made tea during first year of the first cycle*

Treatments	*Yield (kg made tea ha^{-1})*
Tea	2457 "
Tea x Pepper	3317 "
Tea x Coffee	3128 "
Tea x Pepper x Coffee	2778 "

There is no significant effect on yield of tea during the first year of the cycle. Pepper and coffee came in to bearing during the year and the crop harvested was very small. This experiment is in progress

P.B.Ekanayake and A.P.D.A.Jayasekara

5. Thrust A 13 – Development of intercropping systems (with pepper and coffee) for marginal tea lands in mid country estate sector

5.1. Project 13.1. Evaluating the most compatible crop combinations.

13.1.1. Effect of intercropping minor export crops in mid country, Ratwatta Estate, Matale (1998)

There was high percentage of casualties of pepper and coffee due to the prolonged drought experienced during the year. As a result, this experiment has to be abandoned and relocated in another field of the same estate or another estate.

P.B.Ekanayake, A.P.D.A.Jayasekara, Mr.K.B. Nugawela

6. Thrust A.14- Development of intercropping systems (Rubber/coconut) for the low country

Project 14.1. Evaluating the most compatible crop combinations.

14.1.1. Effect of intercropping tea and rubber on productivity- RRI-Kuruwita (1990)

This experiment is conducted in collaboration with the Rubber Research Institute of Sri Lanka. There are 6 treatments in 4 replicates (blocks). They are monocropping of tea, monocropping of rubber (18'x12'), tea (rehabilitated) under rubber (27'x8'), tea (rehabilitated) under rubber (40'x8'), tea (unrehabilitated) under rubber (27'x8'), tea (unrehabilitated) under rubber (40'x8'). Unrehabilitated tea and rubber was planted in 1990 while rehabilitated tea was planted in 1992.

The yield of tea is presented in Table 9.

TABLE 9 - *Yield of Tea*

	Green leaf Yield kg $bush^{-1}yr^{-1}$
Rehabilitated tea	
Tea (monocropping)	1.275
Tea+Rubber (8'x40')	0.607
Tea+Rubber (8'x27')	0.545
LSD (p=0.05)	0.470
CV	33%

The yield of rehabilitated tea under rubber was significantly lower than that of monocropped tea. Although there was a marginal reduction in the per bush yield of tea under rubber at 8'x27' when compared with 8'x40' the difference was not significant. Yield of tea planted without rehabilitation was also compared separately in relation to two spacings of rubber. They were 0.157 and 0.287 kg/bush/yr respectively for rubber at 8'x27' and 8'x40'.

14.1.2. Effect of intercropping tea and rubber on productivity- St. Joachim Estate, TRI-Ratnapura (1990)

Feasibility of intercropping tea in rubber is being tested at St.Joachim Estate. There were three treatments viz. tea, tea under rubber (40'x 8') and rubber (20'x 12') in three replicates. Rubber was planted in 1990 and tea was introduced in 1993. Second pruning was done in April 2001. Plucking and assessments continued. There was no significant difference in tea or rubber yield between treatments. The yield of tea for the 4 months before pruning was 0.419 kg/bush for tea under rubber and 0.726 kg/bush for monocropped of tea. The dry rubber yield for the year 2001 was 12.07g /tree/yr for intercropping and 11.36g/tree/yr for monocropping. The estimated yields of rubber (mix stand) for the same treatments were 4224 kg/ha/yr and 5680 kg/ha/yr respectively.

14.1.3. Effect of intercropping tea and rubber on productivity (Demonstration Plot) St. Joachim Estate-Ratnapura, (1989)

Harvesting of tea and rubber and other field practices continued during the year 2001 in order to maintain it as a demonstration plot.

14.1.4. Effect of intercropping tea and rubber on productivity, (Observation Block) St. Joachim Estate, Ratnapura. (1995)

There are four plots in this observation. They are rubber (20'x 12'),monocropped tea, tea in rubber (40'x 8') and tea in rubber (60'x 8'x 8'). Rubber rows were located in the East-west direction.

Tapping of rubber commenced in May 2001. Yield of tea (fresh weight basis) for the year 2001 was 2.35 kg/bush, 2.13 kg/bush and 2.47 kg/bush for monocropped tea, tea under rubber (40'x8') and tea under rubber (60'x8'x8'), respectively. The average yield of tea planted 2'x3' and 2'x4' was 2.36 and 2.25 g/bush/yr respectively. The dry rubber yield was estimated to be 2600, 1715 and 1984 kg/ha/yr for 12'x18', 40'x8' and 60'x8'x8' spacings.

P.B.Ekanayake, M.A.Wijeratne, C.Gunasekara

7. Thrust A19 - Development of water management techniques for young tea in drought prone areas to minimize causalities

Project 19.1 Determining quantity of water and frequency of application for drought susceptible clones

Project 19.2 Evaluating existing technologies for water application in tea

Under this project, three studies were undertaken at low-country, up-country and Uva.

19.2.1 Evaluation of fertigation

(a) St. Joachim Estate, Ratnapura

(b) Somerset Estate, Nanu oya

(c) Dammaria Estate, Passara

a. Study on drip irrigation-St. Joachim Estate, Ratnapura

A feasibility study on the use of drip irrigation on tea was commenced at St. Joachim estate, Field No. 1. The irrigation system and the technical support were given free of charge by Messrs. Agriworld Pvt.Ltd., Colombo. The system covered about one acre. Yield record over the year 2001 showed that irrigation with liquid fertilizers (fertigation) has given about 12% increase in yield.

Growth of young tea was tested with and without irrigation (drip irrigation with liquid fertilizers) under two systems of planting viz. on raised bed and flat beds (control) where tea was planted at a spacing of 0.6x0.9x1.5m. Two clones viz. TRI 2023 and TRI 3025 were used. Results are given in Table 10.

TABLE 10 - *Tipping weight and Yield*

Treatments	*Tipping weight (g bush^{-1})*	*Yield (kg ha^{-1}) (3 months)*
TRI 2023	73.5	727
TRI 3025	54.4	420
LSD (p=0.05)	6.5	79.5
Raised bed	74.2	687
Control	53.7	460
LSD (p=0.05)	16.5	79.5
Irrigated	77.3	641
Control	50.6	506
LSD (p=0.05)	16.5	79.5
CV %	21.0	36.0

Clone TRI 2023 has given a higher yield than TRI 3025. Yield of irrigated tea was about 26% higher than non-irrigated tea. Planting on a raised bed has also given about 50% increase in yield compared to normal planting.

N.P.S.N.Bandara , M.A.Wijeratne, A.Anandacoomaraswamy

b. Evaluation of fertigation, Somerset Estate, Nanu Oya

In this study, previous treatments were modified to include nitrogen levels. Fertilizer was given with the irrigation water at the rate of 180, 225 and 300 kg N ha^{-1} as urea for 300 days. The annual yield is presented in Table 11. There was an additional treatment of water application only with surface broadcasting of fertilizer at the rate of 360 N kg ha^{-1} in four splits.

Table 11 - *Yield of Tea*

Treatments		*Yield (kg MT ha^{-1})*
1. Fertigation daily 1 hr with	180 kg N ha^{-1}	6056
2. Fertigation Daily 1hr with	225 kg N ha^{-1}	5093
3. Fertigation Daily 1hr with	300 kg N ha^{-1}	5370
4. Water only Daily 1hr with application 4 times in an year	360 kg N ha^{-1}as ground	3760
5. Control (No fertigation)		2439

Daily fertigation with 180kg N ha^{-1}gave the highest yield.

A.R.Amerasekara, U.P.Abeysekara, A.Anandacoomaraswamy

c. Evaluation of Fertigation, Dammaria Estate, Passara

In this study, the four treatments of varying frequencies were tested in large blocks of land (0.25 ha). Fertilizer was given with the irrigation water at the rate of 180 kg N ha^{-1} as urea for 300 days. The yield from January-December is presented in Table 12.

Table 12 - *Yield of Tea*

	Yield (kg MT ha^{-1})
1. Fertigation daily (1hr)	4478
2. Fertigation every two days (1.5hrs)	3935
3. Fertigation once in every three days (1.5hrs)	4969
4. Control (No fertigation)	3543

R.M.A.C.Rajakaruna, J.C.K.Rajasinghe, A.R.Amerasekara, A.Anandacoomaraswamy

8. Thrust A20: Development of harvesting devices to overcome labour shortage.

Project 20.2. Evaluating harvesting devices.

Project 20.3 Modifying harvesting interval

a. Raigama Estate (2000)

A new trial was commenced at Raigama estate to test Kawasaki NV 60H Motorized machine supplied free of charge, by Messrs P.P.P.Jinadasa (Pvt.)Ltd., on two clones planted as hedge rows at two harvesting intervals depending on rate of shoot growth (14 and 21 day)

Treatments:

Method of harvesting: Manual harvesting
Mechanical harvesting (14 days)
Mechanical harvesting (21 days)

Clones: TRI 2027 and H1/58

Results showed that there was a significant decline in yield (33-40%) with the use of machine on both clones (Table 13).

TABLE13-*Yield of tea in relation to different methods of harvesting*

Treatment	*Yield – Made Tea (kgha^{-1}yr^{-1})*	
	H1/58	TRI 2027
Manual	4203	3932
Machine (14 day)	2527	2631
Machine (21 day)	2482	2346
LSD (p=0.05)	586	708
CV%	12.0	15.4

M.A.Wijeratne, N.P.S.N.Bandara, D.W.Vithana

20.4 Modify fertilizer application

a. Galaboda estate

A new experiment was commenced to test harvesting machine Kawasaki NV 60H with different levels of K application.

Treatments:

Method of harvesting: Manual harvesting
Mechanical harvesting (Kawasaki NV 60H)

Levels of K application: Normal rate (Recommended K)
Enhanced rate (1.5 x Recommended K)

Replications: 4

Clone: TRI 2027

Results showed that there was no significant difference in yield between two rates of K applied in relation to mechanical and manual harvesting. However, harvesting of tea by the motorized machine has given about 36% reduction in yield in comparison with manual harvesting.

M.A.Wijeratne, H.S.N.Peiris

20.5. Modify bush management

a. Balangoda estate (1998)

This was commenced in 1998 under the collaborative research programme with the estates. Four systems (spacing) of planting are tested using two clones at Balangoda Estate, Balangoda. The different spacing are 0.6x1.2 m (100%), 0.6x0.9x1.5 (100%) 0.6x0.6x1.5m (114%) and 0.9x0.45'x1.5m (133%) and the two clones are TRI 2026 and DG 39. Tea plants were brought into bearing in year 2000. Assessments and were done on yield, ground cover and relative water content (RWC). Results are given Table 14

TABLE 14 - *Yield, Ground cover % and RWC*

	Yield (kg/ha)	*Ground cover %*	*RWC*
Spacing (m)			
0.6 x 1.2	807	72.4	0.70
0.6 x 0.9 x 1.5	780	71.9	0.71
0.6 x 0.6 x 1.5	918	72.4	0.69
0.9 x 0.45 x 1.5	1200	57.8	0.71
LSD (p=0.05)	73.8	5.49	NS
CV%	8.6	3.5	4.5

Yield records for the first year after bringing into bearing showed that double hedge rows with a spacing of 0.6 x 0.6 x 1.5m and 0.9 x 0.45 x 1.5m has given a significantly higher yield compared to other two spacing tested. That is due to higher number of plants per ha which is 114% and 133% as compared to other two spacings (100%). However, estimates on ground cover 3 years after planting show that the hedge-row system with the highest plant density (0.9 x 0.45 x 1.5) has a poor ground cover compared to other system of planting. Relative water content measurements showed that there was no significant difference in leaf water content between spacing treatments. Of the two clones tested, TRI 2026 has given a significantly ($p<0.05$) higher yield (1061 kg/ha/yr) than DG 39 (792 kg/ha/yr). In contrast % ground covered by TRI 2026 clone was less than that of DG 39. During the dry spell, DG 39 leaves had high relative water content (0.74) compared to TRI 2026 (0.66). Moreover, DG 39 clone showed less wilting than TRI 2026 and hence the former had better drought tolerant properties.

M.A.Wijeratne, H.S.N.Peiris, C.Gunasekara, K.C.Munaweerahetti

b. Noragalla estate (2000):

Growth performance of tea plants were recorded in relation to different spacing and results are given Table 15.

TABLE 15 - *Plant height and Collar thickness*

Spacing (m)	*Plant height (cm)*	*Collar thickness (cm)*
0.6x1.2 (single row-100%)	94 ± 3.8	1.45 ± 0.06
0.6x0.9x1.5 (double hedge rows-100%)	81 ± 2.9	1.37 ± 0.05
0.6x0.6x1.5 (double hedge rows-114%)	91 ± 3.4	1.40 ± 0.06
0.9x0.45x1.5 (double hedge rows-133%)	81 ± 1.7	1.50 ± 0.04

± Standard Error for the mean

A.Wijerane, N.P.S.N.Bandara, D.W.Vithana

9. Thrust 21: Development of devices for improving pruning efficiency

Project 21.1: Evaluating and improving the efficiency of pruning devices.

A new hand pruner was designed and testing will be done in comparison with manual pruning.

M.A.Wijeratne, N.P.S.N.Bandara

Project A 21.2 Assessing post pruning vigour in mechanically pruned bushes.

Tea bushes have been pruned by machine at five different locations *viz.* St. Joachim estate, Deniyaya estate, Hapugasthanna estate, TRI, Kandy and TRI, Passara and their recovery after pruning was recorded in terms of shoot density, average number of leaves per shoot and tipping weight. Analysis of results showed that there was no significant difference in recovery after pruning between manual pruning and mechanical pruning.

M.A.Wijeratne, N.P.S.N.Bandara, D.W.Vithana

10. Thrust A22. Development of cost-effective control methods for integrated management of SHB

Project A 22.4. Determining the time and method of pruning on Shot-hole Borer damage

The objective of the above project is to find out the best time and method of pruning to minimise the attach of shot hole borer on tea. The times of pruning tested were January , April and Ocotober. The styles of pruning were rejuvanation (25cm), normal (45cm) and cut across(60cm).

a. Kiriwanaganga Estate, Deniyaya.

The experiment was terminated after collection of required details on the shot-hole borer damage in relation to different times and methods of pruning by the Entomology division

M.A.Wijeratne, N.P.S.N.Bandara, D.W.Vithana, Staff/Entomology Div.

b. Attempitya Estate, Attempitya

This experiment is in the fourth year of the current cycle. The yield for the period May 2000 to April 2001 is presented in Table 16.

TABLE 16 - *Yield of Tea (kg MT ha^{-1})*

Type of Pruning	*Time of Pruning*			
	October	*January*	*April*	*Means*
Rejuvanation(25cm)	3307	2970	3044	3107
Normal Prune(45cm)	3431	2930	3139	3166
Cut across(60cm)	3264	3305	3337	3302
Means	3334	3068	3173	
LSD (P=0.05) for Method of Pruning	NS			
LSD(P=0.05) for Time of Pruning	NS			
LSD(P=0.05) for Method x Time	NS			
CV	9.0			

A.R.Amerasekara

c. New Peacock Estate, Pussalawa

This experiment is in the fourth year of the current cycle. The yield for the period April 2000 to March 2001 is presented in Table 17

TABLE 17 - *Yield of Tea (kg MT ha^{-1})*

Type of Pruning	*Time of Pruning*			
	October	*January*	*April*	*Means*
Rejuvanation(25cm)	4963	4706	4782	4817
Normal Prune(45cm)	4823	4758	4480	4687
Cut across(60cm)	4663	4502	4669	4611
Means	4817	4687	4611	
LSD (P=0.05) for Method of Pruning	NS			
LSD(P=0.05) for Time of Pruning	NS			
LSD(P=0.05) for Method x Time	NS			
CV	6.8			

A.P.D.A.Jayasekara

11.A 24. Development of Weed Management Strategies in tea

Project 24.1 Screening of herbicides

24.1.1 : Effect of different methods of weed management on yield of VP tea- Galphele Estate, Panwila (1994).

T1 Manual weeding every month
T2 Manual weeding every 2 months
T3 Manual weeding every 3 months
T4 Chemical weeding - Paraquat (1.1l ha^{-1})
T5 Chemical weeding - Glyphosate (0.3%)
T6 Chemical weeding - Sulphosate (0.3%)
T7 Chemical weeding - Paraquat (1.1 l ha^{-1}) + 2, 4-D (1.5 kg ha^{-1})
T8 Chemical weeding - Paraquat (1.1l ha^{-1}) + 2,4-D (1.5 kg ha^{-1}) + Diuron (1.2 kg ha^{-1})
T9 Slash weeding

Plant growth, annual yield and microbial activity in soil are presented in Table 18.

Table 18 - *Effect of different methods of weed management on growth and yield of tea and microbial activity in soil.*

Treatment	*Annual Yield*	*Average Yield*	*Girth*	*Pruning weight*	*Tipping weight*	*Organic Carbon*	*Microbial Carbon*
	MT kg ha^{-1})		*(cm)*	*(mt ha^{-1})*	*(kg ha^{-1})*	*(mg g $^{-1}$)*	*(μg g^{-1})*
T1	3657 a	3380 a	18.1 a	12.0 a	1599 a	13.41	221
T2	3307 ba	3136 ba	17.4 b	11.6 ba	1495 ba	9.94	333
T3	3206 cba	3146 ba	16.7 cb	11.0 cba	1482 ba	9.62	181
T4	3151 cba	2987 b	16.2 dc	10.8 cba	1316 cb	11.80	190
T5	2673 cd	2920 b	15.5 e	9.2 cd	1115 dc	11.96	38
T6	2626 cd	2800 b	15.2 e	8..0 d	951 d	11.12	54
T7	3163 cba	3086 ba	16.2 dc	10.1dcba	1373 cba	12.36	123
T8	2573 d	2904 b	15.5 ed	9.4 cba	1330 cba	9.77	238
T9	2735 dcb	3150 ba	17.0 b	9.9 dcba	1441 ba	13.0	365
CV%	11.8	7.2	2.9	15.1	14.1	13.1	26

Annual yield was significantly reduced in treatments of Glyphosate, Sulphosate and cocktail mixture of Paraquat/ 2, 4-D and Diuron compared to manual weeding at intervals of one and two months. Average cycle yield was also reduced significantly in same chemical treatments and with Paraquat compared to manual weeding alone at monthly interval. Girth of tea bush was reduced in all chemically treated plots compared with that of manual and slash weeding at interval of <2 months. Pruning and tipping weight and the activity of microbes were also reduced drastically with Glyphosate and Sulphosate treatments. Thus, the regular application of herbicides particularly Glyphosate based herbicides are found to be hazardous to tea. Hence, resorting to a minimum number of rounds of the same herbicides within a year, in combination with other herbicides, and practice of other cultural, manual methods in rotation should meticulously be followed. This experiment was terminated after pruning.

A. Jayasekera, P. B. Ekanayake

24.1.2: Screening of new herbicide – Deverinol (Napropamide 45% sc) - a pre-emergent herbicide.

a) Four dosages i.e. 1, 2, 3 and 4 kg a. i. of the product was tested by spraying on to the bare soil of inter-rows of a new clearing at St Joachim estate, Ratnapura in December.

The experiment is in progress.

24.1.3: Weed control efficacy of Glyphosate incorporated with various surfactants - TRI, Ratnapura.

Three rates of Glyphosate (36% a i) i.e 0.3%, 0.5% and 0.7% were tested with the incorporation of following surfactants at two rates, and the visual score for weed injury rate is given in the Table 19.

Table 19 - *Mean visual score for weed injury rate 4 weeks after imposition of various treatment combinations.*

Surfactant	*Glyphosate level*		
	0.3%	*0.5%*	*0.7%*
T1 Ammonium sulphate @4 g l^{-1}	8	9	9
T4 -do- @ 8 g l^{-1}	7	9	9
T3 Kaolin @ 3 g l^{-1}	8	9	9
T4 -do- @ 6 g l^{-1}%	5	9	9
T5 Sandovit-N @ 5 ml l^{-1}	6	9	9
T6 -do- @ 10 ml l^{-1}	4	9	9
T7 Teepol @ 1 ml l^{-1}	6	9	9
T8 -do- @ 2 ml l^{-1}	7	9	9
T9 Glyphosate alone	5	8	8

A partial control was observed in 0.3% glyphosate treatment with or without surfactants. Comparatively, a more severe damage was observed with ½ the rate of surfactants such as Ammonium sulphate, Sandovit-N and Kaolin than that of full rate, incorporated with 0.3% Glyphosate. The most severe damage was observed with 0.5% and 0.7% Glyphosate incorporated with surfactants. All combinations with 0.5% Glyphosate was imposed in a separate study. Thus, the higher score under 0.5% glyphosate was attributed to the drought situation that prevailed after the spraying in addition to the treatment effects. Mimosa pudica was totally killed by 0.3% Glyphosate. *Borreria latifolia and Axonopus compressus* were totally killed by 0.3% Glyphosate incorporated with surfactants or by 0.5% Glyphosate alone. Same were properly controlled with 0.7% alone very effectively.

K. G. Prematilake

Project A 24 . 2 Management of Problem weeds:

a. Demonstration trial on the control of Getakola (*Hedyotis auricularia*) weed - at Rangala estate

A cocktail mixture of Diuron (80% wp) @ 1.1 kg/ha + Round-up 2.2 l/ha best controlled Getakola at tender phase and with further increase of Round-up to 3.0 l/ha in the mixture killed all mature Getakola along with the root system.

A combination of Direx @ 1.1 l/ha + Round-up 1.65 l/ha also showed very good performance. Glufosinate ammonium (Basta, 15% a.i) @ 1.5 l/ha also had very good performance.

Diuron @ 1.2 kg.ha + Hedonal D @ 1.4 l/ha also gave 75% control, a mixture of Round-up @ 2.2 l/ha + MCPA 60% @ 1.65 l/ha and gramoxone @ 1.1 l/ha + Hedonal- D @ 1.2 l/ha gave only a <65% control.

A24.2.1 Effect of various cultural measures on the management of Getakola - Mount Vernon estate, Patana.

This was commenced in 10[th] Feb. 2000 to investigate the effect of soil cover, soil compactness and soil fertility level on the presence of Getakola weed.

TABLE 20 - *Percentage density of Getakola weed at different stages after tow rounds of thatching.*

	% Density				*Fresh weight (g/0.09 m²)*	
					Getakola	*Otherweeds*
			*WAA**			
Treatment	Before	4	7	15	10.5	10.5
T1 Envelop folking	84	28 bc	47ab	32b	21.8ab	36.0
T2 Envelop folking + Compost	70	14 c	22bc	24bc	15.7abc	40.0
T3 Compost alone	81	49 a	66 a	65a	34.5a	22.4
T4 Mana mulch	61	1.1d	6 c	11c	4.4 c	46.9
T5 Eupatorium mulch	80	29abc	30 b	48ab	25.8 ab	32.1
T6 Wild sun flower mulch	86	18 bc	9 c	29bc	12.6 bc	44.3
T7 Control	72	35 ab	36 ab	29bc	21.6 ab	23.8
LSD (0.05)	NS					NS

* *WAA*- Weeks After Application

In 4 WAA, the density of Getakola was significantly reduced ($P<0.05$) with treatmetns T4 and T2. In 7 WAA, it was significantly reduced in T4 and T6. In 15 WAA, significant reduction in density of Getakola was seen only in T4. Fresh weight of weeds was also significantly reduced only in T4 followed by T2 and T6. The presence of a high density of other weeds following break down of materials could itself suppress the recovery of growth of Getakola.

Table 21 - *Percentage density of the weed Getakola after imposition of third round of thatching*

	% Density of the total weeds (Weeks after treatment)	
Treatment	*15*	*30*
T1 Envelop folking	7.21	2.4
T2 Envelop folking + Compost	12.36	4.8
T3 Compost alone	16.37	1.5
T4 Mana mulch	5.40	3.8
T5 Eupatorium mulch	8.70	5.6
T6 Wild sun flower mulch	6.40	7.0
T7 Control	11.60	2.6

The lowest density of Getakola was recorded with treatment 4 at 15 WAA. The density was lower with treatment T1 and T6. Alternate solution for the managment of Getakola weed in open patches is to do slash weeding of Getakola followed by lopping and thatching with either mana or wild sunflower, preferably grown *in situ*. This experiment was terminated in mid 2001.

A24.2.2 Management of Wel kohila (*Syngonium* species) and Arunadevi (*Wedalia trilobata*) weeds.

Two demonstration plots were set up to observe the controlling ability of the above weeds at St. Joachim estate, Ratnapura in August.

Treatments:

T1 Slashing weeds (Using a Wire cord mounted to the brush cutter)

T2 MCPA 60% @ 1.6 l/ha + Surpol @ 1.1l/ha

T3 MCPA 60% @ 1.32 l/ha + Surpol @ 1.1l/ha

T4 MCPA 60% @ 1.32 l/ha + Direx @ 1.1 l/ha

T5 Round up @ 5.5 l/ha + Kaolin @ 3.4 kg/ha

T6 Round up @ 4.4 l/ha + Direx @ 1.1 l/ha

T7 Round up @ 4.4 l/ha + MCPA 60% @ 1.32 l/ha

T8 Slashing (Using a knife)

T9 Control

There was no total control of either weed with any of the herbicide combinations tested. However, almost 75% kill in Wel kohila was observed with the combinations of MCPA 60% + Direx and MCPA 60% + Round-up. About 80-90% control of Arunadevi was observed with MCPA 60% @ 1.6 l/ha + Surpol @ 1.1 l/ha and Round-up @ 4.4 l/ha, but recovery of growth (from the growing buds) was poor in these plots. Recovery of growth was slightly faster in slash weeding using a knife than that with the Emac wire cord. Further investigations are in progress.

TABLE 22 - *Injury % (visual) on weeds as affected by various treatments.*

	Weeks after application			
	Wel kohila		*Arunadevi*	
	3	*5*	*3*	*5*
T1	-	-	-	-
T2	35	60	85	90
T3	10	50	75	65
T4	50	80	50	70
T5	5	50	65	65
T6	5	45	90	70
T7	40	70	90	80
T8	-	-	-	-
T9	0	0	0	0

K.G. Prematilake

A24.2.3 Management of Passali Kodi - Balangoda Estate

Chemical management of Passali kodi (*Anredera cordifolia*).

TABLE 23- *Fresh biomass yield of over-grown passali vines as affected by various herbicides combinations (kg /plot).*

Treatmen	Before*	For 3 months after: *1st application*	*2nd application*
1) Wallop @ 6 l ha^{-1}	2.167	6.150	3.161
2) Spark @ 6 l ha^{-1}	2.100	4.880	4.505
3) Amosuper @ 5.5 l ha^{-1}	1.400	4.466	2.255
4) Weed Master @ 5.5 kg ha^{-1}	1.733	6.716	2.888
5) Diuron @ 1.1 kg ha^{-1} + Round up @ 3 l ha^{-1}	1.550	3.750	2.377
6) Round-up/Surpass @ 5.5 l ha^{-1}	1.133	3.534	1.876
7) Manual removal of all weeds	2.300	2.566	2.022
8) Control	2.300	6.066	3.272
SE	0.657	1.825	0.599

* For a period of two months

There was no difference in weight of passali wines between plots prior to imposition of treatments. However, the lowest weight was recorded in plots to be treated with Round-up alone. Passali weight was significantly lower in manually weeded plots than that of plots treated with Weed Master after 1st application. Plots treated with Spark had the greatest Passali weight which was significantly higher than that of other treatments. Plots treated with Surpass recorded the lowest weight.

Table 24 - *Fresh biomass yield of over-grown passali vines as affected by various herbicides/ combinations (g /plot)*

Treatment	*Before* *July*	*3 WAA** *August*	*11WAA* *October*
T1 Wallop @ 5.5 l ha^{-1} with Knapsack	783	290	2553
T2 Wallop @ 5.5 l ha^{-1} Knapsack + hand sprayer	817	228	1013
T3 Spark 5.5 l ha^{-1} with Knapsack	967	182	2837
T4 Diuron @ 1.3 kg ha^{-1} + Round up @ 3 l ha^{-1}	717	285	2063
T5 Direx @ 1.0 l ha^{-1}+ Round up @ 3 l ha^{-1}	883	237	1603
T6 Goal @1.2 l ha^{-1}+ Round up @ 3 l ha^{-1}	1100	153	2133
T7 Manual removal of all weeds 883	883	190	1337
T8 Control	1200	343	2537
SE	288	115	635

*WAA- Weeks after application

Passali growth was slightly reduced 3 WWA in treatment T3, T6 and T7. After 11WAA, a significantly lower weight of passali vines was recorded with treatment T7 and T2. There was also some reduction in weight with T4 and T6 after 11 WAA. Further studies are in progress.

Project A 24.3 Economics of weed management.

A24.3.1 Impact of various chemical weed management methods on the growth of tea

a. Hemingford Estate, Parakaduwa (2001)

Table 25 - *Mean yield of tea before and after application of various herbicides.*

Treatment		*Yield (kg MT ha^{-1}round $^{-1}$)*	
		Before application*	***After application*****
T1	Wallop @ 3 l ha^{-1}	47.20	34.01
T2	Wallop @ 5 l ha^{-1}	42.48	28.23
T3	Spark @ 3 l ha^{-1}	49.68	36.43
T4	Spark @ 5 l ha^{-1}	36.62	25.85
T5	Weed Master @ 1.65 kg ha^{-1}	45.00	31.98
T6	Weed Master @ 2.75 kg ha-[1]	56.82	36.11

T7	Blaster @ 2.75 l ha^{-1}	54.63	38.45
T8	Amosuper @ 1.65 l ha^{-1}	36.02	27.03
T9	Amosuper @ 2.75 l ha^{-1}	33.18	29.05
T10	Gramoxone @ 1.1 l ha^{-1}	44.09	32.45
T11	Control (Manual / slash)	50.04	32.59
	SE	7.32	4.94
	CV %	19.9	18.8

* Mean yield of 8 month period ** Mean yield of 5 month period

There was no significant difference in yield between treatments at both phases other than in plots to be treated with Amosuper @ 2.75 kg ha^{-1} prior to imposition of treatments.

b. Galphelle Estate, Kandy (2000).

Table 26 - *Mean annual yield of tea before and after application of various herbicides.*

Treatment		*Yield (kg MT ha^{-1})*	
		Before application*	**After application****
T1	Wallop @ 3 l ha^{-1}	4369	8478
T2	Wallop @ 5 l ha^{-1}	2875	5818
T3	Spark @ 3 l ha^{-1}	3091	6214
T4	Spark @ 5 l ha^{-1}	3997	8668
T5	Weed Master @ 1.65 kg ha^{-1}	3085	5976
T6	Weed Master @ 2.75 kg ha-1	3027	7392
T7	Amosuper @ 3.0 l ha^{-1}	3859	7272
T8	Blaster @ 2.75 l ha^{-1}	3707	9738
T9	Round up @ 1.7 l ha^{-1}	3884	10850
T10	Gramoxone @ 1.1 l ha^{-1}(control)	3304	7490
	SE	863	2644

* total yield for 6 month period ** total yield for 12 month period

Two rounds of herbicide applications were given within the year. Unaffected weeds were manually removed. There was no significant difference in yield before and after imposition of treatments.

A 24.3.2 Performance of Emac Wire cord Mechanical weeder mounted to the Brush cutter.

Preliminary studies were carried out under different situations of tea fields at various locations in comparison with manual operations.

Table 27 - *Labour and fuel cost for a single round of weeding on an area of 1000 m^2*

Field	*Man hours*	*Labour cost (Rs.)*	*Fuel cost (Rs.)*	*Total (Rs.)*	*Wireloss(cm)*
a.St. Joachim Estate					
New Clearing-1	3.05± 1.2	64.00±25.00	121.60±36.00	185.60±55.00	38±8.0
New Clearing-2	2.94±0.10	61.50± 2.20	135.50± 4.75	196.86± 6.90	34±5.5
Manual weeding By a mammoty (control)	26.78	560.30	-	560.30	-
Wedalia weed	6.85±0.28	143.41±6.05	375.54±18.45	518.95±12.30	203±8.9
b. Mount Vernon Estate - Mature tea					
(Vacant patches with Getakola)	8.42±3.60	176.20±75.40	280.35±120.70	456.55±12.09	353±138
c. Hemingford Estate, Hantana					
Mature Tea Inter-rows	3.28±0.16	68.82±3.45	65.79±1.06	134.6±4.05	100±28

Further investigations are in progress.

12. B8 - Application of ergonomics to improve the harvesting of tea, worker productivity, income and working conditions

The aim of the above study is to sustain and enhance profitability of tea production by enhancing worker productivity with a pride and dignity for the worker. Harvesting is the costliest field operation in tea production accounting for 40% of total COP and 60% of field COP. The productivity of the pluckers therefore, directly affects plantation profitability. As to the earning capacity of the pluckers, their daily wages are closely related to the amount of tea harvested and the time they spend working. In this study we assessed the efficiency of a combinations different harvesting systems such as the use of the recently-developed TRI Selective Tea Harvester (TSTH) and conventional manual harvesting, in combination with different systems of leaf collection in the conventional urea bag with cane basket/cloth bag and Great-Western innovation and weighment locations at the conventional common leaf weighing spots and *insitu* weighment in the field in low and high elevations. The assessment was made in terms of plucker productivity -intake rate, quality of the made tea, workers preference to the innovations and the economic benefits. The results indicated that *insitu* weighment alone or along with TSTH and Great Western basket improved the plucker productivity and economic benefits.

W.W.D. Modder, W.A.D.P. Wanigasundara, M.W.A.P.Jayatilaka, R.Ravishankar, M.A.Wijerante, J.A.A.M.Jayakody, H.W.Shyamalie, V.Sithakaran, B.A.D.Samansiri, .A.Anandacoomaraswamy, Kumudu Perera and W.A.Pathirana

13. Project D/AGRY (Divisional Activities)

1. Effects of application of refuse tea on soil properties and yield of tea

The treatments were as follows.

1). Application of refuse tea (18 t ha^{-1})

2). Application of Dolomite (1.5 t ha^{-1})

First application of treatments after pruning was done in October 1998. Refuse tea was reapplied (second application) 9 months after the first application. Third application was done in January 2001(17 months after 2nd application) in order to test water relation characteristics affected by enhanced soil K. Although there was no distinct dry period during the first quarter of the year, midday water potential of tea shoots was taken 3 and 5 months after the 3rd application of refuse tea. In addition, monthly assessments on pH, soil organic carbon content and soil and leaf K content was continued. Although there was a significant increase in yield during the 1st year after second application of refuse tea, there was no significant difference in yield during 3rd 6 month after second application.

The soil pH, organic carbon content and soil K content are given in the following Table 28.

TABLE 28 - *pH,organic carbon and soil K in relation to dolomite and refuse tea application.*

	pH	*Organic carbon (%)*	*Soil K (ppm)*
Dolomite	5.3	1.31	146
Refuse tea	5.4	2.12	210
LSD (p=0.05)	NS	0.39	39.9
CV%	—	9.09	12.9

TABLE 29 - *Shoot water potential (SWP), pruning and tipping weight in relation to dolomite and refuse tea application.*

	SWP1 MPa	*SWP2 MPa*	*Pruning weight (kg bush^{-1})*	*Tipping weight (kg bush^{-1})*
Dolomite	-5.1	-5.3	2.0	1.41
Refuse tea	-2.6	-2.6	2.5	2.07
LSD (p=0.05)	1.18	1.02	0.33	0.50
CV%	17.3	14.8	8.3	16.8

SWP 1 and SWP2 are the shoot water potential measured at 3 and 5 months after third application of refuse tea respectively. There was no significant difference in soil pH. Organic carbon % and the soil K levels significantly increased by the application of refuse tea. Application of refuse tea has significantly improved water status of tea bushes i.e. shoot water potential of shoots were high in plots applied with refuse tea. This can be due to high availability of soil K in plots applied with refuse tea. Experiment was terminated.

M.A.Wijeratne, P.Premathunga

2. Different styles of pruning and bringing into plucking on recovery after pruning and yield of tea - Noragalla Estate (1996).

Different styles of pruning (lung pruning at 20"-partial cleaning, lung pruning at 20"-full cleaning, cut across at 26" and lung + cut across pruning-alternate cycles) and two types of bringing in-to plucking (plucking-in and tipping in-to hard green wood) were tested. Results showed that there was no significant difference in the yield of tea between treatments.

M.A.Wijeratne, D.W.Vithana

3. Effect of "Tipping" vs "Plucking" in on the yield of tea - Mid-country station, Hantane

The objective of this study was to compare the different systems of bringing into plucking after pruning on the yield of tea (TRI 2025). This was an observation experiment. First year yields are given in Table 30

TABLE 30 - *Yield of tea (kg MT ha^{-1})*

Treatments	Yield
Plucking in	864
Tipping with	
2 - Tier system	1203
4- Tier system	1496

The 4- tier system gave the highest yield probably due to higher tipping height.

A.P.D.A.Jayasekara

4. Effect of different styles and times of pruning on productivity of tea - Deniyaya Estate, Deniyaya

The experiment was terminated as the estate had pruned experimental plots in April/May, 2001 without consulting the TRI.

M.A.Wijeratne, D.W.Vithana, D.W.R.Jayasooriya,
C.I.Dissanayake, T.D.Dissanayake

5. Effect of different styles and times of pruning on productivity of tea - St Coombs Estate, Talawakele

The objective of this experiment is to compare the different heights of pruning (45, 55 and 65 cm) on yield and shoot densities. This experiment was in the second year of the current cycle. There was a frost attack in late January and early February. The yield is presented in Table 31.

TABLE 31 - *Yield of tea (kg MT ha^{-1})*

Height of Pruning	Yield
45cm	1856
55cm	1924
65 cm	1814
LSD (P=0.05)	45.1
CV(%)	4.9

6. Screening clones for drought tolerance - St. Joachim Estate, Ratnapura.

The experiment was done in collaboration with the Faculty of Agriculture, University of Ruhuna and Plant Breeding Division, TRI. Water relation characteristics of eighteen TRI 3000 series clones were studied and their drought tolerance capacities were compared with well-known drought tolerant clone TRI 2025 and drought susceptible clone TRI 2023. Water relation characteristics such as stomatal density, leaf thickness, relative water content, leaf water potential, transpiration and diffusive resistance were measured. Clones were first statistically compared with two control clones (TRI 2025 and TRI 2023) taking each parameter separately and they were ranked according to their level of drought tolerance giving numbers from 1 to 5 as follows.

Significantly inferior to TRI 2023	- 5
Equal (not significant) to TRI 2023	- 4
Significantly superior to TRI 2023 and inferior to TRI 2025	- 3
Equal (not significant) to TRI 2025	- 2
Significantly superior to TRI 2025	- 1

Thereafter the results (ranks) were pooled i.e. individual parameter was taken as a replicate and the combined result was statistically analysed. Results showed that TRI 3017, TRI 3019, TRI 3020, TRI 3025 and TRI 3069 were equal to TRI 2025 in drought tolerance and hence identified as drought tolerant clones. Water relation characteristics of TRI 3013, TRI 3014, TRI 3022, TRI 3035 and TRI 3051 were not significantly different from TRI 2023 and hence rated as drought susceptible clones. Other tested clones viz. TRI 3015, TRI 3018, TRI 3047,TRI 3052, TRI 3055, TRI 3058, TRI 3072 and TRI 3073 were inferior to TRI 2025 but superior to TRI 2023. Therefore, those clones were grouped as moderately drought tolerant clones. The methodology developed for statistical analysis (analyzing combined or pooled result) in this experiment can be used in clonal screening trials for comparing new clones with known clones. Although all important water relation characteristics pertaining to the canopy have been studied in this experiment, characteristics of the root system have not been observed. Hence, it is necessary to take measurements on root growth and include such results in the statistical analysis before firm conclusions are made.

M.A.Wijeratne and G.N.Shiromali

7. Effect of resting and hard plucking on root starch reserves of tea - St Joachim Estate, Ratnapura

Taking into consideration the results of the previous year, the same study was repeated with following treatments using TRI 2027 clone.

Pruning after continuos plucking (control)

Pruning after 1 months of Black plucking

Pruning after 2 months of Black plucking

Pruning after 3 months of Black plucking

Pruning after 2 months of resting

Black plucking is the removal of all shoots including growing buds.

Starch reserves before imposition of treatments were 6.7%. The starch reserves at pruning and tipping after imposition of treatments are given in the Table 32.

TABLE 32 - *Root reserves in relation to different methods of plucking and resting.*

	Root starch reserves (%)	
	At pruning	*At tipping*
Continuos plucking (control)	13.0	9.7
1 months of Black plucking	13.6	9.7
2 months of Black plucking	12.3	8.3
3 months of Black plucking	9.5	7.2
2 months of resting	7.7	6.1
LSD (p=0.05)	2.9	2.1

Results showed that the root starch reserves have been augmented by resting for two months and also by black plucking (removal of all shoots including growing buds) over a period of 1-2 months. However, extended periods of black plucking have not significantly increased the root starch content. Increase in root reserves after black plucking and resting can be due to the diversion of assimilates down to roots with the absence of growing buds and arimbus (sink) on the plucking table. The investigations will continue in order to explore the practical aspects and economics of black plucking before pruning.

M.A.Wijeratne and P.Premathunga

8. Effect of mulching materials and soil acidity on soil properties and yield of tea -St Coombs Estate, Talawakele

Two experiments were conducted with young tea and pruned tea of clone TRI 2025. The following treatments were tested.

Mulch Treatments:	**Soil acidity**
Control	Control
Refuse Tea –25 Tons ha^{-1}	Dolomite -1000 kg ha^{-1}
Mana (*Cympopogan Confertiflorus*)-35 Tons ha^{-1}	Minplus - 1000 kg ha^{-1}
Dadap (*Erytrina lithersperma* -35 Tons ha^{-1}	(Crushed basaltic rock)
Pangirimana (*Cymbopogan nardus*) - 35 Tons ha^{-1}	

In both young and mature tea, tea refuse and dadap improved soil CEC, microbial biomass carbon, total phosphorus and yield. Improving the soil organic carbon by 1mgg^{-1} increased the CEC by 0.12cmoles kg^{-1} and reduced the thermal conductivity by 0.25Wm^{-1} K^{-1}.

T.Ganesrajah, Final year student of Faculty of agriculture, Jaffna, M.S.D.L.Silva

9. Effect of organic matter on nitrogen requirement of tea plants

This trial was conducted to study the feasibility of using Vermicompost to improve the soil physical properties, N requirement of tea plants under higher organic matter content on growth and yield of tea

a. Brunswick Estate, (1998)

The treatments are combinations of Vermicompost ((@300 g and 600 g bush^{-1}) and nitrogen (150, 300, 450 kg N ha^{-1}). There was no treatment difference in yield. The experiment has completed one cycle.

S.N.Wijesekara and P.B. Ekanayake

b Stellenburg Estate, Kotmale.

The treatments are combinations of earthworm (EW)casts (@600g) and T750 applications.

TABLE 33 - *Yield of tea (kg MT ha^{-1})*

Treatments	*Yield*
T1 - EW casts 600g + T750 - 4 applications	1284
T2 - EW casts 600g + T750 - 2 applications	1134
T3 - EW casts 600g	756
T4- T750 - 4 applications	678
LSD(P=0.05)	NS
CV(%)	45.1

There was no significant difference between treatments probably due to high CV.

S.N.Wijesekara, A.P.D.A.Jayasekara and P.B.Ekanayake

General

1. Publications:

1. **Wijeratne, M.A. (2001).** Shoot growth and harvesting of tea. The Tea Research Institute of Sri Lanka, Talawakelle, Sri Lanka. pp 45

2. **Wijeratne, M.A. (2001).** Hand Pruner: A New Pruning Machine. *TRI Update*. Vol. 6. No.1. June 2001: 2.

3. **Amarathunga, M.K.S.L.D. and Wijeratne, M.A. (2001).** Strategies to sustain yields of clonal tea. *TRI Update*. Vol. 6. No.1. June 2001: 4-5.

4. **Modder. W.W.D. and Wijeratne, M.A. (2001)** Mechanization of Plantation Agriculture. Needs and Prospects. Daily News, August 27, 2001. ("Widusara", October 24, 2001, "Lankadeepa" October 10, 2001).

5. **Amarathunga, M.K.S.L.D., Wijeratne, M.A. and Jayaratne, K.P.S.C. (2001).** Impact of variation of soil properties on bush stand and productivity of tea lands in Sri lanka. *Proceedings of the 57th Annual Session, Part 1- Abstracts., SLAAS.* 96.

6. **K.G. Prematilake and P. Prematunge (2001).** Potential of various green matters as sources of mulch and green manure. Proceedings of the 11th National Workshop on Multipurpose Tree species in Sri Lanka.

7. **Umaah, K., Anandacoomaraswamy, A., and Luxmei De Silva, M.S.D., (2001).** Effects of mulching materials on biological and physical properties of tea soil. Proceeding of Jaffna Science Association in April 2001.Vol 9, No 1.

8. **Sujetha, K., Anandacoomaraswamy, A., and Luxmei De Silva, M.S.D., (2001).** Effects of mulching materials on chemical properties of ultisol and growth of tea. Proceeding of Jaffna Science Association in April 2001. Vol 9, No 1.

Papers accepted for publication

1. Prematilake, K.G. A review paper on "Some developments in weed management in tea plantation" for Jubilee publication of the TRI.

2. Prematilake, K.G., Gamage, A. P. Prematunge. *"Eupatorium innulifolium,* A source of green matter for tea plantation".

3. Prematilake, K.G. "The management of passali kodi (Wal Nivithi) [*Anredera cordifolia*]. A noxious weed in tea fields.

4. Sinhala article on "Green manure and compost from your own tea garden" for "The Tathu" magazine.

5. Sinhala article on "Under exploited plant resources in our tea lands" A news paper article.

6. Sinhala article on "The use of Glyphosate – Be careful" for TSHDA magazine.

2. Advisory, Extension and training activities

1) Dr. K.G. Prematilake presented a seminar on "Integrated Weed Management in tea plantation" at the E & E Forum (Sinhala) for the officers of the TSHDA and Tea Small Holders at the TRI Talawakelle.

2) Dr. K. G. Prematilake and P.B. Ekanayake were involved in script writing and preparation of the Video film on Weed Management and Shade Management in tea plantation in collaboration with the Media Centre of the Open University, Nawala under Plantation Reform Project.

3) Dr. K. G. Prematilake was involved in the Video film on "Pruning of tea" telecast on Channel Eye ~~as a~~ Resource person, together with Dr. M. A. Wijeratne.

4) Dr. K. G. Prematilake continued addressing the students of the NIPM and Eastern University on weed management in tea plantation.

5) Dr. K. G. Prematilake trained and supervised the research project of a final year student of the Faculty of Agriculture, University of Ruhuna. He also trained two students of NAITA on divisional research activities.

6) Dr. K. G. Prematilake was involved in the assessments of oral presentation of seminars by the final year students of Faculty of Agriculture, University of Ruhuna.

Other activities.

1) Dr. K. G. Prematilake completed the screening of a Glyphosate product "Amosuper" and proposed to ACSC for TRI recommendation. TRI has recommended these products provided that residue in made tea is to be analysed.

2) Dr. K. G. Prematilake participated in the workshop on management of *Parthinium histeroporus* weed, held at the Faculty of Agriculture, University of Ruhuna,

3) Dr. K. G. Prematilake participated as a resource person at Regional Scientific Committee seminar held at Ratnapura and Kandy.

4) Dr. K. G. Prematilake also served as a referee for Scientific papers submitted to the SLAAS and Journal of the NSF.

BIOCHEMISTRY DIVISION

I.S.B.Abeysinghe
Acting Head of Division

1. Project – B17 - Development of Chemical/Biochemical methods in the control of Shot-Hole Borer *(Xyleborus fornicatus)* Tea

A new strategy for integrated pest management could be developed with minimal environmental impact and also to limit the development of resistance by studying certain components of the chemical ecology of pests. Shot-hole borer (SHB) is a major insect pest of tea whose infestation is a serious problem affecting 30% of land under tea cultivation in Sri Lanka. The continued depredation and debilitation of the tea bush leads to loss of yield and exposure to attack by secondary pests, fungi and termites. The study of insect chemical ecology in particular has shown that the development of semio chemicals for management of pests has the potential of providing control methods more in line with current demands than the conventional pesticides.

The volatile compounds in the tea plant were studied to explore the possibility of using these chemicals to control SHB. The analysis was carried out using ten clones belonging to TRI 2000, 3000 and 4000 series. TRI 2023, 4053, 4006, 3048 and 3072 were selected as resistant clones and TRI 3014, 4063, 2025, 3020 and 4071 were selected as susceptible clones. Dichloromethane extracts of tea leaves and bark of both resistant and susceptible clones were used for GC-MS analysis. A total of 25 volatile compounds were identified. Major chemical changes were observed between resistant and susceptible clones and also upon SHB infestation.

It was documented that the weed *Montanova bipinnatafida* was found to attract SHB. The dichloromethane extracts of this plant were analysed, using GC-MS, to identify the volatiles present in the plant. It was found that the major volatile compound in this plant was germacrene. Germacrene was identified as a plant-derived semio chemical and experiments are in progress to determine the attractant properties of germacrene towards SHB.

G de Silva, M.L.D.P Gunatilake, I S B Abeysinghe

2. Project – B-26 - Biochemical and chemical methods in the control of Blister Blight leaf disease of tea caused by *Exobasidium vexans*

As no clones have been found to be fully resistant to the disease, appropriate control measures are vital for the survival of the plant. At present, chemical control is the only available method. Accordingly, copper and systemic fungicides are being used extensively in all tea growing areas of the world. The main disadvantage of the continuous use of fungicides is that the fungus could develop resistance to the fungicide. Therefore, the development of biochemical control methods based on natural resistance mechanisms has become indispensable for the survival of the tea industry.

The main objective of this project is to find out the chemistry and biochemistry of disease resistance mechanisms in relation to blister blight leaf disease of tea and to extrapolate this information to control the disease in an environmentally friendly manner by means of exploiting natural disease resistance traits inherent in the tea plant.

The work carried out on this project in the year 2000, focussed mainly on the establishment of catechin profiles of tea clones which are susceptible or resistant to blister blight leaf disease.

It was shown that in resistant clones the (-)-epicatechin level was higher than in that of susceptible clones. It is a known fact that cultivar TRI 2043 is highly resistant to the disease. However, our study on catechin profiles revealed that the epicatechin level in TRI 2043 was on par with the other resistant clones indicating that parameters other than epicatechin are also involved in the resistance mechanism of these cultivars.

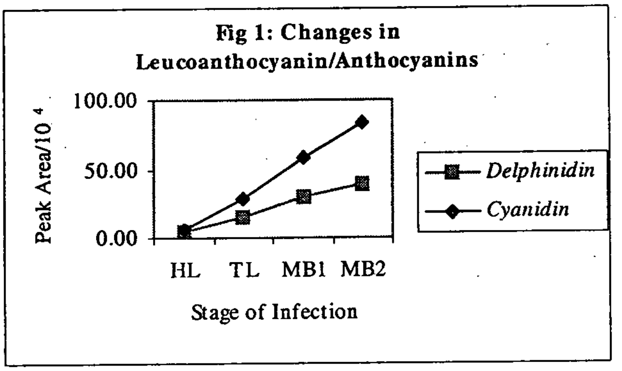
A major difference between TRI 2043 and other resistant tea cultivars is that TRI 2043 contains a higher amount of red pigments giving a reddish green colour to the leaves. It was also observed that in some cases the white blisters turned red on the leaf itself denoting the *in vivo* conversions of leucoanthocyanins to anthocyanins. Therefore, in the year 2001 our research work focused on studying the role of anthocyanins in the resistance mechanism of blister blight in tea.

Identification of Anthocyanidins present in the cultivar TRI 2043

Two anthocyanidins were separated and identified from the cultivar TRI 2043 using HPLC. Anthocyanidins present in TRI 2043 were identified as cyanidin and delphinidin.

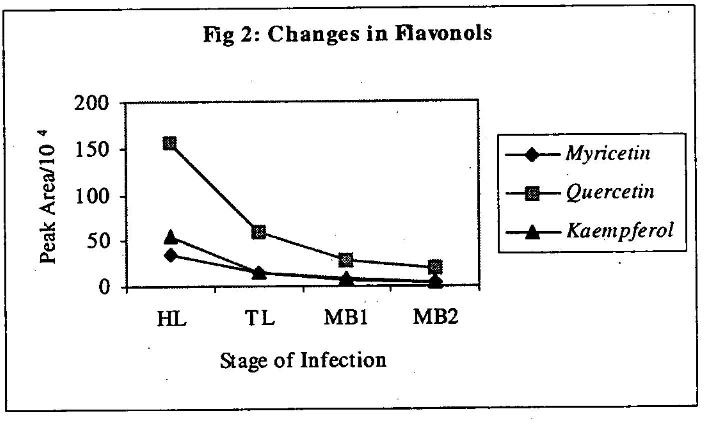
Study of Anthocyanin formation upon Blister Blight infection

The leaf spots from various stages of disease, Healthy (H), Translucent spot (TL), and mature blister (MB1 & MB2) were subjected to acid hydrolysis. The solutions containing various stages of infected material, turned deep red (at the outset blisters were white in colour) indicating the formation of anthocyanidins from leucoanthocyanidins. An analysis of hydrolyzed samples showed a marked increase of leuconathocyanins upon infection. (Figure 1). The chemical factors (anthocyanins) that are presumed to impart a disease resistance to TRI 2043 is being formed and enhanced upon infection of the fungus in other cultivars also.



Study of change of precursors of leucoanthocyanins/anthocyanins upon infection

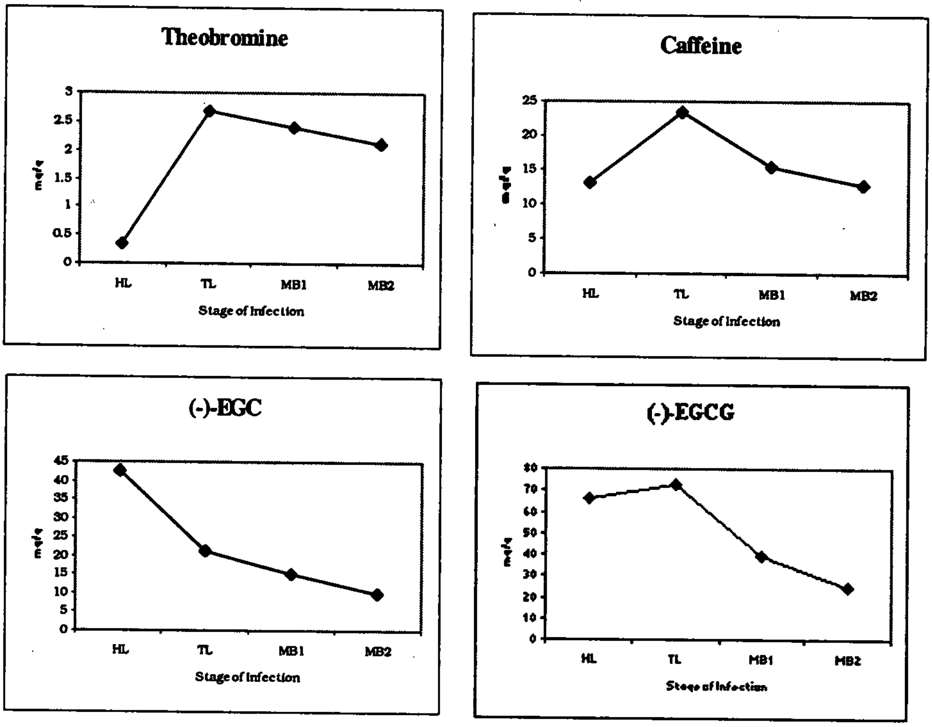
To further study the involvement of anthocyanins in the resistance mechanism, we have investigated the change in the precursors of the lecucoanthoyandins namely three major flavonols aglycones, Quercetin, Myricetin and Kaempferol. The HPLC profiles of three major flavonols are as shown in Figure 2.



From this study it was found that levels of these three compounds decreased upon infection suggesting that flavanols could be the precursors for the formation of leucoanthocyanins/anthocyanins upon infection.

Study of changes of flavanols and methyl xanthines upon infection

In another study an examination of changes in catechins and methyl xanthines (theobromine and caffeine), at different stages of blister blight infection was carried out to examine their role in the resistance mechanism. A significant increase of theobromine and caffeine was observed upon infection (Figure 3). (-)-EC and (-)-EGC levels in the infected leaf areas decreased significantly upon infection. The levels of (-)-ECG and (-)-EGCG increased at the translucent stage of infestation and started to decline during the mature blister stage (Figure 4).



Figs 3&4: The changes of flavanols and methyl xanthines upon infection

It is planned to study the biosynthetic pathway of catechins and anthocyanins in the tea plant in relation to the blister blight infection to obtain a clear picture of the disease resistance mechanism.

TLC Bioassay studies for antifungal activity of anthocyanidins

A TLC bioassay was also initiated using *Cladosporium cladosporiodes* as a prelude to a green house study with *Exobasidium vexans* under a mist propagation system since *E.vexans* could not be grown *in vitro.* Our studies with an anthocyandin mixture containing both cyanidin and delphindin showed fugitoxicity to *C. cladosporiodes.* Further studies are in progress to confirm this observation.

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3. Project- B-18 -Use of DNA markers for molecular characterisation of tea

The first phase of this CARP (Council for Agricultural Research Policy) funded project was completed and the terminal report was submitted to CARP. The details of the project are listed in the Annual Reports of 1998, 1999 and 2000.

Germplasm characterization is an important link between conservation and utilization of plant genetic resources as a source of variance for useful traits in plant breeding programmes. The effective conservation and use of genetic resources of tea are essential for sustainability and for increasing productivity of this vital export plantation crop.

No systemic assessment of genetic variability in tea has been carried out in Sri Lanka. Comparison of plant accessions by morphology alone is not sufficient. DNA technology offers novel methods of observing the genome directly. As a starting point, development of a method for DNA isolation from tea, Randomly Amplified Polymorphic DNA (RAPD) marker based characterization as well as screening of clones for Simple Sequence Repeat Polymorphisms (SSRP) were identified as the objectives of this study.

Genetic relationships of 39 tea accessions representing, 22 TRI recommended clones, 14 estate selections and three distinct phenotypes Yabukita, China and ASM 4/10 were assessed. In this study, DNA was isolated from leaves by applying a CTAB based technique with some modifications. This method yielded sufficient quantities of pure, high quality intact DNA which ranged between 5-30 $\mu g/g$ of leaf tissue.

20 Operon primers were used for RAPD amplification and generated a total of 230 bands of which 223 (96.9%) showed polymorphism with an average of 9.5 bands /primer /accession. A considerable level of genetic diversity ranging between 0.17-0.58 was observed for 39 accessions with an average of 0.37. In both TRI clones and estate selections, not much diversity was found between (0.38) or within two groups (0.35 & 0.33 respectively). Yabukita and China varied immensely both with TRI clones and estate selections. Furthermore, TRI 777, TRI 2016 and TRI 4006 clones demonstrated a much higher degree of diversity with the accessions studied.

The dendrogram readily separates the TRI clones and estate selections into two distinct clusters, confirming most of their origins and parentage. Yabukita and China clustered together with estate selections.

Attempts to screen for SSRPs was not successful owing to incomplete digestion of tea DNA with Sau3AI.

The overall result generated from this study is very useful for the tea breeder. Information gathered on the genetic relationships between tea accessions can be effectively used in maintaining tea genetic resources. Furthermore, these results are beneficial for the improvement and prioritisation of the tea breeding programme and to work towards development of more informative molecular markers such as Amplified Fragment Length Polymorphisms (AFLPs) and Simple Sequence Repeat Polymorphisms (SSRPs) for marker assisted selection.

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4. Projects – A1.5 and 3.5 -Establishment of a correlation between the chemical composition of tea clones and made tea quality – Screening lines for quality

In addition to high yields, other desirable characteristics such as the quality potential of a clone should be taken into account when developing clones for up-country and mid-country dry zone areas. Therefore, evaluating quality potential of clones at the early stage of the breeding programme plays an important role.

As a continuation, tea clones belonging to TRI 3000 and 4000 series were evaluated and quality ratings were established. In addition, 36 selections from the phase two stage of the breeding programme were also analysed for their quality potential using newly acquired environmentally controlled miniature manufacturing facility. Made tea samples were tasted by three professional tea tasters and ranked on the basis of quality, using the hedonic scale procedure. The experiment was repeated five times and results were analysed by Friedman-test using minitab. Nine selections with high quality were identified and the information was passed on to the Plant Breeding Division to help the screening process.

The assistance given by Mr. Claude De Silva, (De Silva Abeywardena and Pieris Ltd,) Mr. Lalith Ramanayake, (John Keells Ltd,) and Mr. Anil Cooke, (Asiya Siyaka Commodities) by providing organoleptic evaluations on made tea samples are acknowledged.

U.R.N Udagama, D.M.U.S. Senarath Bandara, H.K.M.D.Kumarasinghe, A.D.M.Damayanthi, P.B.Chandradasa and I. S.B.Abeysinghe

5. Project B-21 -Development of a method to completely inhibit polyphenol oxidase (PPO) and peroxidase activity

a. Two stage drying using miniature manufacturing unit at St. Coombs Estate

This project was initiated in 1998. The objective of the project is to develop a method to improve the keeping qualities of tea. Preliminary investigations have shown that when fermented dhool is exposed to microwave energy, PPO gets inactivated. (Results presented in the Annual Report of 1998). Further trials on microwave drying, conducted at factory level at Great Western Estate, showed that the microwave-dried tea was less interior to conventionally dried teas in terms of liquor characteristics and flavour profile. However, the appearance or the blackness of made tea was better in the microwave-dried teas. (Results presented in the Annual Report of 1999). Further trials were carried out at the Watagoda factory where low country manufacture is being carried out (results presented in the Annual Report of 2000). The results obtained when microwave oven alone has been used to dry both high and low-country manufactured teas indicate that the quality of the liquor is interior to that of conventionally dried teas in both instances.

Further trials were conducted on two-stage drying where microwave drying was carried out in combination with conventional drying. These trials were initially conducted using St. Coombs miniature manufacturing unit and subsequently extended to factory level at the Great Western Estate factory. The dried dhools were subjected to microbiological analysis in addition to TF, TR, moisture content and flavour.

As a preliminary trial for two-stage drying, miniature ECP drying unit at St Coombs was used in combination with the microwave oven. Two treatments were given for two samples of 50g each of dhool moisture content 19.2% and 15.81% respectively. First treatment was, 7min exposure in the miniature ECP followed by 3mins 10secs exposure at 80% power level in the micro wave oven. The second treatment was 9 min. exposure in the miniature ECP followed by 3min 20 secs exposure at 80% power level in the micro wave oven. For comparison a partially dried sample from the second section of the FBD drier, moisture content 19.35% was exposed to micro wave oven for 3mins. 20 secs. At 80% power level. A 100% FBD dried sample of 4.2 % moisture was used as a standard.

The fired teas were compared for TF, TR, moisture content and taste. The results are given in Table 1.

Table 1 - *Comparison of TF, TR and moisture content of two-stage dried teas as against conventionally dried teas.*

Treatment	*%TF*	*%TR*	*R/TF*	*%moisture*
ECP 7min + mw80% 3min 10secs	0.77	14.04	18.46	5.4
ECP 9min + mw80% 3min 20secs	0.87	13.99	16.09	5.0
FBD 2nd sect^{n} + mw80% 3min 20secs	0.96	13.95	14.47	5.8
FBD	1.10	13.30	12.72	4.2

MW- microwave

On tasting the liquors, it was felt that the teas dried in two stages were thinner and the infusions were duller than the conventionally dried teas. The appearance with reference to blackness of tea for the first 3 samples were better than the FBD dried sample. The moisture content of two-stage dried teas were higher than the FBD dried sample.

Two stage drying at Great Western Estate

The objective of this project is to compare two-stage drying as against 100% microwave drying and conventional drying at factory level. Percentage of TF, TR, moisture content, quality index (QI) together with residual PPO activity and the tasters evaluation have been compared. All samples were sieved through 16 and 25 mesh before analysis. These trials were repeated three times and the averages of the above parameters were compared based on previous studies (Annul Report of 2000).

For two stage drying, 50g of partially dried samples from 1st, 2nd, and 3rd sections of the FBD drier were taken and exposed to microwave energy at 80% power level for 3.5mins and 1.5 mins.

The conventionally dried sample was taken from the 4th section of the FBD. The results are shown in Table 2.

Table 2 - *Comparison of TF, TR, moisture content and polyphenol oxidase activity of two-stage dried teas as against 100% microwave dried teas and conventionally dried teas.*

Treatment	*%TF*	*%TR*	*TC*	*%B*	*TR/TF*	*%MC*	*%PPO*
40% 3min + mw80% 6 min	0.699	14.288	0.626	19.726	20.452	3.1	27.16
FBD 1st sectn+mw80% 5min	0.638	13.871	0.610	19.565	21.745	3.7	41.98
FBD 2nd sectn +mw80% 3min	0.942	14.503	0.863	19.832	15.402	3.1	80.25
FBD 3rd sectn+mw80% 1.5 min	0.999	15.408	0.913	25.260	15.420	3.4	81.48
FBD 4th sectn	1.018	14.216	0.900	27.950	13.971	4.6	93.83

MW- microwave

On comparing the results it was evident that % TFs in microwave dried teas and teas dried with 2-stage drying is lower than that of conventionally dried teas (Table 2). The flavour profile of the teas indicate that the levels of flavour compounds are less in micro wave-dried teas than in conventionally dried teas (Table 3).

Table 3 - *Comparison of flavour compounds of two-stage dried teas as against 100% microwave dried teas and conventionally dried teas.*

Treatment	Trans-2 *Hexanal*	Linalool *oxide-1*	Linalool *oxide-2*	Linalool	Methyl *salicylate*	Geraniol	QI
mw40% 3min + 80% 6 min	3.018	0.119	0.631	0.902	0.019	1.361	0.299
FBD 1st sectⁿ + mw80% 5min	7.331	0.326	1.673	2.652	0.048	2.626	0.362
FBD 2nd sectⁿ + mw80% 3min	8.028	0.401	1.831	3.560	0.063	3.432	0.444
FBD 3rd sectⁿ +mw80% 1.5 min	25.115	0.768	3.175	6.804	0.096	3.821	0.271
FBD 4th sectⁿ	33.772	0.793	3.076	6.739	0.170	3.460	0.200

MW- microwave

Where the % PPO activity is concerned, highest PPO activity was observed in the sample that was dried in the FBD (98.3%) and the lowest was in the microwave-dried sample (27.16%). In the two-stage dried teas the % PPO activity increased with the reduction in time of exposure to microwave energy (Table 2). Appearance-wise, sample No.1 which was exposed to microwave energy alone had the best appearance.

On tasting the samples it was observed that the best liquor was produced by conventionally dried teas and the next best was the sample from the 3rd section of the FBD which was exposed to microwave energy at 80% power level for 1 second. The fully microwaved sample had very light and undesirable liquor. The flavour was also more pronounced in the conventionally dried teas than in the micro wave dried teas.

Microbial Analysis

All samples were subjected to microbial analysis to see the effect of microwaves on the microbial count.

1gm from each sample was shaken for 30mins with 25ml of sterile distilled water and a drop of tween 80. From this, 1ml was added to PDA (potato dextrose agar) and was plated and incubated at 25°C for 48 hrs.

The total number of microbes for each sample is given in Table 4, the total number of colonies is given in Table 5 and the abundance of microbes is given in Table 6. These trials were repeated 3 times and the average has been recorded.

TABLE 4 - *Total number of microbes*

Treatment	*Total No. of microbes/gm*
1. 40% 3min + mw80% 6 min	-
2. FBD 1st sect^n+mw80% 5min	58
3. FBD 2nd sect^n +mw80% 3min	4
4. FBD 3rd sect^n +mw80% 1.5 min	708
5. FBD 4th sect^n	5166

Mw- microwave

TABLE 5 - *Total No. of Colonies on PDA Plates*

Treatments	**1**	**2**	**3**	**4**	**5**	**control**
Rep 1	-	3	-	26	207	-
Rep 2	-	1	1	31	207	-
Rep 3	-	3	-	28	211	-

(at 25°C for 48 hrs.)

TABLE 6 - *Abundance of microbes*

Treatment No.	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5
Aspergillus sp.													++		++
Trichoderma sp.	++	++	++		+								+		+
Pestolatia sp.					+		+	+	+				+	+	
Penicillium sp.															
Yeasts		+		+						++		++	++		
Bacteria		+		+											
Fungi (unidentified)															

(at 25°C for 48 hrs.)

It is observed from Table 6 that the samples subjected to 100% micro wave energy has the least number of species of micro organisms while the samples subjected to 100% conventional drying has the most.

It is seen from the results that the microbial count of the samples that have been subjected to microwave energy alone is very much less than those samples which have been exposed to two-stage drying. The microbial count increased progressively with the reduction in time of exposure to microwave energy during two-stage drying. The highest microbial count was seen in the samples that were subjected to FBD drying. These results indicate that microwave energy has a direct impact on the microorganisms Tables 4, 5 and 6).

In summary, when microwaves are used to dry both high and low country manufactured teas, the quality of the liquor was found to be less superior to that of conventionally dried teas. However, the appearance in connection with blackness is better in microwave dried teas.

Trials on two stage drying indicate that the conventionally dried teas are better than the "two-stage" dried teas both in terms of quality and flavour. Microbial contamination of microwave dried teas were very much less than that of conventionally dried teas.

A C Liyanage, P A N Punyasiri, U B S Bandara, H N L Pradeepa (Pathology Division) L Jayasinghe (Technology Division) and M T Z Mohamed (Technology Division)

6. Project – B-19 – (a) Effect of black tea on oral *Candida* species

Tea extracts are known to inhibit the growth of cariogenic *Streptococcus* species (which cause tooth decay) found in the oral cavity. However, the effect of tea extracts on the growth of *Candida* species (fungus) is not known. Increased populations of *Candida* in the oral cavity could cause Candidasis (oral thrush). Therefore, a project was initiated in collaboration with the Faculty of Dental Science, University of Peradeniya, to study the effect of black tea extract on *Candida* species. In vitro studies have shown that black tea extract inhibit the growth of microorganisms by 30%. Electron microscopy studies, to find the nature of damage to the fungus by tea, indicate that in the presence of tea extract *Candida* cells were deformed due to impaired growth. Studies to find the active ingredient in tea revealed that the highest inhibitory action was in the catechin and theaflavin fractions. These fractions had similar magnitude of activity while the activity of thearubigin fraction was lower. Studies are now underway to compare the activity of these components with the known antifungal drugs.

(b) – Polyphenol content and antioxidant activity of teas produced in different regions of Sri Lanka

Most health-giving properties attributed to tea are due to the antioxidant activity of its polyphenolic compounds. Catechin, the most abundant polyphenol in fresh flush, is converted to theaflavin (TF) and thearubigin (TR) during black tea processing. However, a certain percentage (depending on the type and conditions of processing) of catechin remain unchanged during black tea processing. These three types, i.e., catechins, theaflavins and thearubigins, are the main polyphenols in black tea. The relative amounts of these components vary with the conditions of manufacture. In Sri Lanka, different regions adopt different types of manufacturing procedures and therefore produce different types of teas. A question often raised is whether there is a difference in health-giving properties of teas produced in different regions. A study to find the relative amounts of polyphenols and their relative contribution to total antioxidant activity in teas produced in the up-country, Uva, mid-country and low-country regions of Sri Lanka revealed that all these teas had similar antioxidant activity.

Teas produced in different up country regions such as Nuwara Eliya, Udapussellewa, Dimbulla, Bogo Valley, Malwatte Valley etc. are marketed as specialty teas in the world market. Therefore, this study was further extended to find the relative polyphenolic contents and antioxidant activity of teas produced in different up country regions.

Teas were collected from fifty three estates on a monthly basis and analysis is being carried out to find total polyphenols (TP), theaflavin (TF), thearubigin (TR) content. TR to TF ratio, total colour (TC) and antioxidant activity are also being measured.

The fluoride content of these teas produced in different regions was also measured, and the concentrations observed in the liquors are given in Table 7.

Sri Lankan teas provide 1.37 – 2.05 mg fluoride per day assuming that the consumption is 4 – 6 cups. This amounts to 38% - 57% of recommended daily requirement.

TABLE 7 - *Fluoride concentrations in liquors of tea produced in different regions of Sri Lanka.*

Region	Fluoride concentration in mgl^{-1}
Nuwara Eliya	1.87
Udapussellewa	2.40
Dimbulla	1.62
Bogo Valley & Maskeliya	1.35
Uva	2.57
Kandy & Matale	2.38
Ratnapura & Balangoda	1.52
Galle & Matara	1.60

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7. Project – B-22 – Establishment/Monitoring of flavour profiles of made tea for various agro climatic regions

The changes of flavour profiles in made tea due to the seasonal variation in the Uva region were studied during this year. Made tea samples were received from 7 estates in the Uva region during the season and subjected to gas chromatographic analysis for volatile chemical compounds. This is an on going project and will continue during the year 2002.

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8. Project – D-28 - Establishment of factors responsible for Bogo Valley character

The colour of the tea brew is mainly due to the oxidised phenolic pigments formed during the fermentation stage of tea manufacture. These pigments belong to two major groups of chemical compounds, namely, theaflavins and thearubigins. Theaflavins are bright orange to red in colour and Thearubigins, of relatively low molecular, weight are reddish brown in colour. The ratio between these two group of chemical compounds contributes mainly to the colour of the tea liquors.

Some teas produced in Bogo and Maskeliya Valley regions show an extra redness in their liquors, which cannot be totally accounted for by the contributions made from TF and TR to the liquor. In order to understand the factors responsible for this extra redness, tea samples were collected from Bogo and Maskeliya Valley regions (teas from Dimbula region were used as controls) and analysed for TP, TF, TR, B, TC and fluoride content.

Polyphenols often form coloured complexes with trivalent cations, which may contribute to the redness of the liquor. Therefore, in addition to the above parameters, Fe, Al, Cu, Mn, were also included in the analysis. Chemical analysis of the above parameters were completed and statistical analysis of the results is in progress.

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9. Project - D 30 - Development of multi-residue methods for the analysis of pesticide residues in made tea

Consumer awareness of the use of pesticides and concern about residues remaining in the edible crop has led to national authorities, particularly in the Western countries, to introduce legislation to restrict the use of pesticides to a minimal level. For example, the European Union is conducting a programme to review and set residue levels for 90-100 priority pesticides in a comprehensive range of crops by the year 2000. Tea is also included in this programme. There is thus a growing demand from buyers that pesticide levels of exported tea be contained at acceptable levels.

Under such circumstances, it is of the utmost importance that pre-export testing for residues be carried out in order to establish their acceptability to destination markets since tea has a very high national economic importance. In addition, Sri Lanka imports tea from other tea producing countries for the purpose of blending and it had been noted that these countries use agrochemicals which are not recommended for use by the TRI in Sri Lanka. There is therefore a need for surveillance and compliance monitoring in order to safeguard the tea industry in Sri Lanka.

In order to address these issues, as well as to establish the environmental implications of the use of pesticides in tea lands, a laboratory to analyse pesticides was established with the help of SAREC. Recovery studies were carried out using established methods and thereby analytical methods suitable for made tea, soil and water were identified. In addition to the made tea samples, soil samples and water samples collected from St.Coombs reservior and Lake Gregory, Nuwara Eliya were also analysed for pesticide residues.

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10. Project – Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in tea

PAHs can be formed during combustion in the manufacture of tea and these have long been known to be present in 'smoked' teas such as Lapsang. PAHs could be present in directly fired teas, particularly if combustion is inefficient and in those indirectly fired teas where the drier is leaking, corroded or damaged.

Since some PAHs are carcinogenic, tea importing countries are particularly interested in the levels of PAHs in made tea. Certain countries have already imposed legislation on the levels of PAH in made tea.

This project was started with the objective of establishing analytical methods for various PAHs in tea and subsequently to monitor the levels of PAHs found in teas from various tea growing regions in Sri Lanka.

The extraction methods and chromatographic procedures for the PAH analysis of tea were established. Tea samples belonging to smoky, controlled and clean categories were obtained from a leading tea buyer. The reverse-phase HPLC method was used to determine the levels of PAHs in made tea and in the tea infusion.

Results revealed that smoky tea samples contained higher amounts of PAHs than that of controlled and clean tea samples. Out of the nine PAHs tested the concentrations of phenanthrene, fluoranthene and Pyrene were the highest (>100ppb) in smoky tea samples.

The levels of carcinogenic PAHs such as, benzo(a)pyrene, benz(a)anthracene, benzo(k)fluoranthene and dibenz(a,h) anthracene were found to be low (0-23.5ppb) even in smoky samples, and the levels of these carcinogenic PAHs in smoky samples were well below the levels set by certain countries (50ppb for benz(a)pyrene).

The differences in PAH content between clean samples and controls were not significant for all the PAHs analysed except benzo(a)pyrene. The PAHs levels found in tea produced under normal conditions (clean tea) are well below levels set by certain countries.

Even though the smoky tea samples contained higher levels of PAHs the amount extracted into the tea brew was negligible (0-20ppb) and most importantly carcinogenic PAHs were absent in tea liquor.

The assistance given for this project by Unilever Ltd., Sri Lanka and Unilever Research Laboratory, U.K. is acknowledged.

M.L.D.P.Gunatilake, S. Mahendra Raj (Undergraduate Trainee, University of Jaffna) and I.S.B.Abeysinghe

11. Project A 29.2 – Improvement of technology for producing a liquid tea concentrate

(a) Trials to reduce the use of sodium benzoate as a preservative

Sodium benzoate is used as a preservative in the processing of carbonated tea. However, there is an increasing demand for products with a minimum of additives. This study was therefore initiated in 1999 to determine whether the level of sodium benzoate could be reduced or totally replaced by sterilising the product.

Six samples of carbonated tea were prepared in triplicate as follows; four samples with four different levels of sodium benzoate; 2g/l, 1.75g/l, 1.5g/l, 1g/l, a sample without benzoate and another sample also without benzoate but sterilised. These samples were stored for about one year and were visually observed for colour, brightness, presence of sediments etc, at monthly intervals to evaluate their storage stability. Further microbiological analysis of these samples (total colony count) was carried out at three month intervals.

Samples with 1.75 and 2g of sodium benzoate per litre of concentrate remained fairly unchanged for about one year with respect to colour and brightness. Hardly any sediments were observed in these two samples.

TABLE 8 - *Total colony count of both carbonated tea and the tea concentrate in the six treatments*

Storage time in months	Carbonated tea						Tea concentrate					
	Treatment - NaB g/l						Treatment NaB g/l					
	2	1.75	1.5	1	Without NAB	Without NaB but sterilised	2	1.7 5	1.5	1	Without NaB	Without NaB but sterilised
3	13	5	13	4 7	L.N	-	10	-	-	29	L.N	-
6	6	2	5	6	L.N.	-	-	-	-	-	L.N	-
9	1	-	1	3	-	-	-	-	-	-	L.N	-
12	-	-	-	-	-	-	-	-	-	-	-	-

L.N - Large number of count NaB – Sodium Benzoate

The level of sodium benzoate did not have any effect on the taste of carbonated tea whereas heat treatment had an adverse effect on consumer preference.

It could be inferred that carbonated tea could be stored for about one year with a minimum of 1.75g of sodium benzoate per litre of concentrate, while maintaining the desirable appearance and organoleptic properties.

Since the heat treatment gives a deleterious taste as well, and has an adverse effect on the appearance, heat treatment cannot be applied to preserve carbonated tea.

ii) The effect of citric acid on the taste of carbonated tea

Five samples of carbonated tea were prepared in duplicate with five levels of citric acid; 10g/l, 7.5g/l, 5g/l, 2.5g/l and 0g/l with the objective of seeing if there was any effect on the taste. Subsequently these samples were observed for their keeping qualities.

It was observed that with reduced levels of citric acid, the colour and strength of carbonated tea increased. The softness of carbonated tea also improved with reduced levels of citric acid. The best sample was the one without any citric acid. For four months there had not been any effect on the keeping qualities. However, the stability will be monitored further and the trial will be repeated.

A C Liyanage, G A R P De Silva, P B Chandradasa,
M W Silva and I S B Abeysinghe,

(b) Development of a Tea Sherry/Wine

The tea-based sherry/wine developed in the Division had the problems of coating the tongue with a film of polyphenols which left an after bitter taste, poor clarity and lack of tea character. Due to these factors, tea sherry/wine did not compare favourably with any known brand of wine or sherry.

Experiments were carried out to address these problems with the aim of commercialising the product in both local and foreign markets.

Initially, up-country (St.Coombs and Mattakelle), Nuwara Eliya (Park and Concordia) and low- country (St.Joachim) teas were tested for the suitability of using them as the starting material for tea wine/sherry. In addition, blends of up-country and low-country teas were also tested. A normal brew prepared from these teas was subjected to normal sherry making procedure and fermented for about 5 weeks. The fermented products contained about 10% alcohol. However, all of these samples gave a bitter taste and left a tannin coating on the tongue which was undesirable. In order to reduce these characters, fermented products were matured in Halmilla (*Berraya cordifolia*) casks for about 2 months and samples were tasted thereafter. Even after 2 months maturation, bitterness of the samples had not changed. In order to rectify this problem, various concentrations of tea were used in the fermentation mixture and the fermented samples were matured in wooden casks for about 2 months. A product with good clarity and colour was obtained which did not leave any tannin coating on the tongue. Further experiments are under way to fine-tune the product.

P.B.Chandradasa, G A A R Perera, M.W Silva and I.S.B.Abeysinghe

General

Dr. A.M.T.Amarakoon was promoted to the Selection Segment of Grade 1 with effect from 19th January.

Mr. U.R.N.Udagama and Mr. H.K.M.D. Kumarasinghe resigned from the services of the Institute w.e.f. 31st May and 26th June respectively.

Miss. A.D.M.Damayanthi, J.M.D. Abeysinghe and R.W.T.Darshani were appointed as Technical Assistants with effect from 4th September.

Registration of Mr. P.A.N.Punyasiri for the M.Phill was upgraded to a Ph.D. by the Postgraduate Institute of Science Peradeniya.

Mr. P.A.N.Punyasiri has succesfully completed a postgraduate certificate in advanced biochemistry conducted by the Postgraduate Institute of Science, University of Peradeniya.

Dr. I.S.B.Abeysinghe continued to serve as a member of the Board of Study in Chemical Sciences at the Post Graduate Institute of Science, University of Peradeniya. He is also a member of the Technical Committee on Tea appointed by the Sri Lanka Standards Institution (SLSI). Dr. Abeysinghe continued to serve as an assessor for laboratory accreditation and rendered his services to SLSI.

Dr. A.M.T. Amarakoon was appointed as a committee member of the section E2 of SLAAS.

Dr. Henrik Kylin, a collaborator from the Swedish University for Agricultural Sciences, visited TRI on 16th November.

Collaborators (Non-TRI):

1. Prof. V.Kumar and Prof. (Mrs.) S.Kumar, Department of Chemistry, Faculty of Science, University of Peradeniya on Biological Pest Control Project.
2. Prof. E. Karunanayake, Department of Molecular Biology and Biochemistry, Faculty of Medicine, University of Colombo, on Use of DNA markers for Molecular Characterisation of Tea.
3. Mr. J.M.D.T.Everard, Geneticist/Plant Breeder, Coconut Research Institute, Lunuwile, on Use of DNA markers for Molecular Characterisation of Tea.
4. Dr.G.J.Panagoda, Faculty of Dental Science, University of Peradeniya on Effect of Black Tea on Oral Health.
5. Dr. Henrik Kylin, Swedish University for Agricultural Sciences, Sweden.

Students/Trainees

Mr. S.Mahendraraj and Mr. V.Varatharajah final year students from the Faculty of Agriculture, University of Jaffna successfully completed their research projects titled "Determination of Polycyclic Aromatic Hydrocarbons(PAHs) in Made Tea by High Performance Liquid Chromatography" and "Effect of Water Activity on the Development of Aroma Constituents of Tea Leaf During Withering Operations in Tea Manufacture" respectively.

Mr. W.S.V.K. Jayaratne, Agriculture Student, School of Agriculture, Kundasale underwent training for a period of six months.

Mr.K.S.Thantiriwatta and Mr. M.D.Kumarasiri undergraduate trainees from the Department of Biochemistry and Molecular Biology, University of Colombo were involved in projects titled "Method development for Separation of Tea Polyphenols" and "Fluoride Content in Tea Produced from Tender and Mature Leaves" respectively.

Publications:

1. Liyanage, A.C., Mewan, K.M., Everard, J.M.D.T., Gunesekera, M.T.K. and Karunanyake, E.H. (2001). Use of DNA markers for characterisation of tea cultivars. Tea Research Institute Update Vol. 6 No. 1, 3-4p.

2. Udagama, U.R.N., Amarakoon, A.M.T., Fluoride content in infusions of black tea produced in different regions of Sri Lanka. (2001) Proceedings of 57[th] Annual Sessions of SLAAS, 238.

3. Peiris, H.M.P., Abeysinghe, I.S.B., Wadasinghe, G., Chemical quality parameters and market price of orthodox/Rotorvane and Orhtodox/CTC tea. (2001) Proceedings of 57[th] Annual Sessions of SLAAS, 74.

4. Botheju, W.S., Abeysinghe, I.S.B., Illeperuma, C.K., Effect of plucking standard on quality and profitability of made tea produced in the up country and Dimbulla region during the cropping season (2001). Tropical Agricultural Research Vol. 13, 90-99.

5. Britton, K.L., Abeysinghe, I.S.B. et al., The structure and domain organisation of *E.coli* isocitrate lyase (2001). Acta Crystallographica, D57, 1209-1219.

6. Mewan, K.M., Liyanage, A.C., Everard, J.M.D.T., Gunesekera, M.T.K., Fernando, U. and Karunanayake, E. (2001). Estimation of genetic diversity of tea (*Camellia sinensis* L.) genotypes in Sri Lanka using isozyme polymorphisms and RAPD markers. Proceedings of 2001 International Conference on O-CHA(tea) culture and science (In press).

7. Punyasiri, N., Abeysinghe, I.S.B.,and Kumar, V. (2001) Chemical and Biochemical basis of resistance/susceptibility of tea leaf to blister blight (Exobasidium vexans). Proceedings of 2001 International Conference on O-CHA (tea) culture and science. (In press)

Donors:

1. Sida/SAREC and International Programme in the Chemical Sciences, Uppsala University, Sweden for Biological Pest Control Project

2. Council for Agricultural Research Policy (CARP) for Use of DNA markers for Molecular Characterisation of Tea

3. National Research Council (NRC) for Biochemical and Chemical Methods in the Control of Blister Blight Leaf Disease of Tea caused by *Exobasidium vexans*

Meetings/Seminars

Mr. M.D.L.P.Goonatilake participated in the seminar on "5S application in productivity and quality" conducted by Sri Lanka Standards Institution on 1st February at the Sri Lanka Standards Institution.

Mr. M.D.L.P.Goonatilake participated in the seminars organised by Institute of Chemistry on Laboratory quality management and safety in chemical laboratories on 31st August and 23rd November respectively at Colombo Hilton.

Mr. P.A.N.Punyasiri attended a workshop on mass spectrometry sponsored by Sida/SAREC at the Department of Chemistry, University of Peradeniya from January 23rd to 25th.

Mr. P.A.N.Punyasiri attended a training programme on Waters HPLC-Millenium software at the Waters (India) Pvt. Ltd., Bangalore, India from 23rd-30th June.

Mr. P.A.N.Punyasiri presented a paper titled "Chemical and Biochemical Basis of Resistance/Susceptibility of Tea Leaf to Blister Blight" at the Postgraduate seminar series organised by the Postgraduate Institute of Science, University of Peradeniya.

Mr. K.M.Mewan attended regional training on plant breeding conducted by the Faculty of Agriculture, University of Peradeniya from 15 to 19th May.

Dr. I S B Abeysinghe, Mr. P.A.N.Punyasiri and Miss Gayani De Silva attended the review meeting of the Sida/SAREC funded Biochemical Pest Control Project at Kandalama Hotel, Dambulla from 20th-21st November and presented papers on "The Primary Role of Polyphenolic Compounds in Tea Plant – Self Defence?, "Chemical and Biochemical Basis for Resistance of Sri Lankan Tea Cultivars to Blister Blight Leaf Disease" and "Biochemical Control Method for Shot-Hole Borer.

Dr. I S B Abeysinghe attended a workshop on Nuclear Techniques in Studies of Transport and Fate of Pesticide in Eco-Environment, Beijing, China, 10-21, September 2001 and presented a paper on "Research on Pesticide Residues at Tea Research Institute of Sri Lanka".

Dr I.S.B.Abeysinghe and Dr.(Mrs) A.C.Liyanage attended the 2001 International Conference on O-Cha (tea) Culture and Science October 5-8, 2001. Shizuoka, Japan and presented papers titled "Chemical and Biochemical Basis of the Resistance and Susceptibility of Sri Lankan Tea Cultivars to Blister Blight Leaf Disease (*Exobasidium vexans*)" and Estimation of Genetic Diversity of Tea Genotypes in Sri Lanka Using Isozyme Polymorphism and RAPD Markers" Pespectively.

Dr. I.S.B.Abeysinghe proceeded to Coonoor, India, on 25th December to attend the Commonwealth Executive Management Development Programme in Tea Plantations.

Dr. I.S.B.Abeysinghe made a presentation on "The Effect of the User Friendly Harvesting System on the Quality of Black Tea" at the BMICH on 22nd June.

ENTOMOLOGY DIVISION

Sushila I. Vitarana
Acting Head of Division

1. RESEARCH ACTIVITIES

A 1.6: Continued screening of new clones for their resistance and tolerance to the plant parasitic nematodes attacking tea in the up-country

N 1 A: Screening of some of the TRI 4000 series of clones against the root lesion nematode, *Pratylenchus loosi*, with reference to build up of nematode population in root and soil and growth of tea plant – TRI, Talawakelle.

The clones being screened are TRI 4042, TRI 4046, TRI 4052, TRI 4053, TRI 4047, TRI 2024 and TRI 2025, TRI 2043, DT 95, K 145, NIL 53. The above clones, planted in test tanks in 2000, were not ready for nematode analysis this year and therefore the assessments were rescheduled for the year 2002.

A set of second test plants of the clones PB 29, 81, 139, 146, 241, 250, 288, 294, 379 and 613 raised in MeBr treated soil were being prepared for screening in 2002.

A 2.5: Continued screening of new clones, for their resistance and tolerance to the plant parasitic nematodes attacking tea in the mid-country.

N 1 B: Screening of the TRI 3000 and 4000 series of clones against the burrowing nematode, *Radopholus similis* in relation to build up of nematode population in roots and soil and to the growth of tea plant.

NIB-(1): (2000-2002) Screening of clones for tolerance/ resistance susceptibility to the burrowing nematode - TRI Mid-Country Station, Hantane.

The following clones, transplanted in the testing tanks since December 2000 were being maintained;

TRI 3069, TRI 4053, TRI 4006, TRI 3015, TRI 4014, TRI 3019, TRI 4052, TRI 3025 and TRI 3055 with TRI 2025 and DN as standard.

By the end of the year the plants were 12 months in the testing tanks. They were due for assessment at 15 months in March 2002.

S.I. Vitarana, U.B. Herath & B. Sureshkumar

NIB-(2): (2001-2003) Screening of clones for tolerance / resistance / susceptibility for the burrowing nematode at Hantane Estate, Kandy.

The following Clones were being maintained in the tanks.

TRI 3055, TRI 4046, TRI 3017, TRI 4042, TRI 3014, TRI 4015, TRI 3020, TRI 3025, TRI 4043 with TRI 2025 and DN as the standards.

By the end of the year the plants were 12 months in the testing tanks. They were due for assessment at15 months in March 2002.

S.I. Vitarana, U.B. Herath

N 1 C (2001-2003): Screening of new tea clones against the root lesion nematode, *Pratylenchus loosi*, and burrowing nematode, *Radhopolus similis.* TRI, Uva Station, Passara.

Test plants of the clones PB 29, 81, 139, 146, 241, 250, 288, 294, 379 and 613 were raised in methyl bromide treated beds. Four tanks were newly built in November for screening these clones against a mixed population of *P. loosi* and *R. similis*.

S.I. Vitarana, D.D. Liyanage, P. Udumulla, N. Navaratne

A 3: Development of high yielding clones (yielding above 2500 kg made tea/ha/yr) on a commercial basis, for the mid-country dry zone with high quality, and having resistance to drought, SHB, Blister Blight and suitable for variable soil fertility regimes.

A 3.2 Screening of new clonal lines against shot-hole borer resistance.

Assessments in the following three trials of Plant Breeding Division have been completed:

(a) LVP74 – LVP 30/LC/2 (Deniyaya) – Assessment carried out in April 2001 showed that the lines susceptible to SHB as compared with the standard susceptible clone TRI 2026 are:
PB251, 175, 278, 218, 141, 01, 203, 184, 49, 200, 68, 195 & 157

(b) LVP/2- (Field No. 1, St. Joachim Estate) – At the assessment carried out in July 2001, very low infestation was recorded. However from the observations made it clear that the following selection lines were more susceptible to borer attack when compared to TRI2026: PB7/7, 5/6, 139, 62 and 4.

The clones 23/5, 241, 250, 29, 89 and 75 exhibited infestations comparable to that of the clone TRI 2025 which is more susceptible than TRI 2026.

(c) VP 71 (VP 39/UC 2/1) St. Coombs Estate – At the assessment carried out in January 2001, the following lines were found to be comparable to TRI 2025 in susceptibility:

PB 114, 26, 202, 38, 320, 129, 262, 164, 158, 160, 149, 347, 53, 147, 47, 321, 156, 196, 113, 293, 182, 155, 251, 342, 333, 255, 139, 338, 205, 184, 346, 213, 266, 222 & 27.

A 4: Development of high yielding clones (yielding about 4000 kg made tea/ha/yr on a commercial basis) for the low-country, preferably with dark green leaves and having resistance to drought, Low-Country Live Wood Termites (LCLWT) and Stem Canker (*Macrophoma theae*), amenable to mechanical harvesting and suitable for variable soil fertility regimes.

A 4.1 Screening of clonal lines for resistance to Low Country Live Wood Termites.

LE-83: Observation blocks of 34 selections from Maratenna Division of Balangoda Estate, L.P.G. Division, Block 61 (1999 planted).

Five growth assessments were carried out. The overall observations are given in Table 01.

Table 01: *Performance of the Progeny of Maratenna Selections, Balangoda Estate, 2001*

Label of the Selection	Growth
MT 101	Poor
102	Poor
104	Poor
105	Fair
114	Fair
165	Poor
158	Good
138	Poor
122	Good
131	Good
116	Poor
141	Poor
133	Fair

153	Good
150	Fair
166	Poor
119	Fair
108	Poor
106	Poor
170	Poor
168	Poor
126	Poor
127	Fair
142	Fair
121	Fair
128	Poor
117	Poor
143	Poor
162	Poor
163	Poor
171	Poor
157	Fair
156	Poor
TRI 2025 (standard)	Poor

None of the selections had any more casualties than in the previous year. The experiment is in progress.

S.I. Vitarana, E.R. Perera, A.K. Premathunga

A 4.2: Screening of clonal lines for resistance to Low Country Live Wood Termites (LCLWT)

LE-50: Hapugastenna Estate, Lower Amunutenna Division (Planted 1990).

The best 11 clones which exhibited uniform growth over the 10 year period and were not affected by LCLWT, stem canker or drought were: H 108, H 27, H 101, H 125, H 122, 211, H 134, H 402, H 424, H 426, H 427 & PET1A2. These were ear-marked for further multiplication.

Screening of 132 clonal lines of the original 152 selected for LCLWT resistance from Field No.7 of Hadaraganga Division, was in progress. The best 11 clones that were selected out for propagation and 9 others discarded for other reasons have been excluded from this assessment.

A post prune assessment was carried out on 132 selections in February and the following observations have been recorded:

(i) The following clones were still free of termites and having good branching (in excess of 20 branches per bush) when compared to TV9 clone (standard):

H445, H135, H401, Y2, H474, H374, H220, H314, PO74, PO101, H102, H117, H162, H231, H314, H354, H482, H467, H41, H71, H153, H472, H310, H188 and PET 141 (a Pettigala selection).

(ii) The following selections exhibited very low branching (upto 10 branches / bush) compared to TV 9, but still free of termites:

H363, H198, H247, H480, H327, H354, H521, H211, H405, H113, H127, H115 and PET 241 (a Pettigala selection) and PO 88 (Poranuwa selection).

(iii) The clones H 272, H 205, H 135 and H 474 were found to be as much infested with the low country live wood termites as PO 88 and all to the same extent of infestation (20%).

(iv) The following clones were observed to be affected with stem canker (20% of the bushes), exhibiting prominent cankers:

H 445, H 140, H 407, H 405, H 126, H 484, H 513, H 162 and PO 101.

The clones listed under iii. & iv. are being discarded from the study this year. Those of i. have been ear-marked for multiplication.

LE-78: Hapugastenna Estate, Hadaraganga Division (planted 1998).

Screening of 37 clonal lines selected from Field No.4 of Hadaraganga Division was in progress. Two growth assessments were carried out in June. Five percent of the clones in each replicate was found to be poor in growth. There were no more casualties than in 2000. None of the clones exhibited live wood termite damage todate.

Experimental blocks are being maintained.

LE-81: Hapugastenna Estate, Upper Wewelketiya Division (planted 1997).

Screening of TRI 4000 series clones for resistance to LCLWT was in progress, and the plots are being maintained. One growth assessment was carried out and the general performance of the clones is as given in Table 02.

Table 02: *General Performance of the Clones*

Clone	*Replicate average of the % survival of bushes*	*Growth*
TRI 2026	78	Good
4036	18	Poor
4004	58	Fair
4089	44	Poor
4003	22	Poor
4019	44	Poor
4046	56	Fair
4088	40	Poor
4053	46	Fair
4052	48	Fair
4020	70	Fair
4015	50	Fair
4024	22	Poor

The clones TRI 4004, TRI 4046, and TRI4020 were found to be the most outstanding. TRI 4036 was observed to have succumbed to stem canker damage. The study is in progress.

S.I. Vitarana, E.R. Perera, A.K. Premathunga

LE- 84: Evaluation of the TRI 4000 series clones for Shot-hole Borer resistance. Aigburth and Madampe Estates (planted 1996).

The clonal blocks entered the 2nd year of the 2nd cycle. The plots are being maintained.

S.I. Vitarana, E.R. Perera, A.K. Premathunga

A 22: Development of cost effective control methods for integrated management of Shot-hole Borer.

A 22.1 Screening insecticides for reducing Shot-hole Borer infestations/damage in mature and immature tea.

E-300: Use of insecticides for controlling Shot-hole Borer in mature tea in the mid-country wet zone. Nayapane Estate, Lower Division, Field No.1 (November 1999).

The following treatments were applied in on RCBD design with 4 replicates.

Treatments:

T1	Fenvalerate 20EC (Sumifen 20EC)	@ 500 ml/ha
T2	Fenvalerate 20EC	@ 1000 ml/ha
T3	Regent 50 SC (Fipronil)	@ 1000ml/ha
T4	Regent 50SC (Fipronil)	@ 2000ml/ha
T5	Permethrin (Ambush)	@ 500 ml/ha
T6	Deltamethrin(Decis)	@ 500 ml/ha
T7	Fenthion 50 EC (Laybacid 50 EC)	@ 4500 ml/ha
T8	Untreated control	

Monthly assessments on population development and damage counts were continued. The results indicated that it is only Fenvelerate @ 1 l/ha that gave better control compared to the standard, Fenthion. However, the chemical was not to be encouraged on account of low tolerance of residues in made tea.

This experiment was discontinued.

L.D. Amarasinghe, S. Walgama, A. Abeysekara,
P. Senanayake, M. Jayatilake

E 303: Use of insecticides for the control of SHB in immature tea in the mid-country wet zone. Rangala Estate. Field No: 01 (NC 99) 2000.

In this experiment three pyrethriods were being tested as substitutes for Fenthion on young plants. Treatments were applied in January. Plants were too young for destructive sampling this year. Therefore, branch breakage was recorded monthly and the summary is given in Table 03.

Table 03: *Incidence of branch breakage (Average of breakages in 30 bushes) (February 2001 – December 2001)*

Treatments	*Replicate Average*
Fenvalerate ("Sumifen") 20EC @ 500ml/ha	18
Cyhalothrin ("Karate') @ 500ml/ha	16
Cyfluthrin ("Baythroid') @ 500ml/ha	15
Fenthion ("Lebaycid") EC 50% @ 3500ml/ha	20
Untreated control	29

Cyhelothrin and Cyfluthrin treated bushes recorded lower breakages when compared to the untreated control. The treatments were scheduled to be repeated yearly up to the end of first cycle (mid 2003). The experiment is in progress.

L.D. Amarasinghe, S. Abeysinghe, U.B. Herath,
B. Sureshkumar & D. Pallemulla

A 22.3: Identifying shade species as diversionary hosts for reducing Shot hole Borer damage

Laboratory bioassays were carried out on 29 plant species collected from in and around tea plantations of Up country, Uva and Mid country wet zone. The following observations were made.

(i) <u>Plant species that were attractive to shot hole borer and supported brood development inside stems</u>:

Flemingia congesta	(Leguminasae)
Calliandra calothyrsus	(Leguminasae)
Paraserianthus falcataria	(Leguminasae)
Azadiracta indica	(Meliaceae)
Lantana camera	(Verbenacease)
Erythrina lithosperma	(Leguminasae)

(ii) <u>Plant species to which the beetles were attracted but later found dead inside (trap crops)</u>

Grevillea robusta	(Leguminasae)
Montanoa bipinnatifida	(Compositae) (from Royal Botanical Gardens, Hakgala)
Eupatorium inuliformis	(Compositae)

M. bipinnatifida has been recorded as a trap crop to Shot-hole Borer of tea in India as well.

(iii) <u>Plant species that did not attract Shot-hole Borer (non host)</u>

Grevillea pteridifolia	(Leguminasae)
Tithonia diversifolia	(Compositate)
Eucalyptus alba	(Myrtaceae)

Flemingia congesta was found to be the best host and should not be encouraged in tea lands. The beetle was totally repelled by *Tithonia diversifolia.* This plant will be analysed for its chemical repellents. Other test plants of which most of them are shade and green manure plants, were found to be attractive to the borer, but they could not support its development. The trap cops *Grevillea robusta, Montanoa bipinnatifida and Eupatorium inuliformis* should be encouraged inside tea lands.

L.D. Amarasinghe, P. Senanayake & Tharshini Devi (University of Jaffna)

A 22.4: Determining the time and style of pruning for reducing Shot-hole Borer damage

E 283- Uva; Attampettiya Estate, 1st Division, Field No.7, Ettampitiya (1996)

E 284- Low country- wet zone; Kiruwanaganga Estate, Sirimedura Division, Field No.1 (1996)

E 285- Mid country; New Peacock Estate, NP Division, Field No.6, Pussellawa (1996)

Assessments carried out at the above locations confirmed the previous observations.

Sanitation prune at a height of 45 cm (18 inches,) retaining lungs and carried out at the beginning of the monsoonal period, was found to be the best in order to reduce subsequent borer infestation in the new growth. Pruning at other times and adopting other styles of prune, in fact, were found to worsen the pest attack.

This study was terminated.

L.D. Amarasinghe, A. Abeysekara, P.Senanayake
M. Jayatilake & S. Walgama

A 22.5: Modifying potassium fertilization with a view to reducing Shot-hole Borer damage.

E-289: Atampettiya Estate, First Div., Field No.2A, Ettampitiya (1997)

Application of high potash fertilizer in the form of Muriate of Potash @ 1.5 g, 3.0g and 4.5 g MOP on three clones (DN, TRI 2025 & TRI 4070) was continued.

Only 4 assessments on branch breakage were carried out during the year. There was no significant difference between treatments at this stage. The experiment is in progress.

E-290: Hantane Estate, Factory Division, Field No.9A, Hantane (1997).

Fertilizer applications, yield records and SHB assessments were carried out.

The record of branch breakage in the 4th year is summerized in Table 04.

Table 04: *Branch breakage due to borer attack (average of 3 replicates)*

Replicate	*Treatment*	*TRI 2023*	*TRI 2025*	*DN*
R1	T1	28	59	11
	T2	32	61	10
	T3	29	45	08
	T4	35	40	09
R2	T1	35	49	12
	T2	31	58	13
	T3	29	63	09
	T4	32	29	05
R3	T1	30	56	10
	T2	28	60	12
	T3	32	40	08
	T4	36	35	11

T1 - 0 SOP/ plot
T2 - 2g SOP/ plot
T3 - 4g SOP/plot
T4 - 6g SOP/ plot

It is only the highest susceptible clone that showed some response to high potash. The experiment is in progress

L.D. Amarasinghe, S. Abeysinghe, B. Sureshkumar & D. Pallemulla

A 23: Biological control of major pests and diseases of tea with a view to reducing dependence on pesticides.

A 23.4: Refining cultural practices to manage nematode pests in mature tea, including the incorporation of various soil amendments, usage of trap / cover cops, etc. to help to reduce nematode population.

MN 1: In-vitro culture of *Radopholus similis* for experimental use.

TRI Mid-Country Station, Hantane.

Pure populations of *R. similis* were maintained on carrot callus tissues.

B. Sureshkumar, D. Dhanaprema (Trainee)

N369: Mass propagation of nematode bio control agents

Laboratory cultures of isolates of nematode bio control agents, the bacterium, *Pastueria penetrans* and nematode trapping fungi, *Arthrobotrys musiformis*, *A. oligospora*, *Arthrobotrys* spp., *Dactylella* spp. and *Monacrosporium* spp. were maintained for experimental use and augmenting of bio control activity in the field.

Keerthi Mohotti

N371: Monitoring naturally occurring antagonists of tea nematodes.

Experiments were in progress to monitor soil densities of nematode bio control agents and population dynamics of (a) *P. loosi* in Needwood estate and (b) *Radopholus similis* in TRI Station, Kottawa.

Keerthi Mohotti

Experiments with organically maintained tea.

N370: Role of organic farming on nematode incidence in tea. St. Coombs Estate, field No. 13 (planted 1996).

Experimental plots were being maintained under IFOAM guidelines. Data on plant parasitic nematode populations, and densities of nematode bio-control agents, status of soil microbiology as a bio-indicator, incidence of pest, weed and disease problems, physiological processes, manufacture and quality aspects, plant nutrition and soil properties in organic and conventional soils were periodically monitored in collaboration with relevant research Divisions of the TRI.

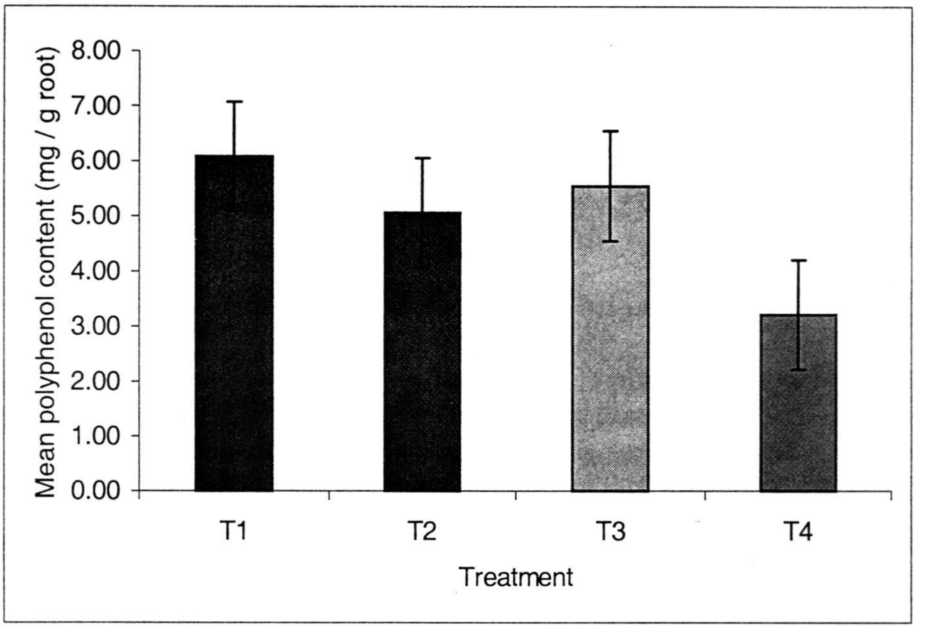
Suppressiveness of populations of the root lesion nematode (*Pratylenchus loosi*) in tea soils maintained organically and conventionally were evaluated. *P. loosi* population was significantly greater in the tea roots of conventionally treated plots than in organically treated plots (pr> F = 0.0212). However, soil populations did not show any significant differences; interestingly, free living nematode populations showed higher numbers in organically treated plots than conventionally treated plots. They acted as beneficial organisms in reducing *P. loosi* damage in tea.

The microbial activity of soils was significantly higher in organically treated plots than in conventional plots (pr> F =0.0030). There was a significant inverse relationship between the *P. loosi* in roots and microbial activity in soil (r = 0.53072 at p= 0.05).

i. <u>Polyphenol content of feeder roots</u>

High polyphenol content was recorded from feeder roots of organically treated tea compared to those conventionally treated. This could enhance nematode tolerance in tea.

Figure 1: Polyphenol content of feeder roots of tea in organically and conventionally treated plots.



(Bars indicate the Standard error of mean)

T1- Tea waste, T2- Neem oil cake, T3- Compost, T4- Conventional

Soil moisture content in organically treated plots was in the range of 28-31% while in conventional plots it was lower than 27 %. The soil moisture would have helped to maintain greater microbial communities in organically treated soils.

Organic matter incorporation and avoidance of synthetic agro chemicals under organic tea culture have proved to be effective in elevating the levels of beneficial soil organisms and enhancing nematode suppressiveness in tea. The incidence of parasitic nematodes in organic tea was less compared to conventional tea. This is in agreement with observations made in most organic tea estates in the country.

S. S. H. M. S. S. Seneviratne, University of Ruhuna,
Keerthi Mohotti and N. Navaratne

ii. Earthworm activity in organic tea soils

The results of the assessment on earthworm bio mass and production of wormy casts are shown in Table 06. There was significantly greater population of earthworms in organically treated plots than conventionally treated plots (pr> chisq = < 0.0329). Total soil biomass, measured as CO_2 evolution rates in soil, showed similar results.

The number and weight of earthworms were determined from 0-15 cm and 15-30 cm soil depths. Conventional treatments did not show earthworm biomass in 15-30 cm depth. Organic treatments exhibited greater number of worms in upper levels. Studies are underway to determine indirect effects of earthworms in the suppression of tea nematode population in soils.

Table 06: *Earthworm activity in organic and conventional tea soils*

	Earth worm cast		*Earth worms*			
			0 – 15 cm		*15 – 30 cm*	
Treatment	*Number*	*Weight (g)*	*Number*	*Weight (g)*	*Number*	*Weight (g)*
Tea waste	49.00 A	31.25	55.00 AB	7.63	11.00 AB	3.56
Neem oil cake	62.66 A	39.48	37.33 A	15.68	18.00 A	4.30
Compost	37.00 A	23.35	20.00 BC	3.81	2.50 B	1.25
Conventional	12.66 A	10.54	11.42 C	1.21	0.00 B	0.00
Pr > F	0.3538	NS	0.0077	NS	0.0641	NS

Means with same letter (A, B, C) are not significantly different at $p = 0.05$

Keerthi Mohotti, A. J. Mohotti, M. L. D. Priyangika (University of Sabaragamuwa), T. M. M. P. Thennakoon (University of Peradeniya), S. S. H. M. S. S. Seneviratne (University of Ruhuna) & U. R. Sangakkara (University of Peradeniya)

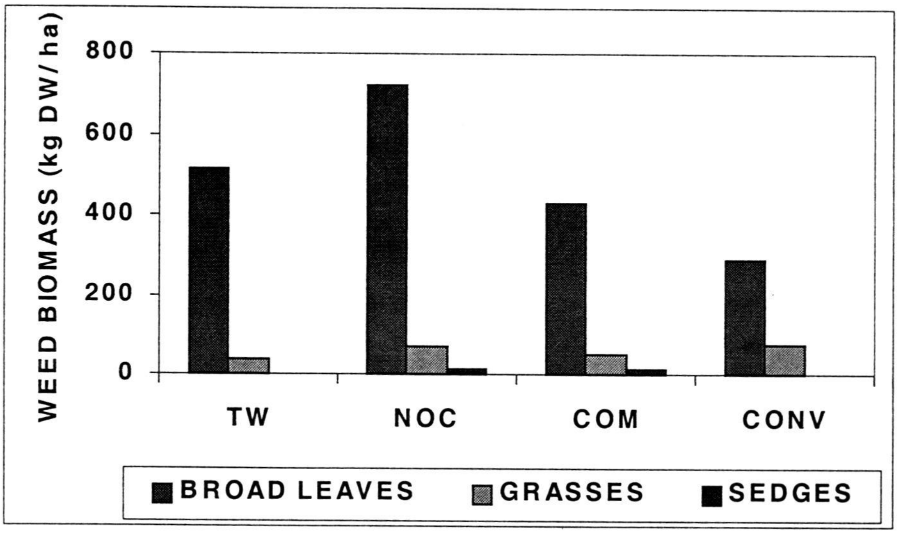
A nature farming model experimental area consisting of compost yard, herbal area, organic nursery, SALT and other soil fertility management and erosion control methods, wormi-composting and vermiwash units, mix cropping and biodynamic practices is been established in the nematology experimental area at TRI. The activities will be for demonstration purposes as well as for experimental use in organic tea trial plots set up in St. Coombs.

Keerthi Mohotti

iii. Incidence of weeds in organic tea fields

The weed incidence in organically and conventionally maintained experimental plots was monitored periodically. Figure 2 shows the weed composition in different systems. The results show that there is heavy weed growth in organically maintained plots. However, proper management of weed species would minimize competition with tea. Also, a greater proportion of succulent weed biomass that could be utilized for composting purposes is available in organic soils.

Figure 02: Composition of weeds in organically and conventionally treated plots.



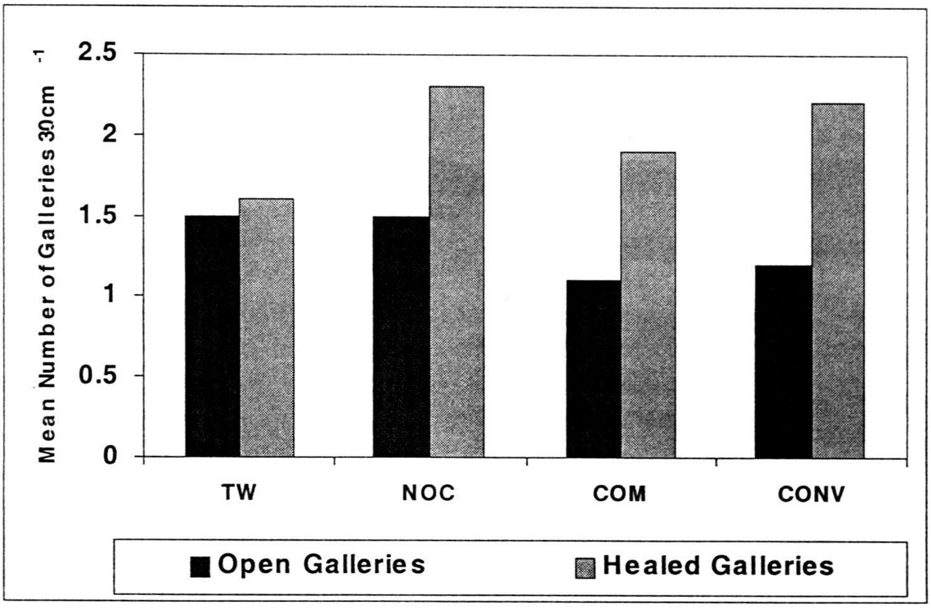
TW- Tea waste, NOC- Neem oil cake, COM- Compost, CONV- Conventional

Keerthi Mohotti

iv. Incidence of Shot-hole borer damage in organic tea fields

The damage caused by Shot-hole Borer in tea bushes grown under organic and conventional treatments was evaluated. The results are shown in Figure 03.

Figure 03: Mean number of galleries caused by Shot hole Borer in organically and conventionally treated plots of tea



TW- Tea waste, NOC- Neem oil cake, COM- Compost, CONV- Conventional

There was no beneficial effect of organic treatments seen in relation to borer attack.

L. D. Amarasinghe, P. Senanayake, Keerthi Mohotti, M. P. T. Premaratne, A. Balasuriya, R. M. A. Ratnayake and N. Navaratne

N385: Effect of incorporation of prune chips in to tea soils on population dynamics of *Pratylenchus loosi*.

Prunings were machine chopped and incorporated into soils *in situ*. Experiments were conducted to assess the role of incorporating prune chips in mature tea fields infested with the root lesion nematode, *P. loosi* as a 'post-prune nematicidal treatment'. The field and glass house experiments are in progress.

Keerthi Mohotti and N. Navaratne

v. <u>Survey of organic farms in Sri Lanka</u>

The present status and future prospects of organic farming in Sri Lanka with special reference to biological diversity of organically managed soils and composts were studied.

Eighteen different organic farms from different agro ecological regions in Sri Lanka were included in the study. Samples from organically maintained fields and bio-compost were collected for determination of biological activity as a measure of bio-diversity.

The majority of organic farms were located in up country wet zone (WM2, WM3) and in mid country wet zone (WU1, WU2). Of the organic farms totalling 500ha, there were 11% of small scale totalling (<0.2 ha), 27% of medium scale (0.2-4 ha) and 61% of large scale farmers.

All units used farmyard manure consisting of cow dung and green manure. Only 11% of them purchased compost. The mean rate of CO_2 evolution in compost was higher as compared to soils of respective farms. Other chemical and physical parameters are being studied on collected soil samples.

The survey data was used to develop a data base on organic farms and a directory of traditional agricultural knowledge users in Sri Lanka, at the Council for Agricultural Research Policy. The work is in progress to develop standards for bio-compost in agricultural use.

Keerthi Mohotti, M. L. D. Priyangika (University of Sabaragamuwa), Kumudinie Athukorala (University of Sabaragamuwa), Chandra Padmini and D. Kirthisinghe (Council for Agricultural Research Policy)

Soil-less medium for tea propagation

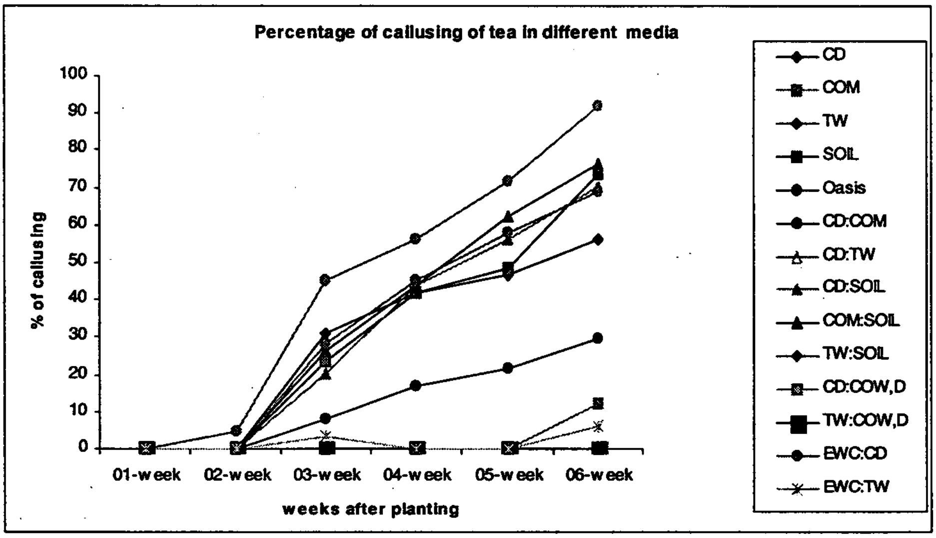
i. N375: To evaluate root and shoot growth of two tea clones (TRI 3072 and TRI 4071) in different media having different combinations of mixtures with soil.

TRI, Talawakelle and Great Western Estate, Talawakelle

The popular horticultural medium, 'Oasis' promoted early callusing and rooting (Figure 04).

The use of a 100% coir dust, 1:1 coir dust: soil and 1:1 compost: soil promoted callusing and root development as much as 'Oasis'. In contrast the use of 1:1 coir dust : compost as well as the media having cow dung or tea waste inhibited callus and root formation.

Figure 04: Callusing of tea cuttings in different soil-less media

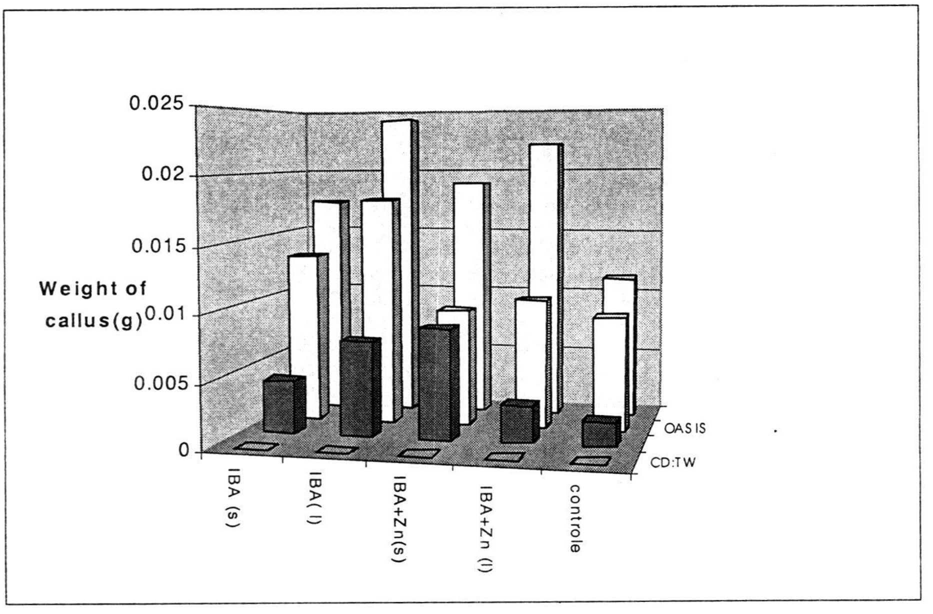


CD=Coir Dust, COM=Compost, TW=Tea Waste

ii. <u>The effects of growth promoting substances on rooting of tea</u>

The effect of growth promoting substances such as Indole Buteric Acid (IBA) 5000ppm, IBA 6000ppm+Zn 6000ppm in a formulation of talc and 50% alcohol was studied. Liquid formulations of growth promoting substances enhanced callus and root development when compared to the solid forms (Figure 05).

Figure 05: Effect of different growth promoting substances in tea propagation



The study also revealed that coir dust with a liquid form of a growth promoting hormones could be used successfully for developing planting material of tea as alternative media in place of soil.

iii. Rubber latex coated soil-less media for tea propagation

Modifications to rubber latex coated soil-less media were in progress at the Rubber Research Institute laboratories, Ratmalana and Proflora work-shop at Wennappuwa. Experimentation is on-going at TRI.

R. P. S. K. Randeniya (University of Peradeniya), Keerthi Mohotti, U. R. Sangakkara (University of Peradeniya), K. Chandralal (Rubber Research Institute) & Meryl Fernando (Proflora Co. Ltd., Marawila)

Transformation of biotic materials for agricultural purposes with special reference to tea husbandry

Usage of bioinoculants in the form of biofertilizers and/or biopesticides in the tea industry is evident. Besides, tea soils are known to be rich in biological diversity. Records on exportation and importation of biotic materials through National Plant Quarantine Services (NPQS) during the period 1985-2000 were studied and it was found that no soil organisms have been exported during the same period of time. None of the bioinoculants reported to be used in the tea industry has been included as items imported in the NPQS records in Sri Lanka.

Further, 58% of plant species, 15 % of seed varieties and 27% of other materials like compressed coir, soils etc. have been exported during the period of 1990-2000. Soil organisms imported during the period 1985-2000 were recorded as 10 and 26 species for agricultural purposes and research purposes respectively.

Macro and micro bioinoculants have been exploited for "composting" purpose, which has constraints in the tea industry. Two earthworm species namely *Eisenia foetida* and *Eudrilus euginae,* imported from Australia and South Africa, have been used in a conventional tea estate in the upcountry wet zone (WU 2). One of the microbial formulations, effective microorganisms (EM), without known origin has been in use in an organic tea estate in the upcountry intermediate zone (IU 2).

The adoption of macro inoculant based compost (macro-IBC) and micro inoculant based compost (micro-IBC) amendments and its influence on growth and pest management were evaluated. Approximately five years yield pattern of the selected estates, their soil chemical and microbial properties and nematode incidences were studied.

The made tea yield of macro-IBC treated conventional tea fields was significantly higher than in the untreated fields (LSD=1376). The mean tea yield of macro-IBC treated and untreated soils were 4524 and 2581 kg/ha/yr respectively.

There was more total N, C, P, and K in tea soils of macro-IBC, although the differences were not significant. Soil microbial activity, as measured by *in vitro* CO_2 evolution rate, was not significantly different for the treatment and the control. The mean CO_2 evolution rate of soils of macro-IBC was lower (0.004 g/day) than that of control (0.007 g/day). Hence the soil biological activity in the macro-IBC plot was lower than in the untreated. Tea roots in macro-IBC soils were subjected to a lower stress, giving a lower CO_2 evolution rate (0.032 g/day), compared to the control (0.048g/day).

Macro-IBC treatments did not affect the management of nematode pests in tea. The population of *P. loosi* in roots of untreated soils (0/100 g soil) was significantly different compared to the fields amended with macro-IBC (138 / 100g soil). Abundance of soil *P. loosi* in control soils was comparatively low (50/100g soil) although not significant.

There was no evidence on improvement of yields with the application of micro-IBC in organic tea fields, in the untreated tea fields gave a significantly higher yield than the treated. The mean yield of micro-IBC treated and untreated were 292 and 549 kg/ha respectively.

Treatment of organic tea soils with micro-IBC was not conducive to improvement of soil chemical properties except for K. Further, untreated soils exhibited greater amounts of organic C, N, P and K nutrients. Soil microbial activity and root respiration rates were also not affected significantly by application of the micro-IBC. However, treated soils showed a lower soil CO_2 evolution rate of 0.001g/day indicating a lower soil biological diversity than the control (0.003 g/day).

Soil population of *P. loosi* was minimal (0/100g soil) in untreated tea soils although not significant. On the other hand, *P. loosi* in tea roots were not recovered under the soils treated with micro-IBC. The free - living nematode population was significantly low in soils treated with micro-IBC (26/100g soil) indicating its low bio control efficacy against *P. loosi* than the control (63/100g soil). There were no significant differences in leaf, shoot or root dry mater production of tomato plants under both conditions as also exhibited in the yield of field-grown tea.

Mrs. R. V. P. K. N. Elliyadde (Post Graduate Institute of Agriculture, University of Peradeniya), Keerthi Mohotti, Dr (Mrs) Rohini Ekanayake (Department of Agriculture) and Dr. S. Thiruchelvam (Post Graduate Institute of Agriculture, University of Peradeniya)

2. BASIC RESEARCH

B 29: Refining the techniques for screening tea clones for natural resistance to the major insect pests of tea, Live Wood Termites and Shot-hole Borer and nematodes.

Time saving techniques for fast screening of clones / LCLWT

Clonal material of the clones in the LVP trials- LVP 56/57/59 were assessed by the three bio assay methods. The clone LVP 10/01 was found to be as highly attractive to termites as TRI 2023.

S.M.Samarasinghe.

B 30: Biochemical and physiological basis of resistance in tea clones towards major pests such as Shot –hole Borer, Live Wood Termites and also Root lesion nematodes.

Olfactometry Study:

The olfactometric analysis showed that clones TRI 3014, 3015, 3063, 3055, 4052, 4053 & DG 39 were as attractive as TRI 2023 to termites confirming that they have the Keiromones. On the other hand the clones TRI 4049, 4048, TRI 62/1 &4052 were repellent like PW 39.

Glass-Plate Bioassay:

Bioassay employing glass-plate feeding study showed that the clones TRI 3063, 3015, 4053, 4049 & PW 39 were more suitable as food material to the termites than the clone TRI 2023 whereas, TRI 4048, 3055, 3014, 4049, TRI 62/1 & DG 39 were less suitable than TRI 2023.

ii. N386: Biochemical resistance of different tea clones to tea Nematodes

Selection of nematode tolerant and resistant clones is one of the most important strategies in nematode management. It is ecologically sound as compared to other methods such as chemical, biological and cultural approaches, although the conventional method of nematode screening has some limitations.

Studies were conducted in order to develop a new screening method on the basis of biochemical investigations, to evaluate resistance to the root lesion nematode, *Pratylenchus loosi* in tea. Thirteen tolerant and susceptible clones in St. Coombs and Loolcondera Estate were selected for the study. *P. loosi* population and polyphenol contents in roots were determined periodically, five times.

The results are presented in Figures 6 and 7. There was no correlation between root polyphenol contents and *P. loosi* infestation in both locations (R^2<0.002941). There was a significant difference between tested tea clones in respect of *P. loosi* infestation (Pr> F < 0.0001) and polyphenol content (Pr> F < 0.0228).

Figure 6: Relationship between Polyphenol content and *P. loosi* population in roots of different tea clones in St. Coombs

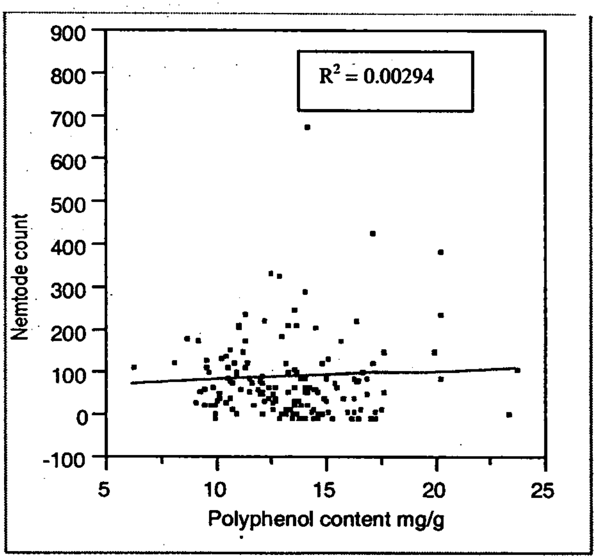
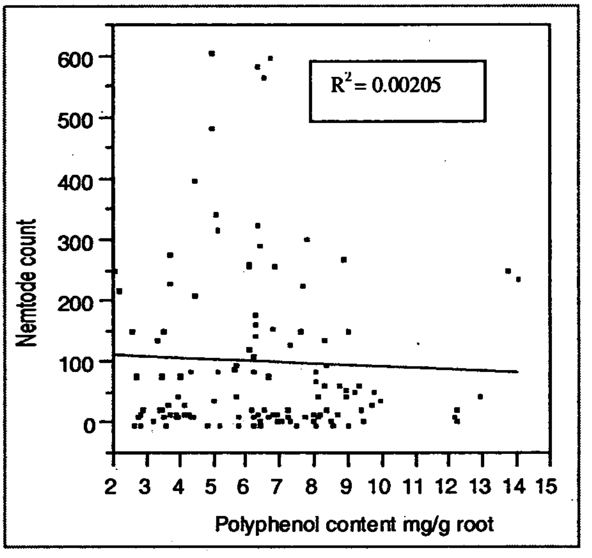


Figure 7 : Relationship between Polyphenol content and *P. loosi* population in roots of different tea clones in Loolcondera



However, levels of polyphenol content of different clones could not be correlated to their nematode susceptibilities. On the other hand irrespective of the clones, was greater under high soil organic matter conditions (Figures 6 and 7).

The results of the current study were not conclusive to support previous studies. Therefore repeated experimentation with close monitoring is in progress for more information. The study is being continued to see a possible existence of different biotypes of *P. loosi* as being responsible for this disparity.

N. S. Senanayake (University of Ruhuna), Keerthi Mohotti,
P. Senanayake and I. S. B. Abeysinghe

N384: Studies on nematicidal action of *Arachis pintoi* in tea soils

Soil populations of *P. loosi*, *R. similis* and *Meloidogyne* spp in the cement-lined tanks planted to *A. pintoi* at TRI, Hantane were being monitored. The experiment is in progress to study the role of *A. pintoi* on population densities of nematodes.

Keerthi Mohotti, Rohini Ekanayake (Department of Agriculture), Bhavani
Sureshkumar & P. B. Ekanayake

Miscellaneous Divisional Projects (D)

Project D-17– Management of nematode pests in tea nurseries and tea fields & MeBr substitutes

Use of Methyl Bromide substitutes in the eradication of nematode pests in tea nurseries and tea fields.

Nematicidal treatments useful in direct planting of nematode infested lands

Two experiments are being carried out:

(i) Moray Estate, Makeliya (2001)

Treatments:

T1	Metham Sodium (@500 l / ha), by injection into holes made round the plant
T2	Cadusaphos ("Rugby" @ 7g/plant) into the planting hole
T3	Vettiver – planting in the inter-row and lopping twice a year
T4	Tithonia thatching @ 1kg/plant- continued as required
T5	Phenamifos ("Nemacur" @ 7g /plant)
T6	"Neemazal 1TS" @ 30ml/plant (of a dilution made with 3ml concentrate in 1liter water;) repeated at 2 month intervals for one year
T7	Untreated Control

Basal application: Tea waste applied to a height of 15 cm (6 inches) at the bottom of the planting hole, to each treatment.

Table 07 - *No. of P. loosi in 100g soil at 04 months from treatment (Moray Estate, Maskeliya, 2000/2001)*

Treatments Replicates	*T_1- Metam*	*T_2- Rugby*	*T_3- Vetiver*	*T_4- Tithonia*	*T_5- Nemacur*	*T_6- Neemazal*	*T_7- untreated*
R_1	0	7	0	13	3	5	3
R_2	0	0	0	0	5	0	5
R_3	0	2	0	2	3	2	3
Avg.	0	3	0	5	3.66	2.33	3.66

Table 08 - *No. of P. loosi in 100g soil at 14 months from treatment (Moray Estate, Maskeliya, 2000/2001)*

Treatments Replicates	*T_1- Metam*	*T_2- Rugby*	*T_3- Vetiver*	*T_4- Tithonia*	*T_5- Nemacur*	*T_6- Neemazal*	*T_7- untreated*
R_1	29	14	41	54	64	139	34
R_2	13	4	89	1	51	64	51
R_3	63	51	38	9	34	53	9
Avg.	35.00	23.00	56.00	21.33	49.67	85.33	31.33

Treatment with Metam Sodium (T1) and *Tithonia diversifolia* (T2) have reduced the nematode population to undetectable levels in 4 months. At 4 months the growth parameters such as plant height, plant girth, etc. did not show any significant difference between nematicidal treatments. However, after 14 months the assessments showed that the nematode population had built up to alarming proportions in almost all treatments.

This shows that direct planting with any of the above treatments is not possible.

(ii) Nayabedda Estate, Bandarawela (September/2000)

Treatments:

T1 Metham Sodium (@500 l / ha), by injection 2 weeks before planting
T2 Tithonia thatching @ 1kg/plant- continued as the thatch perishes
T3 Phenamifos ("Nemacur" @ 7g /plant)
T4 " Neemazal 1TS" @ 30ml/plant of a dilution made with 3ml concentrate in 1 liter water; repeated at 2 month intervals for one year
T5 Phenamifos ("Nemacur" @ 7g /plant) by furrow application at 3 month intervals for one year
T6 Tithonia thatch @ 1 kg + "Nemamort" diluted at 1:4 with water and injected @4 ml of dilution per spot at 30 cm gap in the inter-row at 2 ft interval, for one year
T7 Untreated control

Basal application: 1kg tea waste + 20g T200 applied to a height of 15 cm (6 inches) at the bottom of the planting hole, to each treatment.

Table 09: *No. of P. loosi in 100g soil at 4 months*

	T1	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*
R1	0	18	0	0	2	0	0
R2	3	0	0	13	3	0	8
R3	3	0	5	28	3	0	0

This experiment is in progress.

Chemical Nematicides for Nursery stage:

N 364 (MeBr 41): Hauteville Estate, Agrapatana.

T1 – MeBr fumigation @ 500 g/cum of soil
T2 – Basamid (Drzomet) fumigaiton @ 500 g/cu.bic metric soil
T3 – Metham sodium (Metam) fumigation 600 ml/cu.m of soil soil
T4 – Neemzal 3 ml/l – 3 application at two months interval
T5 – Untreated control

Root nematode counts at 7 month from treatment is shown in Table 10.

Table 10- Root Nematode Count at 07 months from planting cuttings in the Nursery (Avg. *P. loosi* count per 1g of root) (Hauteville Estate, 2001)

T_1- MeBr	*T_2- Basamid*	*T_3- Metam*	*T_4- Neemazal*	*T_5- Control*
00	00	00	07	00
00	00	00	20	07
00	00	00	07	00
00	00	00	11.33	2.33

Metham sodium and Basamid were comparable to MeBr in nematicidal activity at the assessment at 7 months. On the other hand inspite of still harbouring nematodes Neemazal treated plants were comparable to Basamid treated ones in terms of growth of the plants, as shown in Table 11.

Table 11- Influence of chemical fumigants on plant height and nematode count at 12 months. (Hauteville Estate, 2001)

Treatments (n+1)	Avg. plant height (cm)	Avg. Nematode count/g root
T1- MeBr	40.83 *b*	01.00 *c*
T2- Basamid	63.67 *a*	01.00 *c*
T3- Metam	47.00 *b*	01.00 *c*
T4- Neemazal	62.13*a*	12.33*a*
T5- Control	43.93 *b*	03.33 *b*
LSD 5%	15.77	6.38

Basamid (T2) and Metam Sodium (T3) were shown to be comparable to MeBr (T1).At this up-country location, Basamid performed better than MeBr or Metam in relation to plant growth.

S.I. Vitarana, D.D. Liyanage, N. Navaratne, P. Udumulla & U.P. Jayaratne

Development of Steam Chamber for sterilization of infested soil for use in tea nurseries

N-318 (MeBr 9): M.D. Hettiarachchi's Workshop, Colombo (2001).

Second prototype of a steam chamber and a boiler which included improvements over the 1st prototype is under construction. Each part of the equipment was being tested in stages. Work is in progress.

S.I. Vitarana, D.D. Liyanage & M.D. Hettiarachchi

To reduce the use of chemicals and supplement the treatments with soil solarization and soil substitutes:

Two experiments combining soil substitutes, soil solarization and reduced dozes of chemicals were being tested in split-split-plot design, at the following sites.

MeBr 50 (N 381) – Diyagama East Estate
MeBr 49 (N380) – Nayabedda Estate

The treatments included the following in four replicates.

Main Blocks (Treatments)		M1 - Coir dust M2 - Paddy husk M3 - Normal Soil
Sub Blocks (Solarization)	S1 - 6 week solarization S0 - Without solarization	
Sub sub Blocks (Chemical treatment)		T1 - ½ dozen Basamid T2 - ½ dozen Metam sodium T3 - Neemazal F diluted @ 3ml/5 l water-30 ml dilution per plant T4 - Normal soil

These two experiments are in progress.

S.I. Vitarana, D.D. Liyanage, P. Udamulla,
N. Navaratne & U.P. Jayaratne

N-335b (MeBr 21): Deniyaya Estate, Deniyaya (Downside Division)

A follow up study of a nursery trial on soil solarization.

1. Routine roots and soil sampling was undertaken for nematode assessments.

Roots and Shoot weights and nematode analysis were carried out.

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrama

To study the alternatives to rehabilitation for eradication of nematodes in the Field in Up country

N-342 (MeBr 24): St. Coombs Estate, Talawakelle.

The following treatments were given on 2 clones TRI 3025 the susceptible clone & TRI 4052 the tolerant clone, in a split-plot design, in an un-rehabilitated and infested land.

T_1- Untreated controlT_2- Rehabilitated under ManaT_3- "Nemacur 5G" @ 7g / hole (thatching with Mana) (Standard treatment)

T_4- "Neemazal 1%TS" @ 30ml of 0.021% dilution / plant +

Thatching with ManaT_5- Wild Sun Flower thatchingT_6- *Adathoda vesica* thatching (renewed regularly)T_7- Vetiver intercropped

Nematode assessments were carried out at 02 months, 07 months and 12 months. There was no significant difference between clones in relation to nematode counts.

Table 12 - Nematode Count in tea roots (per 1g root) St. Coombs Estate, Talawakelle

Treatment	*At 02 months*	*At 07 months*		*At 12 months*
T_1- Untreated Control	3.095	2.484 *bc*		2.019
T_2- Mana Rehabilitation	-	-		-
T_3- Nemacur	4.077	1.122*a*	*	2.077
T_4- Neemazal	3.511	1.699*ab*		2.595
T_5- Tithonia thatch	3.647	3.241 c		2.726
T_6- Adathoda thatch	4.127	2.418 *bc*		2.697
T_7- Vetiver inter cropped	2.399	1.831*ab*		3.326
LSD at 5%		1.2935		

There was significant difference between treatments only at 07 months. Vetiver intercropping, "Nemacur 5G" and "Neemazal 1%TS" lowered the nematode population at 07 months considerably, compared to the other treatments. However, none of the treatments could eradicate nematodes in any of the plots. This shows that direct planting with any of the above treatments cannot substitute for rehabilitation of the infested land under a non host.

Table 13 - Growth Assessment St. Coombs Estate, Talawakelle

Treatment	*Plant Girth (cm)*		*Plant Height (cm)*		*Tipping Weight (g)*
	At 07 months	*At 12 months*	*At 07 months*	*At 12 months*	*at 12 Months*
T_1- Untreated Control	1.1400*a*	1.3817*ab*	62.200*b*	100.183*ab*	177.13*ab*
T_2- Mana Rehabilitation	-	-	-	-	-
T_3- Nemacur	1.2350*a*	1.5017 *b*	70.600*a* *	110.067*a* *	220.58*a* *
T_4- Neemazal	1.1300*a*	1.3767*ab*	65.500*ab*	101.800*ab*	165.27 *b*
T_5- Tithonia thatch	1.2567*a*	1.4800*ab*	71.583*a*	107.933*ab*	218.67*a* *
T_6- Adathoda thatch	1.1800*a*	1.3217*a*	62.333 *b*	95.300 *b*	130.92 *b*
T_7- Vetiver inter cropped	1.1200*a*	1.3417*ab*	65.300 *b*	95.900 *b*	166.42 *b*
LSD at 5%	0.1612	0.1681	7.0069	12.771	49.911

The treatments were repeated whenever applicable, except Adathoda thatch. *As Adathoda vesica* did not re-grow fast enough for the purpose, of thatching. This treatment had to be dropped from the trial. The plots that were under Mana grass were planted to tea in December 2000. The experiment is being continued in order to confirm the effect of 2 year rehabilitation under Mana on nematode population.

Soil solarization as a substitute to MeBr fumigation to eradicate nematodes in tea Nurseries:

MeBr 35a and 34a: Kellabokke Estate, Nelummula Division, Madulkelle

The test plants of the nursery trials MeBr 35 and MeBr 34 were transplanted in field no. 05, Kellabokke Estate, Nelummula Division, Madulkelle in October 2000. Routine work such as fertilizer application and cultural practices were being carried out. No assessments were scheduled for 2001.The 1st assessment for nematode analysis is scheduled for March 2002.

S.I. Vitarana, U.B. Herath, P. Udumulla

To study the alternatives to rehabilitation for eradication of nematodes in mature clonal tea fields.

N-359 (MeBr 36): Mid country, Rothschild Estate, Pussellawa, YRC division, Field No: 1992 NC.

One experiment was started in March to test nematicides to eradicate nematodes in infested new clearings.

Treatments:

T1 Tithonia diversifolia – Planted in every 02 rows of tea, Tithonia was cut regularly and the material was used to thatch the ground

T2 Marigold – Planted in the inter-row and vacant spaces

T3 Nemacur @ 3g/bush – repeated in 6 month intervals for 3 times

T4 Neemazal 1%TS @ 1 l of 1% Neemazal in 600lt/ ha.

No. of replicates – 02

No. of plants per replicate – Approximately 650

Design – RCBD

Clone – TRI 2025

The first three soil sampling were carried out and the results are given in Tables 14-16.

This experiment is in progress.

Table 14 - Average Nematode Count in 100g soil MeBr-36, Rothschild Estate at 03 months from treatment

Treatment	*P. loosi*		*R. similis*		*R. reniformis*	
	R1	R2	R1	R2	R1	R2
T_1	0	0	0	0	23	2
T_2	2	0	0	0	08	8
T_3	0	0	0	0	07	0
T_4	0	0	2	2	00	0

Tithonia diversifolia and "Nemacur" treated plots showed zero counts of the tea nematodes whereas, Neemazal seem to have eradicated *R. reniformis* which is a pest on weeds, but not *R. similis*. The trial is continuing into another year.

Table 15 - Average Nematode Count in 100g soil MeBr-36, Rothschild Estate, Pussellawa At 09 months from treatment

Treatment	*P. loosi* (100g soil)		*R. similis* (100g soil)	
	R_1	R_2	R_1	R_2
T_1	03	-	-	-
T_2	-	-	-	-
T_3	-	-	-	02
T_4	-	-	-	03

Table 16 - Average Nematode Count in 100g soil MeBr-36, Rothschild Estate, Pussellawa At 12 months from treatment

Treatment	*P. loosi* (100g soil)		*R. similis* (100g soil)	
	R_1	R_2	R_1	R_2
T_1	-	-	-	-
T_2	-	-	-	-
T_3	-	-	-	-
T_4	-	-	-	-

All treatments showed zero nematode count at 12 months. However, the treatments are being continued through the 2^{nd} year.

S.I. Vitarana, H.M.U.B. Herath, G.P. Udumulla

Soil solarization as a substitute for MeBr to eradicate Nematodes in Tea Nurseries.

Fundamental study was carried out to study the depth effect of soil solarization as given below:

MeBr 55 (N389): Effect of Soil Solarization on soil temperature and nematodes

Table : 17

Soil layer	*Depth (cm)*	*Temperature (° C)*	*Pre-Count*	*Nematode count/ 36 g of soil* One week SS	*Three weeks SS*	*Five weeks SS*	*Six weeks SS*
Surface	0	51	-	-	-	-	-
Top	7	40 - 43	50	12	0	0	0
Middle	15	33 - 35	50	23	5	1	0
Bottom	30	29 - 31	50	42	12	2	0

Ambient temperature = 29°C, at noon, under shade

The above study demonstrated that the temperatures of the soil could be increased upto 30 degrees and above under 6 weeks of soil solarization. All nematodes have been killed at all levels of the soil heap to a depth of 30 cms within 6 weeks. Therefore, 6 weeks is considered as the effective period of soil solarization for eradication of nematodes to a depth of 30 cms.

S.I. Vitarana, U.P. Jayarathne

N-363 (MeBr 40): Handford Estate, Deniyaya (System 1A)

This experiment was being continued from 2000.

Figure 9

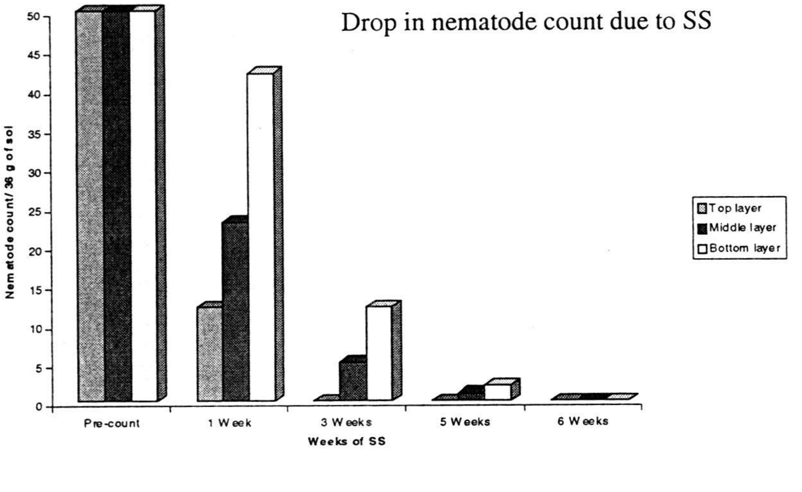
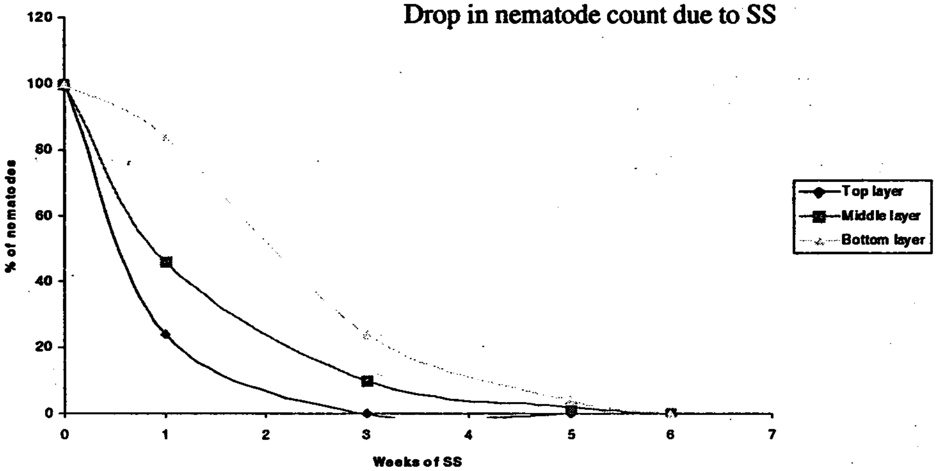


Figure 10



The final assessments were carried out at 9 months after the plants became ready for field planting. Results are given in Tables 18 & 19.

Root and soil sampling was carried out for nematode assessment. Tipping was also undertaken.

Table 18 - Growth assessment at 09 months and prior to field planting (mean of 180 plants) - MeBr 40, Handford Estate, Deniyaya

Treatment	*Plant Height (mm)*	*Plant Girth (mm)*	*Mean No. of Plants*	*No. of Lateral Branches*	*No. of Leaves On Lateral Branches*	*Occurrence of active Bud (%)*
T_1- Urea + 6 weeks S.S.	648.72ab	13.75	23.44a	4.41a	11.99 b	38.89a
T_2- Urea + 8 weeks S.S.	607.10 b	13.75	23.84a	4.13a	11.83 b	25.55ab
T_3- 8 weeks S.S. Only	445.55 c	11.65	18.61 b	3.35 b	09.26 c	18.89 b
T_4- Basamid	608.83 b	13.75	22.49a	4.49a	12.92ab	18.89 b
T_5- MeBr	713.50a	14.0	24.49a	4.58a	13.95a	28.89ab
T_6- Control	407.85 c	12.25	17.75 b	3.32 b	09.63 c	34.44a
$LSD_{5\%}$	72.54	NS	2.98	0.69	1.82	14.55

SS= Soil Solarization

Table 19 - *Nematode analysis at 09 months (mean of 15 plants) MeBr 40, Handford Estate, Deniyaya*

Treatment	*Mean Shoot Weight (g)*	*Mean Root Weight (g)*	*Nematode Count in Root (n+1)*	*Nematode Count in Soil (n+1)*
T_1- Urea + 6 weeks S.S.	30.51ab	11.80ab	1.00a	1.00a
T_2- Urea + 8 weeks S.S.	31.50a	12.13a	1.00a	1.00a
T_3- 8 weeks S.S. only	26.81 bc	10.77ab	1.00a	1.50a
T_4- Basamid	28.22 bc	09.81 bc	1.00a	1.00a
T_5- MeBr	34.01a	12.62a	1.00a	1.00a
T_6- Control	24.15 c	08.48 c	4.33 b	6.33 b
$LSD_{5\%}$=	4.37	02.13	2.78	3.06

The same nematicidal effects seen at 06 months were observed at 09 months also confirming the efficacy of Soil Solarization of Urea supplemented soil. However, best growth was observed with Methyl bromide, at this low elevation location.

The nursery plants were transplanted in June 2001 for follow up studies, in a rehabilitated land. (see MeBr 40A & MeBr 40B).

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrama

N-387 (MeBr 40A): Handford Estate, Deniyaya (2001).

This is a follow up study of the nursery trial MeBr40 where soil solarization with and without nitrogen supplements had been tested. Only the treated plants of MeBr trial were planted in the filed. Root and soil sampling commenced. Experiment is in progress.

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrama

N-388 (MeBr 40B): Handford Estate, Deniyaya (2001).

To find effective nematicidal treatments to eradicate the infestation of nursery plants. These plants of the control (untreated) plots of the experiment MeBr 40 were used for this trial.

Land preparation, pre-sampling, planting tea and planting of vetiver in the inter-rows were carried out. Experiment is in progress.

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrama

To study the method of eradication of nematodes in infested nurseries.

N-378 (MeBr 47): Use of nematicides to eradicate the nematode population of an Infested nursery, Westhall Estate, Nawalapitiya.

The 1999 nursery at Westhall Estate was heavily infested and the plants were stunted and yellowing. Chemical nematicides were tested to eradicate the nematodes and resuscitate the plants. (The current recommendation in a similar situation is to discard all plants).

A Pre-count carried out in October 2000 showed a heavy population of *Radopholos similis.*

The following treatments were applied in 200 plant blocks in RCBD design with 3 replicates.

T1	'Neemazal 1%TS' 30ml/Plant with 3ml/l dilution
T2	'Multineem' 30ml/Plant with 3ml/l dilution
T3	'Multineem' 30ml/Plant with 6ml/l dilution
T4	'Neemazal 1%TS' 30ml/Plant with 6ml/l dilution
T5	'Nemacur' - 2g/Plant
T6	Untreated control

Treatments were applied in December 2000 and repeated at 6-week intervals in the case of Neemazal / Multineem up to 3 applications and at 8-week intervals with 'Nemacur' up to 2 applications.

Nemacur 2.0g showed phytotoxicity in the form of curled leaf + yellowing immediately after application, but cleared up in one month. However none of the plants died. This may have been due to other stress factors such as inadequate watering which was also observed at this period.

Results of assessments carried out at 6 and 9 months are shown in tables 20, 21 and 22.

Table 20 - *Root nematode count (MeBr 47 – Westhall)* *(Avg. number of nematodes per 1 g root matter)*

Treatments *(Weather)*	*Pre-count October 2000 (Wet)*	*At 6 m from Treatment April 2001 (Wet)*	*At 9 m from Treatment July 2001 (Dry)*
T_1	13.6	0	0
T_2	9.0	0	0
T_3	11.0	0	0
T_4	6.6	0	0
T_5	13.6	0	0
T_6	9.0	8.67	0.73

(Control plots recorded nematodes in all 3 replicates)

Table 21: *Soil nematode count (MeBr 47 – Westhall)*
(Avg. number of nematodes per 100 g soil)

Treatments *(Weather)*	*Pre-count October 2000* *(Wet)*	*At 6 months from treatment April 2001* *(Wet)*	*At 9 months from treatment July 2001* *(Dry)*
T_1	8.3	3.83	0.2
T_2	7.6	0.0	0.0
T_3	9.0	0.67	0.2
T_4	8.3	0.0	0.0
T_5	4.6	0.0	0.0
T_6	4.0	5.33	1.93

(Control plots recorded nematodes in all 3 replicates)

Nematodes have been totally eradicated both in the roots and in the soil by "Multineem" diluted at 3ml per liter, "Neemazal 1%TS" diluted at 6 ml per liter (both dilutions used @ 30 ml per plant) and "Nemacur" @ 2 g per plant.

Table 22 - *Growth assessments (MeBr 47 – Westhall Estate)*

Treatmunts	*Root Weight (g)*		*Shoot Weight (g)*	
	At 6 month	*At 9 month*	*At 6 months*	*At 9 months*
T_1	6.73	14.53	11.46	28.70
T_2	9.02	11.46	13.10	19.63
T_3	8.40	11.18	11.38	23.29
T_4	7.94	9.41	14.16	17.16
T_5	6.33	7.52	7.59	20.43
T_6	3.32	10.49	7.76	20.55
LSD at 5%	NS	4.125	NS	NS

Treatments were significantly different from each other only at 9 months and only in relation to root weight. However, neem formulations exhibited generally better root and shoot growth.

It was possible to conclude that the following treatments could be adopted to eradicate nematodes in heavily inferted nurseries.

Multineem or Neemazal F could be applied upto 3 times at 6-week intervals.

Nemacur could be applied once and the samples assessed at 3 months to see if there is any residual population. If light population continues the dosage could be reduced to 1.5 g and applied at 3 months from first application. (½ life period of Nemacur is 45 days.)

S.I. Vitarana, U.B. Herath, G.P. Udumulla

Synergistic effect of reduced doses of chemical nematicides and soil solarization of partial soil substitutes at eradicating nematodes in nursery soils,

N-382 (MeBr51): Handford Estate, Deniyaya (2001).

i. The following treatments were applied in split plot design:

Main Treatments (2M): M1- Tea Waste

M2- Paddy Husk

Sub Plot Treatment (2SS): SS1- Soil solarization of infested soil prior to mixing withorganic soil substitute

SS2- Soil solarization of the mixture of infested soil and org.Substitutes

Sub Sub Plot Treatments (3N): N1- Metham Sodium (Metam) @ 300ml / cu.m.- (1/2 the recommended dose)

N2- Basanid 98%G @ 250g/cube (1/2 the recommended dose)

N3- Neemazal 1%TS @ 30ml of dilution / plant with a dilution of 3ml in 5l water (1/5 of recommended dose)

The growth assessments and nematode analysis are scheduled for February 2002.

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrema

Two experiments similar to N 382 were laid down at Rangala and Nayabedda. (MeBr 52 & MeBr 53) in November 2001. Experimentql work is scheduled for 2002.

ii. **MeBr 52: To study the effect of soil solarization supplemented and Poly tunnel Rangala Estate, Rangala.**

Solarizations of urea treated soil with following combinations of treatments were carried out.

T1 – 6weeks SS of soil treated with Urea (2g/bag)
T2 – 6Weeks SS of soil treated with Urea (2g/bag) + Neemazal doubledosageat Planting cuttings
T3 – 6Weeks SS of soil treated with Urea (2g/bag) + Neemazal single dosage at planting cuttings and repeated at 3month intervals

T4 – ½ dose of Basanid + 3weeks SS of urea treated soil (2g/bag)
T5 – ½ dose of Metam sodium + 3weeks SS of urea treated soil (2g/bag)
T6 – MeBr Fumigation - standard
T7 – Untreated control

Cuttings of TRI 4171 and TRI 3018 were planted in the treated beds. High shade was erected covering the whole nursery. The assessment was scheduled for early 2002.

Routine maintenance work is being carried out, and the experiment is in progress.

D 20: Identification of safe insecticides, acaricides in order to design IPM methods for control of seasonal pests of tea.

Screening of new acaricides with a view to selecting suitable substitutes for Quinomethionate and Propagite.

LE 86: Lauderdale Estate, Iththakanda.

A replicated trial of randomized block design including the following new acaricides was conducted. Six post treatment assessments were carried out at weekly intervals.

Treatments:

T1- Multineem 25ml / 4.5 l @ 5.2l/ha
T2- Neemazal 27ml/ 4.5 l @ 5.6l/ha
T3- AMS 4.1ml/ 4.5 l @ 860ml/ha
T4- Cascade 1ml/ 4.5 l @ 210ml/ha
T5- Sulphur 27g/ 4.5 l @ 5.6g/ha
T6- Untreated control

In the first and the third post treatment sampling, effect of Sulphur was significantly different from other treatments. In the second and fourth post treatment sampling, treatment effects were not significantly different from each other.

S.I. Vitarana, E.R. Perera, A.K. Prematunge & S.B. Vithana

Management of Scavenging Termites on tea lands - Screening of chemical termiticides to manage Scavenging Termites

ME06 (02): Screening of insecticides to manage scavenging termites in the Mid - Country area – Duckwari Estate, Lolgama Division, Field No: 10, (Sep. 2000).

In a previous trial (ME 05) Fipronil in liquid formulation gave promising results. In the current study, the granular formation was compared with the liquid formulation.

T1- Fipronil @ 30 kg/ha ("Prince Granules")
T2- Fipronil Suspension @ 3.5 l/ ha ("Regent")
T3- Fipronil Suspension @ 2.0 l/ha ("Regent")
T4- Control

Treatments were applied in September 2000. Scavenging termite activity was recorded monthly and the summary for the period January to December 2001 is given below:

Table 23: Number of bushes affected (Jan 2001 – Dec 2001)

	Bushes carrying infestation			Fresh Scavenger Activity			Presence of live Termites		
Treatment	R1	R2	R3	R1	R2	R3	R1	R2	R3
T1	04	19	29	03	21	34	01	10	04
T2	04	00	13	03	00	16	02	02	05
T3	02	06	12	02	05	11	00	02	02
T4	27	23	56	25	24	41	11	02	14

The results showed that Fipronil liquid suspension repelled the termites most. There was no difference between the two dosages of the liquid suspension. The treatments will be repeated in 15 months.

S. Abeysinghe, U.B. Herath, B. Sureshkumar & D. Pallemulla

ME 11: To study the effect of soil solarization on White Grubs in the nursery. TRI Mid-Country Station, Hantane (2001).

In other studies soil solarization was found to raise the soil temperatures up to 50°C at the top 5 cm and up to 30°C at the bottom of 30 cm thick soil beds. This experiment was conducted to study the effect of temperature changes on white grubs.

The soil bags were prepared laying nylon green house netting at every 7 cm height to prevent the vertical movement of grubs. In this soil two grubs (in the

3rd stage larval development) and root material were incorporated in to each of three layers. The two treatments were replicated 8 times with 6 White grubs placed in 3 layers in a bag (top, middle & bottom layers) separated by nylon gauge. These bags were covered with clear polythene and exposed to sunlight for six weeks. The bags were examined for grub survival at the end of 6 weeks of solarization.

Treatments-

T I - Control (Nursery bags filled with soil exposed to the light)
T2 - White grubs buried in the nursery bag

All White grubs were found to be dead in all replicates of the solarization treatment, in each of the three layers. This proved that soil solarization can be used to control white grubs.

D. Pallemulla, S. Abeysinghe

ME 12: To study the effective dosage of Cadusaphos (Rugby) to control White Grubs. TRI, Mid-Country station, Hantane. Pot Experiment (2001).

Three different dosages of Cadusaphos were compared with untreated control in relation to their efficacy on white grubs in a pot trial, using 6 grubs in a pot (30cm high × 30cm diameter). Pot contents were examined after 3 weeks and the observations are given in the Table 24.

Table 24 : Survival of White Grubs /head capsules at 3 weeks from treatment

	T1 Cadusaphos @ 2.5 g / pot	*T2 Cadusaphos @ 3 g / pot*	*T3 Cadusaphos @ 2 g / pot*	*T4 Un treated control*
R1	2 dead 1 head capsule	4 head capsules	2 dead 1 head capsules	1 pupa 2 grubs alive
R2	0 3 head capsules	3 head capsules	1 pupa 1 dead 2 head capsules	4 grubs alive
R3	1 dead 1 alive 1 head capsule	2 dead	3 head capsules	3 grubs alive 1 head capsule

Results indicated that dosages at or above 2.5g /plant can cause 100% control of white grubs, in three weeks from treatment.

D. Pallemulla, S. Abeysinghe

E 306: Screening of chemicals against White Grubs, Nematology Nursery, Talawakelle (2001).

A pot trial was established in the nursery to screen the following chemicals against white grubs.

Treatments-

1- Metam sodium @ 30 ml/pot
2- Metam sodium @ 20 ml /pot
3- Metam sodium @ 10 ml /pot
4- Fipronil ('Regent') @ 10 g/pot
5- Carbofuran ('Furadan') @ 7 g/pot
6- Untreated control

10 grubs were introduced into each pot, and the chemical treatments were carried out after two days. Two assessments were done at weekly intervals.

Table : 25

Treatment	*After 7 days from treatment*				*After 14 days from treatment*			
	R1		*R2*		*R1*		*R2*	
	Dead	*Live*	*Dead*	*Live*	*Dead*	*Live*	*Dead*	*Live*
1. MetamSodium-30ml/pot	8	(2)*	8	(2)*	9	(1)*	8	(2)*
2. Metam sodium-20ml/pot	9	(1)*	8	(2)*	10	-	8	(2)*
3. Metam sodium-10ml/pot	8	(2)*	8	(2)*	8	(2)*	9	(1)*
4. Fifrinol-10g/pot	2	6	5	(5)*	3	3	5	3
5. Carbofuran - 7g/pot	4	2	6	4	2	3	4	1
6. Control	-	7	-	6	1	6	1	6

Missing numbers are believed to have either disintegrated or migrated out of the pot.

Since all three concentrations of Metam sodium were effective on the pest another experiment was laid out to reduce the concentration of the chemical.

E 306a: To test for the effective minimum dosage of Metam Sodium to control White Grubs.

Treatments were,

T1 Metam sodium @10 ml/pot
T2 Metam sodium @ 5 ml/pot
T3 Metam sodium @ 2 ml/pot
T4 Metam sodium @ 1ml/pot
T5 Control

Only T1 & T2 were effective on the pest.

To determine the correct concentration of the chemical, another trial was laid out with three concentrations of Metam sodium and two other chemicals.

Table : 26

Treatment	*After 7 days*				*After 14 days*			
	R1		*R2*		*R1*		*R2*	
	Dead	*Live*	*Dead*	*Live*	*Dead*	*Live*	*Dead*	*Live*
1. Metam sodium - @10ml/pot	10	-	10	-	9	(1)	7	(3)*
2. Metam sodium - @8ml/pot	10	-	10	-	10	-	7	(3)*
3. Metam sodium - @5ml/pot	10	-	10	-	10	-	8	(2)*
4. Carbofuran - @7 g/pot	1	9	2	8	6	4	7	3
5. Fifrinol - @10 g/pot	1	9	2	8	3	7	7	(3)*
6. Control	3	5	4	6	3	7	-	6

* Missing (disintegrated) emigrated.

It was concluded that a minimum dose of 5ml Metam sodium can be used to control whilte grubs in tea.

S.I. Vitarana, R.S. Walgama & A. Abeysekara

ME 13: To compare effective doses of Rugby and Metam Sodium to control White Grubs. TRI, Mid-Country Station, Hantane – Pot Experiment (2001).

Metam Sodium which has been successfully tested against Nematode pests in the soil was compared with Cadosaphos ("Rugby") which gave promising results in ME 12.Two larvae of *Holotrichia disparalis in the* fourth instar incorporated into each pot 18cm × 18cm and allowed to stabilize over 2 days.

Treatments:

T1 - Rugby at @ 2 g /pot
T2 - Rugby at @ 2.5 g /pot
T3 – Metam Sodium @ 10 ml / pot
T4 – Metam Sodium @ 5 ml / pot
T5 – Metam Sodium @ 2 ml / pot
T6 – Control

Assessments were carried out after 7 days.

Table : *Survival of Grubs at 7 days from treatment*

	T1	T2	T3	T4	T5	T6
R1	02 Dead	02 Dead	02 Dead	02 Dead	02 Dead	02 Live
R2	02 Dead	01D + 01 L*	02 Dead	02 Dead	02 Dead	02 Live
R3	01D + 01 L*	02 Dead	02 Dead	02 Dead	02 Dead	02 Live

* The single live grubs in T1/R3 and T2/R2 were also dead after 3 weeks whereas, the grubs survived and pupated in the untreated control.

All dosages of Metam sodium were equally effective and marginally better than Rugby.

Thus Metam Sodium @ 2ml / plant and Rugby @ 2g / plant can be recommended as treatment against white grubs of tea at planting time.

D. Pallemulla, S. Abeysinghe

Biological Control of Tea Mites

E-272: Lauderdale Estate, Iththakanda. (1997)

Monthly sampling was carried out in seven blocks where the predators had been released in 1997. Five blocks were pruned in early February. The predatory mite, *Phytoseiulus persimilis* and *Amblycius californicus* could be recovered from the blocks, even now.

Outbreaks of red spider mite were encountered only during the month of July and August during the course of the year, but the mites disappeared as soon as they appeared whereas, mite outbreaks persisted in other fields and on neighbouring estates. Also Red Spider mite counts were very low, indicating that the predatory mites are active in the field.

E-273: Deverenside Estate – Rakwana (1997).

To study the effect of biological control of *red sp. den mite (Oligonychus coffeae)* using the predatory mites, *Phytoseiulus persimilis* and *Amblycius californicus*, on the productivity of tea fields during mite outbreak periods.

Monthly post treatment sampling was being carried out in order to mark the first outbreaks after the introduction of the predators in 1997. Outbreaks of red spider mite were encountered only during the month of July and August during the course of the year, but the mites disappeared as soon as they appeared.

S.I. Vitarana, E.R. Perera, A.K. Prematunge & S.B. Vithana

D 19: Pest ecology and management with special reference to Live-Wood Termites in the low country

Clonal Resistance as a component of IPM

Bio assay of the prospective TRI 5000 series clones for Termite resistance

By using the biochemical methods of Clonal Screening eight of the prospective TRI 5000 Series clones (code numbered as : 26/4, 68, 62, 12/11, 163, 145, 379 & 23/5) werw identified as resistance to *Glyptotermes dilatatus*, the Low-Country Live-Wood Termite. The conventional method would have taken ten years to yield this result.

S.I. Vitarana, S. Samarasinghe, B.S.N. Vithana

Miscellaneous studies:

<u>New Organisms</u>

A thread like worm, a nematode, was encountered for the 2nd year in quick succession on tea (TRI 2025) in field no. 14, Lower Division and two other fields of Stellenberg Estate, Pupuressa. It was identified as *Mermis nigrescens* (family: Mermithidae), an ecto parasite nematode of Tea Tortrix.

The same nematode was associated with Tea Tortrix outbreaks this year on Rangala Estate, Madulsima as well.

A mermithid nematode had been encountered as an ecto parasite of Tea Tortrix from time to time, but the species had not been identified then.

S.I. Vitarana, D. Pallemulla, U.P. Jayaratne

Staff Position

Mrs. S.I. Vitarana, Entomologist continued to serve in the the dual capacity of Actg. Head of Entomology Division and the Officer-in-Charge of the TRI Low-Country Station, Ratnapura.

Mrs. R.M.D.T. Pallemulla continued her post graduate studies, at the Post Graduate Institute of Agriculture, Peradeniya.

Mrs. B. Sureshkumar registered for post graduate studies at the Post Graduate Institute of Agriculture, Peradeniya and commenced course work in September.

Mr. M.M. Jayathilake continued with part time training on the Certificate Course in Laboratory Technology at the Open University of Sri Lanka.

Mrs. R.M.D.T. Pallemulla participated at the Regional Training Programme on "Management of Natural Resources" held at the Post Graduate Institute of Science, Peradeniya , from 3rd October - 2nd November 2001.

Mr. R.S. Walgama, Research Assistant proceeded to Australia in November to follow the first segment of his training in Computer Simulation Modelling in Pest Management leading to a Ph.D, at the Department of Zoology/ Entomology, University of Queensland, Australia.

General:

Mrs. S.I. Vitarana continued to serve on the following Committees:

Pesticides Technical and Advisory Committee appointed by the Hon. Minister of Agriculture

Specialist Committee on Plant Protection appointed by the Council of Agricultural Research Policy (CARP)

Steering Committee on National Plant Quarantine to formulate the Regulations for Plant Quarantine Act

Steering Committee of the Asian Development Bank Tea Development Project

Chairperson of the Publication and Presentations Panel of the TRI

The Convenor / Secretary of the Consultative Committee on Estates and Advisory& Extension Services of the Tea Research Board

Chairperson of the Agrochemicals Screening Committee of the TRI

Dr. Mohotti and Mrs. Vitarana served as members of the multidisciplinary team nominated by the Director, TRI to investigate into the problem of death of bushes in the Deniyaya area.

Dr. Mohotti supervised the following undergraduate and post graduate projects.

a) Final year research projects of the undergraduates, Messrs. R. P. S. K.Randeniya and T. M. M. P. Thennakoon of Faculty of Agriculture, University of Peradeniya, Messrs. N. S. Senanayake and Messrs. S. S. H. M. S. S. Seneviratne of Faculty of Agriculture, University of Ruhuna and Miss M. L. D. Priyangika of Faculty of Agricultural Sciences, University of Sabaragamuwa.

b) Research project of the directed study of M. Sc. Degree in Natural Resources Management of Mrs. R.V.P.K.N. Elliyadde of Post Graduate Institute of Agriculture, University of Peradeniya.

c) Research project of M.Sc. Degree of Mrs. P. Dharmalatha of Post Graduate Institute of Science, University of Peradeniya Dr. Mohotti also served as a member of the teaching panel of the Board of Study on Plant Protection of the Post Graduate Institute of Agriculture, University of Peradeniya a visiting lecturer of Faculty of Agricultural Sciences, University of Sabaragamuwa.

Dr. Mohotti was upgraded from Associate membership and placed in the category of 'Member' of the Institute of Biology, Sri Lanka.

Dr. Mohotti was appointed as Country Co-ordinator – ARNOA (Asian Research Network for Organic Agriculture) of IFOAM (International Federation for Organic Agriculture Movement).

Co-ordinator for Interim Committee of LOAM (Lanka Organic Agriculture Movement)

Resource Person – Indigenous Knowledge in Agriculture of the Sri Lanka Resource Centre for Indigenous Knowledge (SLARCIK) at the University of Sri Jayawardenapura, Colombo, Sri Lanka.

Resource Person and member of expert committee on 'Organic Products Promotion Program' of the Ministry of Environment and Natural Resources.

Resource Person for development of databases on Traditional Knowledge in Agriculture at the CARP.

Secretary (Joint), National Agriculture Association of Sri Lanka.

Mrs. Vitarana supervised the undergraduate projects of two students from Universityof Ruhuna.

Seminars, Conferences, Meetings, Workshops and Field Days

1. S.I. Vitarana, L.D.Amarasinghe, R.S.Walagama , D.Pallemulla & S.M.Samarasinghe attended the workshop on 'National Priorities in Plant Protection" at In-house Training Center, Gannoruwa on 18th May Conducted by the Specialist Committee on Plant Protection (SCPP) of the CARP.

2. L.D. Amarasinghe, R.S.Walgama & S.M.Samarasinghe attended the workshop on "Novel Strategies in Pest Management of Stored Grains in Developing Countries"organized by the SLASS, University of Kelaniya and FAO at the Sri Lanka Foundation Institute (SLFI), Colombo on 13th July.

3. R.S.Walgama attended the workshop on "Statistical Techniques" at the National Institute of Buisness Management (NIBM), Colombo from 18th to 22nd June.

4. Dr. Keertie Mohotti attended the Annual Symposium of the Department of Agriculture (ASDA 2001) held at Gannoruwa, Peradeniya during 20-22 September.

5. S.I. Vitarana, L.D. Amarasinghe, Dr. Keertie Mohotti attended the workshop on Microbial Pesticides / Preparations held at the national Science Foundation, Colombo on 8 June, 2001.

Presentations:

Dr. Keertie Mohotti made the following presentations.

1. Workshop on Use of Effective Micro organisms in Agriculture conducted by the Department of Agriculture in Peradeniya on 12 June and made a presentation on 'Beneficial micro organisms from Sri Lankan Soils'.

2. Workshop on the Formulation of a National Strategy for the Conservation and Sustainable Use of Indigenous Knowledge in Sri Lanka in Colombo on 16 November, and made a presentation on 'Use of indigenous knowledge in agriculture in Sri Lanka, limitations and recommendations'.

3. Was invited by the Organic Tea Research and Development Center (OTRDC) of TRI China to attend the 5th IFOAM-asia Scientific Conference held in Hangzhou, China during 31 October – 4 November, and made oral presentations on Comparison of Yield and its Components of Tea Supplemented with Various Manures under Organic and Conventional Cultivation and Bio Prospecting of Organic Farmlands – Evidence from Sri Lankan Organic Tea Soils.

   Dr. Keertie Mohotti, was exposed to OTRDC activities, organically grown green tea estates and small and large scale organic farms in china during the visit.

4. was invited as a guest speaker to address the PA meeting of the Kalutara District on 27 June and made a presentation on 'Organic farming concept and plantation agriculture'.

5. At the 3rd Ornithological Research seminar and 19th Birdwatchers Conference at the University of Colombo on 5 July and presented 'influx of bird populations in organic farms – importance as bio indicators in studies on organic farming, natural resource management and IPM.

6. Made a presentation at the In house seminar at TRI on 'Organic farming as a sustainable agricultural system in tea'.

7. Made a presentation at the In house seminar at TRI on 'Problems affecting tea in the Deniyaya region'.

8. Addressed planters in Deniyaya region at Deniyaya on 'Problems affecting tea in the Deniyaya region'.

9. Delivered a lecture for NIPM participants in sinhala on 'Environmental and nature farming concept and organic tea cultivation'.

Publications

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PLANT PATHOLOGY DIVISION

A Balasuriya
Acting Head of Division

1. APPLIED RESEARCH PROJECTS

Project A-1.2. Screening for Resistance - Upcountry

1.1.1. PP/POR1/98 - Screening of new clones for the resistance/ susceptibility to Poria root disease (St Coombs Estate).

Objective: To screen new clones that are to be released by the Plant Breeding Division, for the resistance/ susceptibility to Poria root disease

After more than three years of exposure and in the absence of many new infections occurring, it was decided to terminate this trial and start a new screening either with the same clones or with a revised list of clones.

1.1.2. PP/BB3/99 - Selection of OST bushes for their resistance to Blister Blight disease (Diyagama East Estate).

Objective: To select tea bushes from existing old seedling teas that show good resistance/tolerance to blister blight leaf disease, with a view to recommending to the Plant Breeding Division for inclusion in their breeding programme.

A number of visits were undertaken during the year, introducing further selection pressure. Nineteen seedling bushes with high level of tolerance to blister blight were earmarked for final selection and multiplication in the nursery. These bushes were pruned and fertilized in preparation for taking cuttings.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake

1.1.3. PP/POR1/00 - Screening of new clones for their resistance/ susceptibility to Poria root disease (St Coombs Estate).

Objective: To be able to screen new clones that are to be released by the Plant Breeding Division, for their resistance/susceptibility to Poria root disease (serialised activity).

The plants were getting established in the presence of the inoculum. A second round of inoculum was introduced to the establishing plants. Majority of plants/ clones were not showing much vigour from the beginning. Only two plants showed symptoms of poria root disease. In view of the poor performance of these plants, it was decided to discontinue this experiment and restart with better quality plants as soon as they are available.

A Balasuriya, R M A Ratnayake

1.2 PROJECT A-4.2. Screening for Resistance - Low-country

1.2.1 PP/MC1/00 - Selection of OST bushes for their resistance to Macrophoma Canker Disease (Hulandawa Estate, Akuressa).

Objective: To select tea bushes from existing old seedling teas that show good resistance/tolerance to Macrophoma canker and frame debilitation, with a view to recommend to the Plant Breeding Division for inclusion in its breeding programme.

Several visits were undertaken during the year, introducing further selection pressure. Seventeen bushes with good vigour were selected, rested and pruned in prepartion for taking cuttings.

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1.2.2 PP/MC1/01 - Screening of bi-clonal seedlings for Macrophoma Canker (Maliboda Estate).

The section of the field that was available for this study was assessed on the following scale of disease intensities:

- 0 No sign of cankers
- 0.5 Only hidden lesions (some tolerance)
- 1 Up to three small (1-2 cm) cankers
- 2 More than three small cankers
- 3 Up to three large (>2 cm) cankers
- 4 More than three large, and/ or canker spreading to the base
- 5 Dead due to canker

TABLE 1 - *Number of bushes under each category of canker rating with the final average score*

Clone	Disease intensity rating							No.of	Total	Average
	0	0.5	1	2	3	4	5	bushes	Score	Score
TRI 2043	295	51	23	20	20	33	0	442	280.5	0.635
TRI 2025	85	19	1	0	3	3	0	111	31.5	0.284
TRI 2023	141	69	6	1	14	15	0	246	144.5	0.587
S 106	193	36	5	0	6	5	0	245	61.0	0.249
TRI 3063	193	29	5	1	5	58	0	291	268.5	0.923

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1.3 PROJECT A-23.1. Screening and evaluation of biological control organisms

Objective: To screen and evaluate naturally occurring microorganisms from Sri Lankan tea soils in their ability to suppress some of the common root diseases of tea, with a view to reducing the usage of fungicides.

1.3.1 PP/BC1/01 - Evaluation of soil born fungi with antagonistic properties to major root diseases

The three locally isolated fungi, *Trichoderma pseudokoningii. Aspergillus niger* and *Penicillium aurantiogriseum* were tested for their antagonistic properties against red root disease (*Poria hypolateritia*) and white root disease (*Rigidoporus lignosus*) of tea. The antagonistic property of the above three fungal species was assessed following the dual culture technique. Petri dishes (9 cm diameter) containing Potato Dextrose Agar (PDA) medium were inoculated with mycelial discs (No. 04 cork borer) of the pathogen alongside the antagonists, on diametrically opposite points. They were incubated at 25°C and the area of growth of pathogen was measured after ten days in *Poria hypolateritia* and after five days in *Rigidoporus lignosus*.

Pathogen and the antagonists were introduced to the PDA medium at different time intervals as given below;

Pathogen and the antagonists inoculated on the same day
Pathogen inoculated few days before antagonists
Pathogen inoculated few days after antagonists

In the simultaneous culture, *T. pseudokoningii* completely smothered *R. lignosus* in two weeks. *A. niger* and *P. aurantiogriseum* were able to invade the pathogen completely only when it was introduced two days before the pathogen. When *R. lignosus* was introduced two days earlier, it was able to suppress the growth of *A. niger* and *P. aurantiogriseum* completely.

TABLE 2 - *Area of growth of Rigidoporus lignosus cultures grown on PDA medium in the presence of the antagonist fungi, introduced at different time intervals*

Time interval between pathogen & antagonist	Area of growth in cm^2			Control
	P. aurantiogriseum	*T. pseudokoningii*	*A. niger*	
0 days	45.0±6.7	40.0±0.6	32.5±3.0	63.6±0.0
Pathogen 2 days prior	60.2±1.8	62.1±1.4	60.0±0.4	63.6±0.0
Pathogen 2 days later	4.3±2.1	8.9±1.0	5.5±2.8	39.4±0.6

A. *niger* and *T. pseudokoningii* exhibited good control on the growth of *Poria hypolateritia.* A. *niger* and *T. pseudokoningii* smothered the pathogen completely in twenty days when they were inoculated simultaneously. But when *Poria* was introduced five days prior to antagonists, only *T. pseudokoningii* was able to invade the pathogen completely. *P. hypolateritia* was able to recover from the initial suppression caused on its growth by *P. aurantiogriseum*, with time. The effect of antagonists on the growth of *P. hypolateritia*, when the latter is introduced five days after is pending.

TABLE 3 - *Area of growth of Poria hypolateritia cultures grown on PDA medium in the presence of the antagonist fungi, introduced at different time intervals*

Time interval between pathogen & antagonist	Area of growth in cm^2			Control
	P. aurantiogriseum	*T. pseudokoningii*	*A. niger*	
0 days	11.7±3.2	3.6±0.6	4.7±0.6	50.5±1.1
Pathogen 5 days prior	35.4±2.3	13.8±1.1	38.3±2.1	50.5±0.5
Pathogen 5 days later	pending	pending	pending	-

1.3.2 PP/BC2/01 - Screening against fungicides

Three systemic fungicides Bitertanol (Baycor), Tridemorph (Calixin) and propiconazole (Tilt) were tested *in vitro* against all these microorganisms. Three concentrations of the fungicides, ie. 0.05%, 0.1% and 0.15% were used. Test fungicides were incorporated into PDA media before inoculating with the relevant microorganism, using mycelial discs (No. 04 cork borer). They were incubated at 25°C for five days and the radial growth of the organisms was measured periodically.

1.3.2.1 PP/BC3/01 - Effect of Bitertanol

Bitertanol did not have any effect on the growth of the three beneficial (saprophytic) fungal species; *Trichoderma pseudokoningii, Aspergillus niger* and *Penicillium aurantiogriseum.* All three organisms were fully grown, covering the entire surface of the petri-dish, at the end of the incubation period. There was no difference in any of the concentrations used.

However, variations in growth were observed in *P. hypolateritia* and in *R. lignosus* with increasing concentration of the fungicide.

TABLE 4 - *Radial growth (cm) of P. hypolateritia and R.lignosus at different concentrations of Bitertanol*

Pathogen	Concentration of fungicide tested			Control
	0.05%	0.1%	0.15%	
Poria hypolateritia	2.1±0.2	1.1±0.1	0.0	6.1±0.2
Rigidoporus lignosus	7.2±0.1	7.5±0.3	7.0±0.2	8.1±0.1

1.3.2.2 PP/BC4/01 - Effect of Tridemorph

Tridemorph completely controlled the growth *in vitro* of *P. hypolateritia* and *R. lignosus* at all concentrations tested.

A. niger and *P. aurantiogriseum* did not grow in the three concentrations tested. Signs of growth was observed in *T. pseudokoningii* plates in all concentrations at the end of the five-day incubation period. Therefore, the incubation was continued with periodic measurement of diameter.

TABLE 5 - *Radial growth (cm) of T. pseudokoningii. at different concentrations of Tridemorph*

Incubation period	Concentration of fungicide tested			Control
	0.05%	0.1%	0.15%	
After 10 days	1.5±0.03	1.3±0.0	1.2±0.1	9.0±0.0
After 20 days	2.3±0.0	1.9±0.1	2.1±0.2	9.0±0.0

The control treatment sporulated after ten days, whereas treated plates did not produce any spores. When examined through the microscope, the following features were observed in the cultures grown on Tridemorph.

1. Mycelial strands of cultures grown in the concentrations 0.05% and 0.1% were thicker than that of the control.

2. There was a brownish tinge in the mycelium grown in the presence of Tridemorph.

3. The mycelial walls of the fungus grown in Tridemorph-treated medium showed a rugged appearance

4. Structures resembling budding (vegetative propagules) were formed along the mycelial walls

TABLE 6 - *Average thickness of T. pseudokoningii. mycellium in micrones*

	Concentration of fungicide tested			Control
	0.05%	0.1%	0.15%	
Average thickness (ĩ)	2.19	3.60	1.60	1.50

1.3.2.3 PP/BC4/01 - Effect of Propiconazol

Propiconazole completely controlled the growth *in vitro* of *P. hypolateritia* and *R. lignosus* at all concentrations tested.

A. niger and *P. aurantiogriseum* did not show any growth at the three concentrations of the fungicide tested. Signs of growth was observed in *T. pseudokoningii* plates at all concentrations, at the end of the five day incubation period. Therefore, they were incubated for a continued period for the measurement of radial growth periodically.

TABLE 7 - *Radial growth (cm) of T. pseudokoningii. at different concentrations of Propiconazol*

Incubation period	Concentration of fungicide tested			Control
	0.05%	0.1%	0.15%	
After 10 days	2.4±0.0	1.9±0.03	1.6±0.1	9.0±0.0
After 20 days	4.7±0.4	4.8±0.3	3.8±0.1	9.0±0.0

When examined through the microscope characteristics similar to that observed with the Tridemorph treated cultures were experienced. In addition, there were a heavy presence of clamidospores, in the fungicide treated cultures.

TABLE 8 - *Average thickness of T. pseudokoningii. mycellium in micrones*

	Concentration of fungicide tested			Control
	0.05%	0.1%	0.15%	
Average thickness (μ)	2.15	2.15	1.4	1.5

1.3.3 PP/BC4/01 - *In vitro* inoculations

Autoclaved root pieces (about 5cm) were inoculated with mycelial disks of *T. pseudokoningii, A. niger* and *P. aurantiogriseum* species (No 04-cork borer) and incubated for two days. After two days they were inoculated with *Rigidoporus lignosus* (No 04 cork borer) and incubated at 25°C. After seven days of incubation it was observed that *T. pseudokoningii* restricted the growth of *R. lignosus*. While it was capable of growing over the established *A. niger* and *P. aurantiogriseum* infections, thus showing they were inefficient in the control of pathogen.

T. pseudokoningii and *A. niger* exhibited very good control on the infections by *Poria hypolateritia, invitro*. But with time, the pathogen was able to overcome the initial suppression caused by *P. aurantiogriseum* on its growth.

1.3.4 PP/BC5/01 - Bio-conversion of common-tea-garden organic materials

A series of experiments using these same organisms was completed with the involvement of an undergraduate from the Jaffna University, in which the efficacy of bio-conversion was assayed on material such as tea litter, mana grass and an assortment of weeds. These studies concentrated on two *in vitro* experiments, one in the laboratory in the absence of soil and the other in the glass house in the presence of soil. *T. pseudokoningii* and *A. niger* were proved to be more efficient in bringing about bio-degradation of the above materials.

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1.4 PROJECT A-23.2. Screening and Multiplication of VAM

Objective: To decide the best possible potting mixture (medium) for the multiplication of VAM under local conditions with a view to introducing in the planting hole of tea, in order to reduce root disease disorders.

Twelve large containers were prepared mixing equal volumes of a natural compost mixture. Naturally occurring VAM spore counts were taken in each of the containment. The twelve compartments were planted with six common weed species (in two replicates) picked from St Coombs Estate. Each individual species was selected for its individual special characteristic features.

Soil samples collected from individual plots/tanks (12) were given to SPND for the analysis of pH, N, P, K, Ca, Mg, S etc. Only three of the weed species showed promise in their biomass during and at the end of six month's period. Two species, which showed profuse growth had to be harvested (cut back) once, in between this period. They were dried, weighed and stored for chemical analysis later. All three species were harvested at the end of six months and the material pooled together for chemical analysis.

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1.5 PROJECT A-23.3. VAM as a Nutrient Improviser and an IPM Tool

Objective: To confirm preliminary findings in which mycorrhizal treatments improved P utilization efficiency and also to test the degree of tolerance VAM could impart to the young tea root systems against early-field-establishment problems.

The topsoil, collected from St Coombs Estate was fumigated using Basamid. Further activities were not possible as the officer assigned to this activity was involved in the Open University course from time to time. This will be continued in the year 2002.

2. SUPPORTIVE PROJECTS

2.1 PROJECT D-21 (D/LEAFDC) – Leaf Disease Control

2.1.1 Screening *Camellia sasanqua* for blister resistance

A series of observations made in the field and in the laboratory, on the variety of *Camellia sasanqua* revealed that this is very resistant to blister blight leaf disease. The following combinations of inoculation were made on young healthy leaves of *Camellia sasanqua* using blister spores *in vitro*.

a. Upper surface whole leaf

b. Lower surface whole leaf

c. Upper surface upper half of the leaves

d. Lower surface upper half of the leaves

e. Upper surface lower half of the leaves

f. Lower surface lower half of the leaves

Inoculated leaves were only able to produce tiny yellow/red (translucent) specks, identical to those that were seen under normal field conditions.

2.1.2 An unusual leaf spotting

An unusual leaf spotting was reported from Campion Estate. Earlier it was thought to be an entomological problem. The isolated fungal organisms (two) were not able to reproduce any symptoms on their own. Since this was found on clone N2, nursery plants of the same clone was obtained from Norwood Estate for the glass house trials. The results of this investigation were inconclusive. A future occurrence has to be awaited for further studies. Meanwhile the problem disappeared in the field, where it was first reported.

2.1.3 Tea leaf surface microorganisms

Isolation work was started with a view to monitor their population-build up with changing weather patterns (seasons) and to test the effect of commonly used fungicides on them. The information derived from the latter will be used to rank the presently recommended fungicides on account of their eco-friendliness. This concept was tested earlier and was found to be very useful. About 15 different fungal species were collected and they are in stock cultures at present awaiting their screening against *E.vexans* and the fungicides

Repeated attempts were also made to make leaf extracts for incorporating into culture media, for the purpose of growing *E.vexans* spores on media.

2.1.4 Tridemorph exposure/residue studies

Calixin (active ingredient tridemorph) is one of the systemic fungicides, which is recommended for the control of Blister Blight. It belongs to the chemical group of morpholine derivatives. Tridemorph is a colourless to weak light Yellow fluid. It is formulated as an emulsifiable concentrate with 75% active ingredient and forms a stable emulsion with water.

Tridemorph can enter the human body through the skin and by inhalation. It was recently reported that direct exposure to tridemorph could result in developmental toxicity in pregnant women. Therefore, women of childbearing age are advised to avoid exposure to tridemorph products.

In order to find out how much of tridemorph is left and for how long on the crop canopy, an investigative study was undertaken with funding from the local agent. It was also intended to analyse the exposure residues of the product on human body parts, at different time intervals.

Two plots of one-hectare each were sprayed with Calixin (75%) at the recommended rate of 170ml diluted in 170L water/ha. In plot number one, two sets of approximately 100g of flush/leaves were plucked; one from the plucking table (plot No 01) and the second from either side of the inter-row, to determine the wash off residues of leaves that will come into contact with the hands and arms of tea pluckers. Plucking was done at 2, 4, 6, 8 and 10 days after application. Each leaf sample was washed in one liter of distilled water. The second plot was plucked after five (05) days of fungicide application using ten (10) pluckers; five of them wearing short sleeved dress and the balance wearing long sleeved dress. At the end of plucking, hands and arms of each plucker were washed in one liter of distilled water. Leaf and human hand washings were sent to the Industrial technology Institute (ITI) for the analysis of tridemorph residues. The analytical results are awaited.

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2.2 PROJECT D-22 (D/STEMDC) - Stem Disease Control

2.2.1 Wood Rot

2.2.1.1 PP/WRH4/96 - Observational experiment on training of bush frame (Nuwara Eliya Estate - Oliphant Division).

Objective: To discourage any new shoots arising at or near ground level of the bush, by periodic removal when they are still tender. In this manner it is intended to maintain a clearance from ground to the branching-off point (neck effect) so that, in the event of any future infection by Hypoxylon, the total infection could be removed through the process known as rejuvenation pruning.

Visited this trial on six occasions during the year, effecting the necessary treatments. There is no sign of any Hypoxylon Stem Blight infections yet.

2.2.1.2 PP/WRG1/99 - Replicated experiment to assess the effect of different protective paints in reducing the extent of wood-rot (St Coombs - Field 8).

Objective: Since pruning cuts serve as one of the main focal points in wood rotting, different protective paints were used to establish a suitable method to quantify such decay, under different treatments.

There was no new activity in this trial as pruning is awaited before the next round of wood rot assessments.

2.2.1.3 PP/WRG1/00 – Assessment of wood rot in SPND trial, treated with different levels of fertilizers with special reference to the levels of K (Tokatiyamulla Estate).

Objective: It is often argued that K has an important role in the wood matrix, which should among other things resist decay of wood frame caused by the involvement of natural microorganisms. It is aimed at assessing this phenomenon, using an already available trial of the SPND, where different levels of K, is being maintained.

The repeat exercise in a similar trial in Houpe Estate in Ratnapura was not possible due to unforeseen circumstances.

2.3 PROJECT D-24 (D/PNDC) – Phloem Necrosis Disease Control

Objective: This being the only known virus related disease on tea, it did not receive much priority lately, due to its limited spread. It is intended here to identify the causal organism with certainty, with the possibility of recommending remedial measures.

The activities connected with this trial were put in abeyance due to budgetary constraints.

2.4 PROJECT D-25 (D/MISCEL) - Miscellaneous Activities

2.4.1 PP/HHB1/00 - Horse Hair Blight (HHB)

Objective: It was known for a long time that the fungus causing HHB is an epiphyte, not capable of causing any disease on the tea bush. Since of late, the incidence of this has been pronounced, causing alarm among growers in the low country districts. In view of this, it was intended to start a series of experiments to investigate, whether there is any direct damage to tea by this organism and also to undertake possible control measures, using fungicides, to bring down the incidence.

In the *in vitro* studies it was found that both Propiconazole (Tilt) and Champion [$Cu(OH)_2$] controlled the growth of the mycelia *Marasmius equicrinis*, which causes HHB. But apparently these same fungicides failed to control the spread of rhisomorphus strands ('horse hairs') *in situ*.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake

2.4.2 High-forest problem

Objective: To understand the exact nature of the problem and to come out with remedial measures the following line of investigations were undertaken

a. Two affected patches were monitored throughout the year with application of Plantomycin (Streptomycin Sulfate and Tetracycline hydrochloride) and Captan (Phthalimide fungicide). The treatments did not yield any notable observations except that in the Captan treated patch the symptoms did not spread as fast, compared to the non-treated patch.

b. A large number of stem and root sections/pieces were obtained from affected as well as unaffected plant parts of the same clone (Nuwara Eliya & St.Coombs Estates) and their morphological and microbiological affiliations were compared. The affected sections of the stems showed a relatively high proportion of darkened spots in the xylem area.

c. The organisms isolated from these sections were sent to the IMI for necessary identification.

2.4.3 Smut of *Panicum repens*

Objective: A natural fungal infection of *Panicum repens* was found to occur in the neighbourhood of St Coombs Estate. Since this fungus causes a smut of its panicle, the situation is considered a favourable one, in the control of *P. repens* weed, in the tea plantations. In this exercise it is intended to test and quantify the significance of this phenomenon as a biological weed control tool.

The tentative identification of the causal fungus is *Ustilago digitariae.*

Trial plots were prepared by removing all the rhizomes present, sprayed with Glyposate (1%) in 1/3 m wide strip around each bed in order to ascertain that it remains free from any rhizomes. These plots were kept under observation for the past 6 months.

2.4.4 Tea cider

Objective: Kombucha fungus has the potential to yield an alcoholic beverage of about 1% strength. It is intended here to maintain this fungus for any interested parties while refining its growth requirements.

The Cider culture can be maintained for a period of three months in the same tea decoction containing 10% sugar. New layers of the inoculum are formed until the third month.

Cotton wool plugs proved to be a better stopper to cover the vessel containing cider medium compared with polyethylene sheets or cotton cloth.

A Balasuriya, J W K K Jayasundara

2.4.5 Fungal infections of tea tortrix larvae

A field (No 6) in Stony-Cliff Estate had a heavy infestation of tea tortrix larvae and it was reported by the Manager that the infestation was under control without any chemical treatment. Very high percentage (80%) of diseased caterpillars were found dead/infected in the field. Four fungal species suspected to be entomopathogenic were isolated from the dead caterpillars. The fungal cultures are preserved for future testing.

A Balasuriya, B A P Cooray

2.4.6 Identification of Organisms

Six isolates (3 fungal, 2 bacterial and 1 yeast) were sent to the CABI Bioscience Centre in the UK for identification purposes. They have received five cultures in good condition. Confirmed identifications are awaited.

3. DIVISIONAL ACTIVITIES (OVERHEADS)

3.1 PROJECT D/PLPA

3.1.1 Estate Visits

The following estate visits were undertaken during the year;

Stony-Cliff Estate, combined with Advisory Division, on a problem of bush debilitation.

Campion Estate, on a problem of leaf spotting of doubtful nature.

Moray Estate to explore possibility of collaborative studies connected with Poria.

Several visits to Nuwara Eliya and High Forest Estates, in connection with the High Forest problem.

Hanford, Aningkanda and Kiruwanaganga Estates; exploratory visits on the Deniyaya problem. .

Several small holders in Kottawa area, to initiate a radio programme on the occurrence and the spread of horse-hair blight (HHB) problem.

Several visits to Hulandawa Estate on screening of OST bushes with resistance to canker

Several visits to Diyagama East Estate, on screening of OST bushes with resistance to blister blight

Maliboda Estate, on assessing bi-clonal seedlings for the resistance of canker

Razeena Estate on patchy debilitation/death of TRI 2026 bushes.

3.1.2 Seminars/Workshops/Lectures

Divisional staff attended seminars conducted by the following:

Dr L Manivel, Horticultural Consultancy Services of India on plant nutrition.

Ms S I Vitarana, and Mr C C Mawilmada of TRI on Agricultural Research & Financial Management.

Drs Liiyanage and Krishnarathne of Sarvodaya movement on Organic Farming.

The eigth Sinhala E&E forum.

Dr Balasuriya was involved in the following activities during the year;

Recorded for broadcast, a fifteen-minute-discussion (in the field) for the 'Lak handa' radio service, in conjunction with the Advisory & Extension Division, on the problem of HHB disease, in low country, targeted for the small holders.

Attended a three-day Workshop on Environmental Impact Assessment (EIA), organized and conducted by the Central Environment Authority (CEA), in Athurugiriya (NIPM).

Conducted a three-hour lecture on common diseases and their control for the NIPM training module.

Addressed Passara PA annual general meeting, on the significance of major root diseases and their control.

Made presentations on 'Some factors affecting Deniyaya yield decline' at the 203rd E&E forum and at the RSC seminar in Ratnapura.

Organised, through the Research Leaders' Forum (RLF) of the National Science and Technology Commission (NASTEC) and took active part in a workshop on SWOT analysis of the Sri Lankan R&D institutions.

Dr Balasuriya also attended the following;

Workshop on National Priorities on Plant Protection and was elected to represent the TRI (plantation sector) on the proposed Plant Protection Assosiation of Sri Lanka.

Attended Public Lecture on 'Categorisation, Prediction and Prevention of Alien pests and Plant Quarantine', at SLAAS auditorium, Colombo.

Attended workshop on Bio-pesticides, conducted by the NSF in Colombo.

Attended workshop at the BMICH, on Development and Evaluation of a user-friendly harvesting system for the Sri Lankan tea industry, sponsored by the TRI.

A month long training programme on Agricultural Research Management conducted by the PGIA, under the auspices of the Ministry of Foreign Affairs.

Attended the inaugural sessions of the 13th Annual Congress of the PGIA, Peradeniya.

Attended most part of the 57th annual scientific sessions of the SLAAS in Moratuwa University.

3.1.3 Meetings/Discussions

Dr Balasuriya was involved in the following;

Elected as rapporteur, Section B of the SLAAS and attended 5 committee meetings and reviewed 15 abstracts for publication in the proceedings of the 57th annual sessions.

Elected as a steering committee member of the Research Leaders Forum organized by the NASTEC and attended three steering committee meetings.

Coordinated four HOD meetings of the TRI.

Divisional staff attended three Grades I-V meeting.

Attended eight SLAAS committee meetings (in the capacity of rapporteur).

Participated in one TRI/TSHDA interactive meeting.

Coordinated work connected with the revision of Corporate Plan for the 2002 and onwards and prepared the final draft for the Director.

Took part in two Advisory & Research linkage meetings.

Participated in one Sinhala and one English E&E preview discussions.

3.1.4 Overseas visits/presentations

Dr Balasuriya attended a four week advanced training programme on Tea Plantation Management, sponsored by the Commonwealth Fund for Technical Corporation held in Coonor, India in January. Dr Balasuriya also made a presentation by invitation, at the International Symposium on Tea Science, sponsored by the UPASI Tea Research Foundation on the occasion of its Platinum Jubilee, held in Chennai, India, in February.

3.1.5 Visitors/Trainees

A group of students from Aquinas College, Colombo visited the Division for practical demonstrations.

A group of 25 undergraduate students from the Eastern University, visited the Division on a familiarization tour.

Received two groups of undergraduates for demonstrations, from the faculties of Agriculture of the Eastern and Jaffna Universities.

Five planter trainees from Maskeliya Plantations Ltd., exposed themselves to a short training in the Division.

A planting executive from Horana Plantations Ltd., spent one day in the Division for an exposure.

Mr Andrew White of Merck Eurolab Ltd., visited the Division accompanied by Mr Michael Vanhoff of Hemsons Ltd.

3.1.6 New Capital Items

Division obtained a shaking water bath.

Received connection to the Internet, through two terminals in the Division.

3.1.7 Publications

Balasuriya A, Wimaladasa G D, Ratnayake R M A, 2000. Effect of application of NPK fertilizers on the natural incidence of Vesicular Arbuscular Mycorrhiza in the rhizosphere soils and feeder roots of tea (*Camellia sinensis*). S.L.J Tea Sci., 66(1/2): 61-68.

Balasuriya A, Jayasundara J W K K, Ratnayake R M A, 2001. Horse Hair Blight of Tea. TRI Update, 6(1).

Balasuriya A, Pallemulla R M D T, Ratnayake R M A, 2001. Blister Blight Field Assessments – A new approach. TRI Update, 6(2).

4. General

Ms B A P Cooray assumed duties as Research Assistant filling up the vacancy of Mr T S Gunasekare who failed to report back after his post graduate studies.

Mr R G Vijayaratnam, an undergraduate trainee from the Faculty of Agriculture, University of Jaffna, completed his final year project work from April to August. Mr R M A Ratnayake (EO) continued his part time training course on laboratory technology with the Open University in Nawala.

Two Technical Assistants were assigned to the division, with effect from 4th September 2001.

PLANT PHYSIOLOGY DIVISION

A.Anandacoomaraswamy
Acting Head of Division

1.Basic Research Projects

1.1 B 11-Studies on Photosynthesis and Dry Matter Partitioning

Partitioning of assimilates in relation to aging of clonal tea in a pruning cycle, St Coombs Estate – (1992)

The annual yield of clones TRI 2025 and DT1 with age is presented in Table 1.

TABLE 1 - *Effect of age on yield (kg MT ha^{-1})*

Clone	TRI 2025	DT1
Year after Prune		
1	964	741
2	2438	2086
3	2529	1981
4	1565	1812
LSD(P=0.05)	150.1	128.2
SE	215.8	166.8
CV(%)	11.5	10.1

Like previous years, the yield increased from 1st year to second year and remained steady in the 3rd year. TRI 2025 gave higher yield than DT1. Higher yield of TRI 2025 may be attributed to higher shoot percentage, lower thermal time, higher shoot growth rate and higher number of dormant shoots per unit area

Sithakaran V

2. Experiments on shade effects and shade trees

2.1 Photoinhibition of photosynthesis in tea

Daily changes in photosynthetic rates in tea show a midday depression, and the causal factors are to be identified. It was hypothesized that this is due to the photoinhibition of photosynthesis. This study was carried out to investigate whether photoinhibition really occurs in tea and to evaluate the shade effects on photosynthesis and photoinhibition.

Three treatments were used: artificial shade, shade tree (*Grevillea robusta)* and unshaded. Photosynthesis and chlorophyll fluorescence measurements were made starting from before dawn until dusk to evaluate the effect of photoinhibition.

The results confirmed the midday depression of photosynthesis. Unshaded treatment showed consistently lower rates of photosynthesis than the two shaded treatments, which showed similar values. The Fv/Fm was measured to be high (0.8) before dawn, decreased with time, and was lowest around midday in all treatments, and again increased towards afternoon. Unshaded Fv/Fm was consistently lower than the shaded treatments and did not reach the values of the shaded even during the night, suggesting the damage to the photosystem II caused by high light intensity is of permanent nature. Other factors measured, namely stomatal conductance, leaf water potential, leaf temperature, vapor pressure deficit, did not affect photosynthesis.

Results revealed that photoinhibition of photosynthesis occurs in tea and it is the main causal factor for the midday depression. Having shade trees decreases the incident radiation thereby decreasing photoinhibition, resulting in increased rates of photosynthesis under shade.

S. Gunasinghe, A. J. Mohotti, S. Navaratne and D. C. Bandara

2.2 Alternate shade tree species

2.2.1 Possible new shade tree species

A thorough literature survey was done to prepare a list of possible species that can be used as alternate shade species to the existing ones.

The feasibility of using these species in tea plantations is being studied.

A. J. Mohotti, H. P. Ratnatsiri and H. P. Beddage

2.2.2 Growth and yield of tea under some tree species grown for shade in tea estates

2.2.2.1 Techoma stans (Kelenitissa)

Techoma as a medium shade tree species is being used in Roeberry Estate, Madulsima. It is not being attacked by goats, which is a problem there with the recommended species of shade.

Plots containing approximately 30 plants around the shade trees were marked out. Plots with Erythrina lithosperma as the shade tree and unshaded plots also were marked as the control. Shoot growth and yield of these plots are monitored.

The experiment is in progress.

Rajakaruna, V. S. Sithakaran and A. J. Mohotti

2.2.2.2. *Alstonia macrophylla* (Hawari nuga) and *Michelia champaca* (*Gini sapu*)

In Porawa Estate, Ginigathena, high shade species *Albizzia moluccana* and two other alternative tree species, namely *Alstonia macrophylla* (Hawari nuga) and *Michelia champaca* (Gini sapu) are used as shade trees for tea. Around these shade trees and unshaded areas, plots containing approximately 30 plants were marked out and shoot growth and yield were monitored.

Shoot dry weight and yield increased with shade compared to unshaded with a corresponding increase in shoot dry weight and shoot extension rate. Shoot density increased under unshaded condition, but shoot dry weight, shoot extension rate and the proportion of active buds decreased. Tea under *Alstonia macrophylla* gave the highest yield and *Albizzia moluccana* the lowest yield between different shade tree species. The shoot dry weight was highest under *Albizzia moluccana* but they had the lowest shoot density.

H. P. Ratnasiri, A. J. Mohotti, V. S. Sithakaran and U. R. Sangakkara

3 Experiments on 'High Forest Problem'

3.1 Examining the samples for possible pathogens

Several scientists around the world who have worked on pathological anatomy were contacted after the observation of the 'tyloses' formed in the affected plants (Annual Report, 2000). These scientists included Prof S. Fink from Germany (Author of Pathological and Regenerative Plant Anatomy, Encyclopedia of Plant Anatomy, 1999), Dr J Waller and Dr Mike Rutherford from CABI, UK. According to their opinion, the samples needed to be re-checked for any possible pathogens. The Plant Clinic of the CABI Bio Sciences, UK offered to do this without a charge.

An interim report was sent by Dr J Waller, Consultant Plant Pathologist, CABI Bio Sciences, UK, and a basidiomycete fungus *Phellinus noxious*, pathogen causing brown root rot was reported to have been isolated from the affected samples sent from the High Forest Estate. The final report is yet to be received.

J. Mohotti and S. Navaratne

3.2 Glass house experiments with different extracts of xylem sap of affected bushes

Experiment 1:

The xylem sap and different parts of the bush (stem bark, stem without bark, whole stem and roots) were extracted using different solvents, namely hexane, di-chloro methane and methanol, from affected and unaffected bushes from High Forest and Nuwara Eliya Estates. These extracts were separately mixed with autoclaved soil from St Coombs estate. One-year-old plants of the susceptible clone TRI 2025 and DN as non-susceptible clone were planted in these soils. In addition, fresh xylem sap, xylem+phloem sap was also mixed with soil as treatments (Annual Report, 2000).

No symptoms were developed in any of the plants for a period of 22 months

M. D. L. P. Gunatilake, S. Navaratne, J. Mohotti and B. P. Chandradasa

Experiment 2:

Xylem sap was poured on the young tea plants of the above two clones of same age after scraping the leaves, the stems and roots, without wounding the plants, and by direct injection of the sap to the stems. A control was left without adding the xylem sap.

No symptoms were developed in any of the plants for a period of 14 months.

S. Navaratne and J Mohotti

Experiment 3

Water was applied at weekly interval to the part of the affected area in the field at High Forest Estate during the dry weather period of June –August. Further, affected area was mulched so that there was no exposure of ground surface. Some of the plants were shaded during the dry months. Most of the affected plants showed the signs of recovery by the early November. By the end of December, most of the plants had recovered.

A.Anandacoomaraswamy, DMS Navaratne

4. Studies on organic tea

Studies were undertaken to examine tea shoot growth after pruning in different production systems. Growth parameters of conventional and organic tea were compared. Yield of each treatment and weather data were monitored.

Plant grown with neem oil cake had a lower shoot growth rate than that of other treatments, but number of shoots per bush were similar in all the treatments. Due to longer shoots of plants after pruning to tipping stage, the highest tipping weight was recorded in plants grown with tea waste.

T. M. M. P. Thennakoon, J. Mohotti, K. Mohotti and U. R. Sangakkara

5. Effect of change in level of carbondioxide on physiological process and growth of tea

Two experiments were conducted with nursery and mature plants of TRI 2025. Plants were grown for three months under polythene cover with CO_2 levels ranging from 350-380ppmv for young tea and 310-370ppmv for mature tea. In young tea was growth was measured in terms of height, girth, dry weight, specific leaf weight and root shoot ratio. Transpiration, soil moisture, leaf conductance and yield was measured for mature tea. In young tea specific leaf weight increased with increase in CO_2 while root/shoot ratio decreased. Leaf carbon, nitrogen and phosphorus increased with level while, leaf potassium, conductance, transpiration and yield decreased for mature tea

A.Anandacoomaraswamy and Kaniciusra Anthers

6. Publications:

1. Gunawardena V. L., Mohotti A.J., Bandara D.C. and Navaratne D.M.S. (2001). Photosynthesis and Some Related Processes of Young Tea (*Camellia sinensis* L.) As Affected by Short-term Water Deficit, Proceedings of the 57th Annual Session, Sri Lanka Association for the Advancement of Science.

2. Mohotti A.J., Mohotti K.M., Premaratne M.P.T. and Sangakkara U. R. (2001). Comparison of Yield and its Components of Tea Supplemented with Various Manures under Organic and Conventional Cultivation. Proceedings of the 5th IFOAM-Asia Scientific Conference held in October 31st-November 4th, Hangzhou, China, 89-92.

3. Mohotti A.J. and Lawlor D.W. Photoinhibition and Diurnal Variation of Photosynthesis in Tea and the Effect of Irradiance and Nitrogen Supply during Growth in the Field. Accepted for publication in Journal of Experimental Botany, February 2002.

PLANT PROPAGATION AND BREEDING DIVISION

V. Shanmugarajah
Officer-in-Charge

RESEARCH ACTIVITIES

1. Thrust A 1 – Development of clones for the up-country

Project 1.1 Evaluation of clones for up-country

1.1.1 Phase I trials

1.1.2 Phase II trials

1.1.3 Phase III trials: Regional testing of clones

1.1.4 Evaluation of TRI 3000 and 4000 series clones in Venture Estate, Norwood

1.1.5 Evaluation of TRI 3000 and 4000 series clones in Luckyland Estate, Udapussellawa

1.1.6 Selection

Project 1.5 Screening for quality

Project 1.6 Screening lines for nematodes

2. Thrust A 2 - Development of clones for the mid-country

Project 2.1 Evaluation of clones for the mid-country wet zone

2.1.1 Regional evaluation of TRI 3000 and 4000 series clones in phase III trials at TSHDA, Sooriyagoda

Project 2.5 Screening lines for nematodes

3. Thrust A 3 – Development of clones for the mid-country semi-dry zone

Project 3.1 Evaluation of clones for the mid-country semi-dry zone

4. Thrust A 4 – Development of clones for the low-country

Project 4.1 Evaluation of clones for the low country

4.1.1 Phase I trials

4.1.2 Phase II trials

Project 4.2 Screening lines for resistance to SHB, LCWT and Stem Canker (Macrophoma)

4.2.1 LVP 74 (LVP 30/LC/2) - Handford selection at Deniyaya station

4.2.2 LVP 75 (Phase II trial) at St Joachim Estate

5. Thrust A 5 – A 8 Development of bi-clonal and polyclonal cultivars

Project A 5.1 Development of seed varieties for up-country

Project A 6.1 Development of seed varieties for the mid country wet zone

Project A 7.1 Development of seed varieties for the mid country semi-dry zone

Project A 8.1 Development of seed varieties for the low-country

6. Other experiments

6.1 Characterization of germplasm

  6.1.1 Morphological characterization of tea accessions

6.2 Characterization and evaluation of *Camellia sasanqua*

  6.2.1 Evaluation of biotic stresses

6.3 Duplication of germplasm

6.4. Polyploidy breding

  6.4.1 Induction of polyploids

  6.4.2 Rapid screening method for identification of polyploids

6.5 Nursery trials

  6.5.1 Up-country

    (a) Effect of different sizes of bags on the growth of cuttings

    (b) Comparison of TRI recommendations with that of Indian practice in the nursery

  6.5.2 Low-country

    (a) Comparison of shoot and root growth of some TRI 3000 and 4000 series clones in the nursery

6.6 Evaluation of the performance of seed stocks planted by the estates – Aislaby Estate

7. Project D 1 – Use of *in vitro* techniques

7.1 Development of embryo rescue technique

  (a) Inter-specific hybridization

  (b) Monitoring fruit development to aid embryo rescue

  (c) Immature embryo culture

7.2 Somatic embryogenesis

7.3 Quantification of plantlet formation and shoot multiplication in seedling material

7.4 Callus cultures

7.5 *In vitro* induction of mutants by gamma rays

7.6 Use of poly-house and coir pots for hardening tissue-cultured plants

8. Issue of cuttings

8.1 Up-country

8.1.1 Issue of shoots for estates and small holders

8.1.2 Summary of issue of shoots for ADB Mother Bush Project

8.2 Low-country

8.2.1 Issue of shoots for estates and small holders

8.2.2 Summary of issue of shoots for ADB Mother Bush Project

9. Other Activities

9.1 Other Divisional Activities

9.2 Visitors

9.3 Worshops/Seminars/Training Programs/Meetings attended

9.4 Publications/ Posters

9.5 Papers submitted

9.6 Training programs conducted

9.7 Services

9.8 Correspondence

General

- Evaluation of 1029 lines in the up country, Uva and low country was undertaken to develop region specific clones
- Selection of promising bushes from the old seedling fields was carried out.
- Assessment of quality of the 36 genotypes in the Phase II trial at St Coombs was carried out and 9 of them were found to be of high quality.
- Measures were taken to create genetic variability and to broaden genetic base by establishing micro-seed gardens in the form of crossing blocks. Seven such gardens were established.
- Morphological characterisation of 31 accessions resulted in distinguishing three main phenotypic groups.
- A part of the germplasm at Talawakelle was duplicated at Kottawa.
- Method of colchicine treatment for apical buds was perfected for inducing polyploids in tea.

- A technique was perfected for early screening of polyploid clones.
- Commenced evaluating performance of mature bushes of seed stocks already available in estates, for use as seed cultivars.
- An experimental protocol has been worked out to recover plants *in vitro* from immature zygotic embryos.
- Preparation of herbarium and a clonal album is underway
- Major portion of the cuttings of the TRI 3000 and 4000 series clones were issued to the clonal Mother Bush Project of the ADB. Cuttings were also issued to some estates and small holders.
- A document on the distribution of cuttings of TRI 3000 and 4000 series clones was published.

Towards meeting the objectives of the TRI Corporate Plan 1999 – 2003, the following activities were undertaken by the Division.

1. Thrust A 1 - Development of clones for the up-country

Project 1.1 - Evaluation of clones for the up-country

Of the 503 genotypes evaluated under Phase I trial, 56 were found promising (Table 1). Average cycle yields of the bushes of three trials, which have completed one pruning cycle, are given in Table 2.

Of the 73 genotypes evaluated under Phase II trial, 13 were found promising of which 1 – 2 are expected to be released on completion of the trials (Table 3).

1.1.1 Phase I trials

A new Phase I trial was established and the details are as follows:

Location: Field No. 10 , St Coombs

Date of planting: 19.9.2001

No. of accessions: 45

Control clone: TRI 2025

Design: CRD

TABLE 1 - *Clones under evaluation for the up-country*

Serial No.	Trial No.	Year of planting	Origin #	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control Clones	Yield of the control clones (kg MT ha^{-1})
1.1.1	VP 71	1994	A	Field No. 14 St. Coombs	First cycle completed. See Table 2				
1.1.2	VP 72	1994	B	Field No. 14 St. Coombs	First cycle completed. See Table 2				
1.1.3	VP 73	1994	C	Field No. 14 St. Coombs	First cycle completed. See Table 2				
1.1.4	VP75	1995	N	Field No. 14 St. Coombs	28	02	3145-3188	2025	3031
1.1.5	VP 76	1995	O	Field No. 14 St. Coombs	58	14	2960-4082	2025	2964
1.1.6	VP 77	1996	P	Field No.12 St. Coombs	121	4	3427 - 4300	2025	3426
1.1.7	VP78	1996	K	Field No.12 St. Coombs	210	20	2300 - 2600	2025	2300
1.1.8	VP82	1998	F	Field No.12 St. Coombs	46	16	2103 - 3000	4052 2025	2086 1651
1.1.9	VP 84	2000	R	Field No.10 St. Coombs	40	--	--	-	-
Total					503	56			

Refer foot note under Table 3

TABLE 2 - *Cycle yields of Phase I trials completed*

VP 71 Genotypes selected for Phase II trial	Average cycle yield (kg MT ha^{-1})	VP 72 Genotypes selected for the Phase II trial	Average cycle yield (kg MT ha^{-1})	VP 73 Genotypes selected for the Phase II trial	Average cycle yield (kg MT ha^{-1})
2025	**2551**	613	2860	1034	4571
39	2302	814	2814	1035	4178
333	2119	743	2786	909	4125
149	2118	558	2537	963	4072
		700	2410	**2025**	**4414**
		626	2286		
		655	2134		
		571	2082		
		598	2080		
		568	2057		
		561	2018		
		2025	**2012**		
CV	24	CV	22	CV	16.9

1.1. 2 Phase II Trials

A new Phase II trial was established and the details are as follows:
Location: Field No. 10 , St Coombs
Date of planting: 28.8.2001
No. of accessions: 20

Replicates: 4
Control clones: TRI 2025, 4006, 4052 and 4053
Design: RCBD

TABLE 3 - *Clones under evaluation for the up-country*

Serial No.	Trial No.	Year of planting	Origin#	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones	Yields of the control clones (kg MT ha^{-1})
1.3.1	VP 80	1996	D	St. Coombs Field No.12	31	8	1085 - 1553	DN 2025	628 1080
1.3.2	VP 81	1998	E		22	5	1609 - 1833	2024 2025 3016 3072 3073 4052	715 1527 2384 1487 1511 1283
1.3.3	VP 83	2000	A	St. Coombs Field No.10	20	---------	------------	4006 4052 4053 2025	--------
Total					73	13			

Origin of the clones in the pipe line

A - *VP 39 selections* (crosses made in 1980/ 1981 using clones TRI 777, TRI 2025, TRI, 2026, ASM 4/10, DT1 and DN)

B - *VP 43 selections* (crosses made in 1982/ 1983 using clones TRI 777, TRI 2025, TRI 2024, TRI 2023, TRI 2043, TRI 2142, TRI 62/9, ASM 4/10, DT1, DN, CY9, DT 95, H 1/58, DG 39 and China types)

C - *VP 44 selections* (crosses made in 1984, using clones TRI 777, TRI 2025,TRI 2142, TRI 2143, ASM 4/10, DN, CY9, DT1 and DG 39)

D - *VP 37 selections* (obtained after open pollination of clones TRI 777, TRI 2025, DT1 and TRI 2043)

E - *VP 38 selections* [Bi-clonal seed selection of Aislaby (2025 X 2024), Hugoland (2025 X 2024), Hantane (2025 X 2023) stocks]

F - *VP 65 selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks at Carolina Estate, Watawala (1992)]

G - *LVP 30 Selections* [Bi-clonal seed selections of Aislaby (2025 X 2024) and Hugoland (2025 X 2024)]

H - *LVP 42 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks at Parambe Estate, Kegalle (1989)]

I - *LVP 28 Selections* [Bi-clonal seed selections of Aislaby (2025 X 2023) stock at St. Joachim Estate, Ratnapura (1992)]

J - *Pettigala Selections* [Bi-clonal seed selections of Vykumbura (2025 X DN) stock at Pettigala Estate, Balangoda]

K - *LVP 49 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, at St. Joachim Estate, Ratnapura (1991)]

L - *LVP 45 & 46 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, at St. Joachim Estate Ratnapura (1989 & 1990)]

M - Introduction from Assam, India, in 1988

N - *VP 45 Selections* [Seed stocks obtained from the crosses of 1985 using TRI 777, 2024, 2025, 2142, DT 95]

O - *VP 52 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 9, St. Coombs Estate (1990)]

P - *VP 58 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 9, St. Coombs Estate (1991)]

Q - LVP 69 Selections [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 2A St. Joachim Estate (1994)]

R- VP 74 Selections [Biclonal seeds selections of El Teb (DN X 2025) and Poly clonal seeds selection from Sapumalkanda S106]

V.Shanmugarajah, K.Gunasekare, M.Ratnayake, M.A.B.Ranatunga, R.Paskarathevan, B.A.Rathnagoda, A.K.Mudalige, J.D.Kottawa Arachchi

1.1.3 Phase III trails: Regional testing of clones

Evaluation of TRI 3000 and 4000 series clones in Venture Estate, Norwood

During the first year of the second cycle, of all the clones evaluated under organic cultivation conditions, TRI 4071 continued to yield considerably higher than the control TRI 2025. Clones TRI 3016 and 3019 also have yielded more than the control clone (Table 4).

TABLE 4 - *Mean yield of clones in the 1st pruning cycle and the first year of the 2nd cycle*

Clone	First cycle average (kg MT ha^{-1})	% yield increase or decrease over control	First year of 2nd cycle	
			Average yield (kg MT ha^{-1})	% yield increase or decrease over control
4071	3025	32	3950	60
3072	2554	11	1489	-39
3018	2329	1	942	-61
3016	2329	1	2623	6
2025	**2298**	--	**2462**	-
4063	1900	-17	1437	-41
3069	1893	-18	1507	-38
3073	1770	-23	1679	-31
4052	1634	-29	1973	-19
3015	1409	-39	1694	-31
3019	1399	-39	2788	13
3020	1336	-42	1086	-55
4053	1335	-42	1185	-51
3017	662	-72	1272	-48

1.1.4 Evaluation of TRI 3000 and 4000 series clones in Luckyland Estate, Udapussellawa

Of the 16 clones evaluated under normal estate conditions, 9 yielded more than the control TRI 2025. Clones TRI 3019, 3069 and 4006 have yielded considerably higher than that of TRI 2025 (Table 5).

TABLE 5 - *Yields (kg MT ha^{-1}) of clones in the first cycle*

Clone	Year of the Cycle			Average	% yield increase or decrease over control
	1st year (1999)	2nd year (2000)	3rd year (2001)		
2025	**1082.6**	**4611**	**3639**	**3111**	**0**
3013	1906.3	4320	3142	3126	0.49
3014	2121.3	5163	2700	3328	6.99
3015	1919.1	5673	2530	3374	8.46
3016	1878.8	4840	3193	3304	6.21
3019	2397	5903	3236	3845	23.61
3020	1559	4769	2755	3028	-2.68
3049	2239.6	4612	3395	3416	9.79

3069	2107.2	5086	3401	3531	13.52
3072	2321.7	4609	2304	3078	-1.05
3073	1892.4	4492	2939	3108	-0.1
4006	2391.3	5271	3102	3588	15.34
4052	2196.5	5065	2357	3206	3.06
4053	1945.4	4763	1748	2819	-9.39
4071	1784.8	4661	2075	2840	-8.7
4078	2141.8	4246	2230	2873	-7.66
4079	1567.7	3750	1449	2256	-27.5

1.1.5 Selection

Selection of outstanding bushes from the old seedling fields at the Scrub Division of Pedro estate, Nuwara Eliya was carried out and cuttings from 36 bushes selected were propagated at TRI for evaluation.

Project 1. 5 - Screening for quality

An assessment of the 36 genotypes evaluated under Phase II trial in St Coombs indicated that nine of them were of high quality and 8 were of moderate quality. The number of the high and moderate quality selections are given below.

High quality	Moderate quality
3	21
17	2
33	24
15	16
8	28
23	20
14	27
18	36
4	-

V.Shanmugarajah, M.T.Z.Mohamed*, I.S.B.Abeysinghe**, R.Paskarathevan and B.A.Rathnagoda (* Technologist, ** Biochemist)

Project 1. 6 - Screening lines for nematodes

Evaluation of two clones of TRI 2000 series, five clones of TRI 4000 series and three estate selections for their resistance/susceptibility to *P. loosi* (Nematology division Trial No. reference N1A) was continued. The clones under evaluation are: TRI 2024, 2025, 4042, 4046, 4047, 4052, 4053, DT 95, K 145 and NIL 153.

S.I.Vitarana, M.Ratnayake, D.D. Liyanage, G.P. Udumulla

2. Thrust A 2 - Development of clones for the mid-country wet zone

Project 2.1 - Evaluation of clones for the mid-country wet zone

Regional evaluation of TRI 3000 and 4000 series clones in phase III trial at TSHDA, Sooriyagoda

TRI 4046, 3018 and 4006 performed better than the control, TRI 2025, in the first cycle. However, on an average, all the clones except TRI 3018, 3020 and 4042 have performed better than the control clone TRI 2025 during the second cycle (Table 6). In both the cycles, TRI 4046 gave the highest yield.

TABLE 6 - *Mean yield of clones in the first pruning cycle and year wise yield in the second*

Clone	Yield- 1st cycle Average (kg MT ha^{-1})	% yield increase or decrease over control	Yield 2nd cycle (kg MT ha^{-1})			
			1st Yr.	2nd Yr.	3rd Yr.	Average
4046	5922	34	6843	5974	6606	6474
3018	4918	11	4759	5147	5635	5180
4006	4792	8	5202	4583	5922	5326
2025	**4417**	**0**	**4998**	**5428**	**5467**	**5298**
3015	4369	-1	5489	5340	6109	5646
4042	4162	-6	4520	4548	5419	4829
3013	4247	-4	6864	6316	6132	6437
3020	3864	-13	4926	4302	6132	5120
3014	3849	-13	5151	5143	5620	5305
4053	3619	-18	5145	5536	6213	5631
3019	3556	-20	6907	5087	6097	6030
4047	2583	-42	5066	5939	6137	5714
CV%			21.7	21	18.2	--
LSD			-	1562		
SE			592			

V.Shanmugarajah, U.Sritharan, M.Ratnayake

Project 2. 5 - Screening lines for nematodes

Screening of TRI 2000, 3000, 4000 series clones and estate selections for their resistance/ susceptibility to burrowing nematode (*Radopholus similis*) in mid country wet zone was under taken and the trials were continued.

S.I. Vitarana, U.B. Herath, B. Sureshkumar, P. Udumulla

3. Thrust A 3 - Development of clones for the mid-country semi-dry zone (Uva)

Project 3.1 - Evaluation of clones for the mid-country semi-dry zone

Sixty-four genotypes are under evaluation in Phase I and Phase II trials. On completion of the Phase II trial 2-3 clones may be released (Table 7).

TABLE 7 - *Clones under evaluation in phase I and II trial in mid-country semi-dry zone (Uva)*

Serial No.	Trial No.	Year of planting	Origin*	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg $MTha^{-1}$)	Remarks
3.1 Phase I Trials								
3.1.1	UVP 10	1998	F	Field No. 4 Passara station	40	—	—	Pre-plucking done, yields to be recorded.
Sub-total					40			
3.2 Phase II Trials								
3.2.1	UVP 9	1998	D	Field No. 4 Passara station	24		------	Pre-plucking done, yields to be recorded.
Sub-total					24			
Total					64			

Refer foot note under Table 3

V. Shanmugarajah, J. C. K. Rajasinghe and M. Ratnayake

4. Thrust A 4 - Development of clones for the low-country

Project: 4.1 - Evaluation of clones for the low country

The number of genotypes under evaluation in Phase I trials are 176 (Table 8) and all these were planted during 2000.

The average cycle yields of the promising genotypes of the Phase I trial(s) completed are given in Table 9. As the number of genotypes tested was large, they were planted along with the control clones TRI 2025, 2026 and 2027 in 18 groups. The group numbers are given in parenthesis along with the number of the trial (LVP 73).

4.1.1 Phase I Trials

TABLE 8 - *Clones under evaluation for the low country*

Serial No.	Trial No.	Year of planting	Origin*	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones	Remarks
4.1.1	LVP 84	September 2000	Q	Field No.1 St. Joachim estate	176	---	---	TRI 2026, 2027, 4042	---

TABLE 9 - *Average cycle yields (kg MT ha^{-1}) of promising selections*

LVP 73 (1)		(LVP 73 (2)		LVP 73 (3)		LVP 73 (4)		LVP 73 (5)	
Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield
2026	5385	A39	4818	2026	4615	2026	5143	A130	4711
A31	5070	A41	4551	A71	4613	A101	4710	A125	4125
A10	4609	2026	4436	2027	3485	2027	3415	A139	4055
A1	4600	A50	4131	2025	3160	2025	2460	2026	3779
2025	4015	2027	3558					2027	3007
2027	3010	2025	3529					2025	2659
CV	19.9	CV	16.9	CV	34.4	CV	19.1	CV	32.7

LVP 73 (6)		(LVP 73 (7)		LVP 73 (8)		LVP 73 (9)		LVP 73 (10)	
Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield
2026	5016	2026	5065	B47	5158	B61	5102	2026	5873
A180	4981	B25	4533	2026	5148	B64	4787	B92	5268
A169	4733	2025	3959	B36	5087	2027	4736	2027	3461
2027	4317	2027	3223	B30	5078	2025	3085	2025	3413
2025	3931			B45	5015	2026	2870		
				2027	4302				
				2025	3715				
CV	24.8	CV	15.5	CV	26.5	CV	20.2	CV	32.6

LVP 73 (11)		(LVP 73 (12)		LVP 73 (13)		LVP 73 (14)		LVP 73 (15)	
Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield
C22	5436	2026	7012	D25	3799	2026	5556	2026	5433
C31	5203	C62	6651	2025	3619	D27	4555	G15	5305
C23	5146	2025	4281	2027	3617	2027	3803	G22	5304
C37	5014	2027	3496	2026	3606	2025	2993	G13	5296
C38	4916							2027	4980
2025	4913							2025	3891
2026	4721								
2027	3734								
CV	18.7	CV	16.6	CV	24.5	CV	44.8	CV	27.4

LVP 73 (16) (LVP 73 (17) LVP 73 (18)

Selection No.	Cycle Yield	Selection No.	Cycle Yield	Selection No.	Cycle Yield
2027	5211	119	6384	J9	3772
H18	5162	H37	5107	124	3725
H16	4954	2026	4755	123	3690
H22	4452	2025	3441	2026	3617
2025	4371	2027	3169	2027	3021
H20	4289			2025	2761
2026	3098				
CV	34.1	CV	32.1	CV	31.4

4.1.2 Phase II Trials

Of the 213 genotypes evaluated under Phase II, 20 were planted during 2001 and of the rest 23 are promising (Table 10).

TABLE 10 - *Clones under evaluation for the low country*

Serial No.	Trial No.	Year of planti - ng	Origin#	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones & Yields	Remarks
4.2.1	LVP 74	1997	G	Deniyaya Station	35	3	4053 - 4500	TRI 2026 6051	---
4.2.2	LVP 75 [I]	1997	D		11	4	4078 - 5990	TRI 2025 3833	---
4.2.3	LVP 75 [II]	1997	H		21	1	4947	TRI 2025 4762	---
4.2.4	LVP 75 [III]	1997	I		5	2	4760 - 5200	TRI 2025 4553	---
4.2.5	LVP 75 [IV]	1997	J		8	13	4183 - 7265	TRI 2025 3995	---
4.2.6	LVP 76	1999	H	Field No 1 St. Joachim Estate	22	---	---	---	Due for plucking
4.2.7	LVP 77	1999	L		13	---	---	---	Due for plucking
4.2.8	LVP 78	1999	J		15	---	---	---	Due for plucking
4.2.9	LVP 79	1999	M		6	---	---	---	Due for plucking
4.2.10	LVP 80	2000	A		12	---	---	---	1st Centering was done
4.2.11	LVP 81	2000	B		15	---	---	---	1st Centering was done
4.2.12	LVP 82	2000	C		12	---	---	---	1st Centering was done
4.2.13	LVP 83	2000	L		18	---	---	---	1st Centering was done
4.2.14	LVP 85	2001	A		20	---	---	---	---
Total					213	23	---	---	---

Refer foot note under Table 3

P.D.Upali, A.K.M.Jayasena, J.H.N.Piyasundara, V.Shanmugarajah

Project 4.2 Screening lines for resistance to SHB, LCLWT and Stem Canker (*Macrophoma*)

4.2.1 LVP 74 (LVP 30/LC/2) – Handford selections at Deniyaya station

Field assessments for shot-hole borer was carried out. Though very low infestation was observed, the following selections were found more susceptible compared to the control clone TRI 2026:

Susceptible ones: 01, 49, 68, 141, 157, 175, 184, 195, 200, 203, 218, 251, 278

4.2.2 LVP 75 (Phase II trial) at St Joachim Estate

Field assessment for shot-hole borer indicated that selection Nos. 4, 5/6, 7/7, 62 and 139 are more susceptible compared to clone TRI 2026. Selection Nos. 23/5, 29, 75, 89, 241 and 250 were more susceptible compared to TRI 2025.

5. Thrusts A 5 - A 8 Development of bi-clonal and polyclonal seed cultivars

The four field trials established in 2000, in the different regions, with 16 bi- and polyclonal seed stocks were monitored with the aim of developing seed cultivars.

Project A 5.1 Development of seed varieties for up country

A micro seed garden in the form of crossing block was planted in St Coombs.

Location:	Field No.12, St Coombs estate (near Camellia hostel)
Combination:	N 2 x DT 1
Number of plants:	20 each
Date of planting:	20.9.2001

R.Paskarathevan, B.A.Rathnagoda, V.Shanmugarajah, A.K.Mudalige and M. Ratnayake,

Project A 6.1 Development of seed varieties for mid-country

Two micro seed gardens in the form of crossing blocks were established in the fields of Tea Smallholdings Development Authority, Hantane and the details are given below:

Location	*Combination*	*No. of plants*	*Date of planting*
TSHDA training centre	TRI 4053 x N 2	15 each	September 2001
TSHDA training centre	TRI 4052 x TRI 3017	15 each	October 2001

U.Sritharan, V.Shanmugarajah and R.Paskarathevan

Project A 7.1 Development of seed varieties for mid-country semi-dry zone

Project A 8.1 Development of seed varieties for low-country

Four micro-seed gardens in the form of crossing blocks were established at the low country station at Ratnapura and the details are given below:

Location	*Combination*	*No. of plants*	*Date of planting*
St Joachim estate			
Nursery area	TRI 4006 x TRI 2043	18 each	February 2001
Coconut area	TRI 4004 x TRI 2043	18 each	March 2001
Coconut area	TRI 2016 x TRI 4071	18 each	March 2001
Coconut area	TRI 4053 x TRI 4004	20 each	March 2001

P.D.Upali, A.K.M.Jayasena, and J.HN.Piyasundara

6. Other Experiments

6.1 Charcaterization of germplasm

6.1.1 Morphological characterization of tea accessions

Thirty-one accessions in *ex-situ* field gene bank were characterized using 12 morphological descriptors. Randomly selected 5 plants from each accession were scored for 12 variables related to vegetative characteristics namely leaf size, leaf shape, leaf pose, immature leaf color, mature leaf color, petiole length, leaf pigmentation, petiole pigmentation, young shoot color, leaf pubescence, young shoot pubescence and leaf apex habit. Average Linkage Cluster Analysis and Principal Component Analysis were used to group the accessions by constructing the dendrogram and to identify the most important variables, which describe the greatest portion of variability in tea germplasm. Based on average linkage cluster analysis it was possible to group these accessions into well-separated 3 main phenotypic groups as follows:

Group I	*Group II*	*Group III*
TRI 4071	TRI 4061	TRI 2043
N2	TRI 4079	
DN	TRI 3025	
KEN 16/3	ASM 4/10	
HS 10A	TRI 2025	
TK 48	TRI 3069	
TRI 3055	TRI 2027	
TRI 777	TRI 3022	
DT 95	TRI 2026	
DT 1	TRI 3013	
TRI 3018	TRI 4052	
CY 9	TRI 2016	
DG 39	TRI 2023 (4x)	
PK 2	MT 18	
	TRI 2023	
	TRI 3016	

Of the 16 accessions clustered in group II, 14 accessions were TRI clones. All the characteristics except leaf pigmentation were found useful in discriminating the accessions in this group. Most of the estate clones formed another well-separated group (Group I). Except leaf pigmentation, petiole pigmentation and leaf shape, other characteristics were found to be important to distinguish clones in this group. Clone, TRI 2043 formed a distinct single branch in the dendrogram.

K.Gunasekare, J.D. Kottawa Arachchige,
A.K. Mudalige and T.U.S. Peiris

6.2 Characterization and evaluation of *Camellia sasanqua*

6.2.1 Evaluation for biotic stresses

In a series of studies carried out both *in vitro* and *in vivo,* it was confirmed that *C. sasanqua* is very resistant to infection by *Exobasidium vexans* fungus.

A. Balasooriya*, B.A.P Cooray* and K.Gunasekare (* Pathology Division)

6.3 Duplication of germplasm

The gene bank at Kottawa was extended with 20 plants each of 100 accessions from St Coombs.

M.Ratnayake, B.A.Rathnagoda, A.K.Mudalige, J.D.Kottawa Arachchige and K.D.Dahanayake

6.4 Polyploid Breeding

6.4.1 Induction of polyploids

In a preliminary study to monitor the recovery of apical shoot meristem, two clones (TRI 3013 and 3016) recovering after pruning were used. In another attempt to monitor the survival rate and the regeneration capacity of shoot meristem, agar blocks treated with colchicine were tried out on the same clones. In a parallel study, cotton wool swab method was compared with the agar block method in inducing polyploids. Method of colchicine treatment for apical buds was perfected and it was found that cotton swab method was superior to agar block method where 69% success was achieved with the former method as compared to 0% recovery with the latter.

Using cotton swab method, apical shoot buds of clones TRI 2027 and DG 39 were treated with colchicine. Sensitivity (degree of response) of apical meristem to colchicine treatment was found to vary with the clone used. Morphological aberrations were observed in 15% of the treated buds in TRI 2027 while none of the recovered shoots of DG 39 showed any such aberrations after the colchicine treatment. Morphological aberrations, in the form of distorted leaves, succulent leaves and swollen apical buds with rosette appearance, partially confirmed the induction of polyploids in TRI 2027. Cuttings of putative polyploids were propagated in the nursery to obtain whole plants for assessing their usefulness as new cultivars.

Shoots with colchicine treated apical buds, established in the propagator for close monitoring, were divided into single nodal cuttings and propagated in the nursery for screening these material for possible induction of polyploids.

Apical buds of five months old plants raised from single nodal cuttings of clones, TRI 4006, 4052, 4053, 4078, CY9, DG 39 and KEN 16/3 were treated with aqueous solution of colchicine. Shoots recovering after treatment and their morphological aberrations were recorded (Table 12).

TABLE 12 *Percentage survival and percentage of shoots showing morphological aberrations after colchicine treatment in apical buds of different tea clones*

Clone	*% survival after treatment*	*% shoots showing morphological aberrations (2 months after treatment)*
TRI 4006	45.5	18.2
TRI 4052	75.0	0.0
TRI 4053	20.0	0.0
TRI 4078	40.0	0.0
CY 9	50.0	0.0
DG 39	100.0	0.0
KEN 16/3	100.0	0.0

M.A.B.Ranathunga and K. Gunasekare

6.4.2 Rapid screening method for identification of polyploids

Available induced polyploid clones and their diploid counterparts were compared, using morphological, anatomical and cytological methods, to find a suitable technique for the confirmation of level of polyploidy. Data collected for assessing variations between diploids and their polyploids were statistically analysed to find the useful parameters in screening polyploid clones. Parameters studied were: pollen diameter, anther length, fresh and dry weight of two and a bud, leaf area and leaf length to breadth ratio of mature leaves, stomatal density, stomatal length to breadth ratio and chloroplast counts in stomatal guard cells. Of the parameters studied, the only parameter which showed consistent significant differences between diploid and tetraploids was the chloroplast count in stomatal guard cells (Table 13). Although statistically significant differences were observed between the diploid and their tetraploid counterparts in stomatal density, anther length and pollen diameter of clones TRI 2023, TRI 2024 and TRI 2026, the differences observed in the other clones in relation to these parameters were not statistically significant. These results show that only chloroplast number in guard cells could be used for early screening of polyploid clones.

TABLE 13 *Number of chloroplasts per guard cell in different polyploids and their diploid clones*

	Clone									
	TRI 2023	TRI 2023 (4x)	TRI 2024	TRI 2024 (4x)	TRI 2025	TRI 2025 (4x)	TRI 2026	TRI 2026 (4x)	DT 95	DT 95 (4x)
Number of Chloroplasts per guard cell	16.9	22.9	18.6	22.3	22.3	26.7	18.3	23.2	18.7	29.7
P value	0.0017		0.0107		0.337		0.0192		0.0002	
CV%	10.34		8.64		8.47		11.47		11.51	

M.A.B.Ranathunga and K. Gunasekare

6.4.3 Chemical variations

Green leaf (two and a bud) of tetraploid clones and their diploids were analaysed to detect quantitative variations in various chemical constituents and the results are presented in Table 14.

TABLE 14 *Chemical variations in polyploid clones and their diploid counterparts (all units in mg/g dry weight)*

Clone	TP	Ch A	Ch B	EGC	C	EC	EGCG	ECG	CAFFEINE	AA
TRI 2023(2x)	313	0.89	0.45	49.9	1.2	14.42	106	29.8	29.35	6.5
TRI 2023(4x)	272	0.73	0.31	39.63	0.87	10.73	99.05	26.8	29.17	8.81
TRI 2024(2x)	287	0.80	0.32	24.52	1.8	11.95	105.4	43.2	30.09	10.65
TRI 2024(4x)	274	0.80	0.33	23.29	1.21	11.36	97.89	39.6	29.08	9.6
TRI 2025(2x)	292	0.74	0.31	22.81	2.05	9.45	101.2	29.7	27.38	7.52
TRI 2025(4x)	288	0.84	0.46	25.57	2.01	11.47	108.4	32.2	28.37	7.84
TRI 2026(2x)	264	0.73	0.30	42.26	2.24	16.97	86.51	32.6	23.88	7.06
TRI 2026(4x)	271	0.75	0.27	38.63	1.71	15.82	98.77	33.8	29.74	8.57
DT 95 (2X)	221	0.74	0.30	18.53	1.62	5.87	72.35	16.9	18.32	10.1
DT 95 (4X)	255	0.54	0.26	25.66	2.36	8.41	83.18	21	19.25	5.42

(TP - Total polyphenols; Ch A, Ch B - Chlorophyll A, B; EGC- Epigallocatechin; C - Catechin; EC - Epicatechin; EGCG - Epigallocatechin gallate; ECG - Epicatechin gallate AA - Amino acids)

Data are being analysed statistically to see whether any significant chemical variations exist between tetraploids and diploids.

I.S.B. Abeysinghe*, M.A.B.Ranathunga, J.D. Kottawa Arachchige and K. Gunasekare (* Biochemistry Division)

6.5 Nursery Trials

6.5.1 Up country

(a) Effect of different sizes of bags on the growth of cuttings

A trial was established to study the effect of different size of bags on the growth of cuttings. The aim was to reduce the use of soil as the rooting medium as well.

(b) Comparison of TRI recommendation with that of Indian practice in the nursery

The objective of this trial was to compare the TRI recommendation of disbudding and thumb-nailing with that of the Indian practice of allowing the plants to grow freely in the nursery.

M.Ratnayake, B.A.Rathnagoda

6.5.2 Low country

(a) Comparison of shoot and root growth of some TRI 3000 and 4000 series clones in the nursery

A study was established to compare the differences in shoot and root growth of some TRI 3000 and 4000 series clones under low country conditions.

Clones used: TRI 3014, 3025, 3055, 4006, 4042, 4049, 4053 and 4061.
Control clones: TRI 2026 and 2027
Duration: October 2001 to May 2002
Replicates: 3 (80 plants of each clone per replicate)

J.Mahindapala*, P.D.Upali and J.H.N.Piyasundara
(* Adivisory Division)

6.6 Evaluation of the performance of seed stocks planted by the estates - Aislaby estate

Action was taken to compare the performance of seed stocks planted in estates. The yields recorded over nine plucking rounds of the Ailaby seed stock and two clones at Aislaby estate, Bandarawela showed that the seed stock yielded more than two clones planted in the same field. The seed stock gave a yield of 1481 kg MT ha^{-1} whereas clones MT 16 and DG 7 gave yields of 1106 and 906 kg MT ha^{-1} respectively.

V.Shanmugarajah and R.Paskarathevan

7. Project D 1 - Use of *in vitro* techniques

Progress of tissue culture work carried out at Hantane from 1996 to 2000 was reviewed in order to draw up work plans for each experiment. Detailed work plans with time frames were prepared for embryo rescue technique, immature embryo culture, quantification of present miropropagation system, initiation of callus cultures from stem and leaf explants and to assess radiosensitivity of *in vitro* shoots for gamma rays.

K. Gunasekare

7.1 Development of embryo rescue technique

(a) Inter-specific hybridization

Past data collected in relation to inter-specific hybridisation was analysed to determine the stage at which fruit abscission takes place in inter-specific hybrids. An analysis of data generated for 2 years of work on inter-specific hybridisation between *C. sasanqua* and *C. sinensis* (DT1, HS 10A, TRI 777) showed that in most of these crosses fruit abscission takes place between 3-4 months after pollination depending on the *C. sinensis* clone used. This suggests that it is necessary to rescue inter-specific hybrids prior to 4 months from the date of pollination.

Data collected on interspecific hybridisation using clones TRI 2016, 2023, 2025 and DN with *C. sasanqua* carried out this year were tabulated for a period of 4 months from pollination (Table 15). These are to be used for rescuing inter-specific hybrids.

TABLE 15 - *Number of flowers pollinated, number of fruits remaining in the tree after pollination and percentage fruit set in inter-specific crosses*

Cross	No. of flowers pollinated	Number of fruits remaining on the tree 3WAP*	1MAP**	2MAP	3MAP	4MAP	% fruit set 3MAP
TRI 2016 x *C. sasanqua*	179	101	72	27	19	to be assessed	10.6
TRI 2023 x *C. sasanqua*	97	11	3	0			0.0
TRI 2025 x *C. sasanqua*	187	74	63	21	3	0	1.6
DN x *C. sasanqua*	48	5	0				0.0

* - weeks after pollination

** - months after pollination

U. Sritharan, K. Sarathchandra, H. Jayaweera and K. Gunasekare

(b) Monitoring of fruit development to aid embryo rescue

Number of naturally pollinated flowers tagged after anthesis in each clone and the fruit development studies done using those are summerised in Table 16.

TABLE 16 - *Total number of naturally pollinated flowers tagged for fruit development studies and the duration for which those were monitored*

Clone	Number of flowers tagged after anthesis	Fruits assessed
TRI 2016	809	1st, 2nd, 3rd and 4th months
TRI 2025	321	1st, 2nd and 3rd months
TRI 2021	268	1st and 2nd months

Assessments of fruit and embryo development were done using anatomical and morphological features. This study is being continued to monitor the fruits until maturity to sequentially tabulate the embryo and fruit development stages from pollination up to fruit maturity.

U. Sritharan, H. Jayaweera, K. Sarathchandra and K. Gunasekare

(c) Immature embryo culture

A total number of 90 embryos representing 3 different immature embryo stages were inoculated on a simple culture medium devoid of growth regulators (MS and Gamborg B5 supplemented with 10% glucose and 40% sucrose), to monitor their development under *in vitro* conditions. It was found that B5 is superior to MS in terms of growth of immature embryos. However, it took 5 months to form a plantlet even on the B5 medium. As most of the explants in growth regulator free medium did not show good response, this medium was supplemented with growth regulators. Therefore, the observation on growth performance in the presence of growth regulators (i.e. B5 + 2.5mg/l BAP + 0.5mg/l IBA) is being continued.

Whole fruits of 1, 2 and 3 MAP were surface sterilised in 40% Clorox for 30 min. followed by 70% alcohol for 2min. This method of surface sterilisation was not optimum for explants taken from 1 – 2 MAP in which 100% contamination was observed. On the other hand, fruits obtained at 3MAP could be established with the same surface sterilisation procedure and the rate of contamination was only 70%. After 3 - 4 months of culture initiation most of the explants turned brown. However, few explants remained green but no plantlet formation or any kind of growth was visible.

An experimental protocol (method of surface sterilisation, developmental stage of the fruit and composition of the culture medium) was worked out to recover plants *in vitro* from immature zygotic embryos obtained from fruits developed at very early stages (5 months after pollination). Explant used was the piece of seed coat having zygotic embryo initials attached to the seed coat. Fruit coat was removed and seeds were sterilised in 30% Clorox for 30min. Seed was then dissected and a piece of seed coat together with zygotic embryo initials was separated out and cultured on half strength MS supplemented with 0.5mg/l ABA. When contamination rate was 50% and 33%, explants turned brown but did not form any plants. In contrast, 17% of the explants which turned brown initially were able to produce complete plantlets 3 months after culture. Results of this study confirmed that there is a possibility of using this protocol for rescuing embryos from inter-specific hybrids at a very early stage of embryo development.

Based on the seed coat color, maturity stages of the embryos were assessed and 3 maturity stages were cultured on MS medium supplemented with 0.5mg/l ABA to study the response of these explants on a single culture medium (Table 17).

TABLE 17 - *Effect of seed maturity on the explant response*

Seed coat color	*Contamination %*	*percentage and type of explant response*
Light yellow	20	80% somatic embryo formation
Yellow-light brown	20	67% somatic embryo formation,
		13% plantles from zygotic embryo
Dark brown	0	100% plantles from zygotic embryo

Based on the results it is evident that immature cotyledon explants tend to produce somatic embryos whereas mature cotyledons showed pronounced zygotic embryo growth.

H. Jayaweera, K. Sarathchandra and K. Gunasekare

7.2 Somatic embryogenesis

Mature cotyledonary explants cultured on MS growth regulator free medium, MS + 2.5mg/l BAP + 0.01mg/l IBA and MS + 0.5mg/l ABA formed somatic embryos. Formation of somatic embryos on these explants (mature cotyledonary explants) was not influenced by the growth regulator composition of the medium.

Somatic embryos formed on initial explants were sub-cultured onto two media to enhance germination: MS + 1mg/l GA3 + 1mg/l IAA (filter sterilised) and MS

+ 5mg/l GA3 + 2mg/l NAA. Growth regulator composition in (B) was changed in order to suppress precocious root formation. Medium (B) was supplemented further by adding 2.5mg/l BAP to promote shoot growth. Somatic embryos were inoculated in three different culture media to compare their response to the different cultures (Table 18).

TABLE 18 *Observation and percentage of somatic embryos responding on somatic embryo germination media*

Culture medium		Type of organogenesis/ morphogenesis	% of cultures responding
(A)	MS+ 1mg/l GA3 + 1mg/l IA	Secondary somatic embryos	100
(B)	MS + 5mg/l GA3 + 2mg/l NAA	Root formation	88
(C)	MS + 5mg/l GA3 + 2mg/l NAA + 2.5mg/l BAP	Callus formation	100

As germination was not encouraging on the solid media tested, somatic embryos were isolated and sub-cultured in liquid culture medium (MS + 1mg/l GA3 + 1mg/l IAA) on a shaker, to improve their growth. Work is being continued to improve somatic embryo germination to obtain whole plantlets.

From the preliminary experiments using medium MS + 1 mg/l GA3 + 1mg/l IAA, it was found that the growth of somatic embryos on germination medium was dependent on the stage of the somatic embryo at which these were isolated from the initial explant for sub-culture. When cultured on this medium, very immature stages (heart –globular or smaller) tend to produce secondary somatic embryos with an average of 15 secondary somatic embryos per culture whereas somatic embryos isolated at torpedo or cotyledonary stages developed into plantlets.

T.M.Sarathchandra, H. Jayaweera and K.Gunasekare

7.3 Quantification of plantlet formation and shoot multiplication in seedling material

Mature cotyledons were cultured on MS + 3mg/l BAP + 0.1mg/l NAA medium to quantify the seedling formation and their subsequent multiplication rates. Twenty five to thirty per-cent plantlet formation and 70-75% somatic embryo formation were observed on the same medium. At the first sub-culture (after 2 months of culture initiation) the average shoot multiplication rate was 3.5.

N. Karunathilake and K.Gunasekare

7.4 Callus cultures

(a) Stem explant

Culture medium composition (1/2MS + 2mg/l 2,4-D + 0.5mg/l Kinetin) used in the past to initiate callus on stem explant showed that callus produced was compact on this medium. Therefore, new growth regulator compositions have been formulated and stem explants were cultured on the following media:

Medium code	Composition
C1	MS + 2mg/l BAP + 1mg/l NAA
C2	MS + 1mg/l BAP + 1mg/l NAA
C3	MS + 1mg/l BAP + 0.1mg/l NAA
C4	MS + 2mg/l BAP + 3 mg/l NAA
C5	MS + 2mg/l BAP + 1mg/l 2,4-D

Callus proliferation was high and the type of callus produced was better in C5 than in any other media.

N. Karunathilake, T.M. Sarathchandra and K.Gunasekare

7.5 In vitro induction of mutants by gamma rays

As contamination of *in vitro* cultures was found to be a serious problem, steps were taken to initiate cultures from seed materials, which could be used to determine microshoot radiosensitivity to gamma rays. Over 170 mature embryos were cultured *in vitro* for this purpose.

In vitro shoots were irradiated with gamma rays (from ^{60}Co source) at 3 different dosages (1, 2 and 3 Kr). It was found that the dose rates used were not sufficient to induce any morphological aberrations in the materials. Experiments are in progress to irradiate more shoots at higher dosages to work out LD50 value for *in vitro* shoot cultures

T.M.Sarathchandra, R.Peiris * and K. Gunasekare
(* Horticultural Research and Development Institute)

7.6 Use of poly-house and coir pots for hardening tissue-cultured plants

A raised polyhouse was locally fabricated to raise tissue culture plants, with a mist propagator facility. *In vitro* raised microshoots were transferred to the pots made out of coir fibers. Various rooting mixtures are being tried out in these pots to assess the suitability of polyhouse conditions in combination with potting materials for hardening plants.

T.M.Sarathchandra, U. Sritharan and K. Gunasekar

8. Issue of cuttings

8.1 Up-country

Major portion of the cuttings of the TRI 3000 and 4000 series was issued to the Tea Development Project funded by the Asisn Development Bank (ADB) and the balance was issued to some estates and smallholders.

8.1.1. Issue of shoots to estates and small holders

Date of issue	Place	TRI 3000 Series	No. of shoots	TRI 4000 Series	No of shoots
2/1/2001	Great western	3072	100	----	----
		3073	500		
21/2/2001	Galkantha	3013	300	4071	600
		3020	350		
		3049	500		
7/3/2001	Udapussallawa	3018	250	4052	250
		3073	250	4071	250
30/3/2001	Smallholder, Kitulgalla	3015	50	4053	35
		3018	25		
		3019	30		
		3020	35		
		3052	40		
13/4/2001	Alton	3072	400	4052	400
				4071	250
				4078	250
13/4/2001	Labukelle	3020	300	4052	1000
		3037	300	4071	1000
		3072	500	4078	500
20/4/2001	Labukelle	3015	200	4071	700
		3017	500		
		3018	750		
		3073	300		
18/5/2001	Horamulla	3014	200	4052	700
				4053	200
				4054	500
				4055	200
12/6/2001	Diyanilakelle	3015	100	4052	100
		3016	100	4071	100
12/6/2001	Waverly	3072	100	4052	100
		3073	100	4071	100
				4079	100
27/6/2001	Pundaluoya (North)	3013	150	4052	100
		3015	100	4067	100
		3016	150	4071	100
		3018	100	4079	125
		3019	100		
		3020	100		
		3072	100		
		3073	150		
29/6/2001	Alton	----	----	4067	100
				4079	250
10/7/2001	Kalugalla	3014	50	4047	100
		3015	50	4053	100
		3017	100	4071	250
		3018	100	4079	100
		3019	50		
		3020	150		
25/7/2001	Pundaluoya (North)	3020	200	4052	150
		3072	200	4053	100
		3073	200	4071	500
				4079	700
9/8/2001	Fairloan	-----	-----	4052	400
				4067	400
				4071	500
				4079	300

8.1.2 Summary of issue of shoots to ADB Mother Bush Project

CLONE	ADB/ Ratnapura	ADB/Matugama	ADB/Hantana	ADB/St. Coombs
3013			700	2100
3014	3525	300		
3015			400	
3017			200	
3018			1100	4190
3019			300	4100
3020				
3047	1975	100		
3052	4950			
3055	1075			
3069	4520			
3072		550		3600
3044		150		
4006	3100			
4042	1300			
4043	970			
4046	2400			1270
4052	9600	500	800	
4053	4950		700	
4054	4600			
4055	5800			
4059	150			
4067	100	100		
4071			800	1600
4078			600	3350
4079		300		2760
4085				
Total	49015	2000	5600	22970

8.2 Low-country

8.2.1. Issue of shoots to estates and small holders

Date of issue	Smallholder	TRI 3000 series clones	No. of Shoots	TRI 4000 series clones	No. of Shoots	Other Clones	No. of Shoots
09.09.01	Kathuraliyagama NewTown Ratnapura					2026 2027	200 800
14.09.01	J.A. Gunathilaka, NO.26, Mahawala Rd, Ratnapura.	3014, 3046 3065	100 each	4049, 4059	100 each		
14.09.01	J.A.D. Dayananda, 3/5, Kapila Abarathna Mawatha, Ratnapura	3046, 3060 3063, 3065	100 each	4049	100		
25.09.01	Mr.T.I.Peires, Fernando Rd, Panadura [PeirsEst. Mullagaha Handiya, Baduraliya.]	3057, 3058	50 each	4014, 4042 4049, 4061	100 each		
27.09.01	D.G.Siriyawathee Batahira,Kahangama, Hiddallana					2027	100
01.10.01	-do-					2027	100
27.09.01	HAChaminda,3A, Upper Hakammuwa, Marapana	3014, 3046 3060	100 each			2022, H 1/58	100 each
27.09.01	A.G.Pitarathna, Urupallauwa, Kuruwitta	3014, 3058 3055	100 each 50	4053, 4049, 4061	50 100 each		
27.09.01	Pannawanna Est. Kahawatta.	3046, 3058 3065, 3069 3047	50 each 100	4049, 4061	100 each		
27.09.01	Lal Peris, Miriswatha Mukalana, Palawatte.	3014, 3046	100 each	4049, 4061	100 each	H 1/58	100
01.10.01	Mr D.Hewage, No.31, Mahawalawatte Rd. Ratnapura [Silver Land, Galaboda,Gallala],	3058	50	4014 4049	50 100	2027	300
01.10.01	P.R.M.Bandara, 32/2,Panagoda, Homagama [Ferreby Est, Nagawatte, Puwakpittya.]					62/9, 62/6, 2027	100 each.
04.10.01	B.C.M.Bandara, MaraliyaValauwa Dodape, Ratnapura	3060, 3069	50 each	4004, 4014 4049, 4059 4089	50 each	2022 62/1, 62/3	50 each
04.10.01	B.H. Samarasena, Gangodakanda, Mahinda kade bare, Aiyagama.	3014, 3046, 3055	50 each	4047, 4049 4061	50 each	2027 62/1, 62/6	100 50 each
04.10.01	M.B.C. Kurruppu Gunakamala, Madalagama, Kahawatta	3058	50	4047, 4049 4056, 4059	50 each	2027 62/1,62/3 2/6	100 50each
04.10.01	W. Benaragama, No. 50/20, Varalupe Pansala Para, Galannda, Ratnapura [Madagalathura, Baduwalakanda]	3014, 3046 3055, 3065	50 each	4049, 4061	50 each	2027 62/1, 62/6	100 50 each
05.10.01	S.D.Kudaligama , Dellabada , Karangoda					2027	500
05.10.01	S. Danawathee, Near the Co-op , Kahanegama , Hiddallana					2026	100
10.10.01	A. Samarathunga ,Danagala Es. Ehaliyagoda					2027	200
10.10.01	M.H. Karunawathee, Hiddallana					2027	100

Date of issue	Smallholder	TRI 3000 series clones	No. of Shoots	TRI 4000 series clones	No. of Shoots	Other Clones	No. of Shoots
10.10.01	Ven. Kobawaka Seevali, Rajamaha Vihara, Horana	3060	100	4049, 4059 4061	100 each	62/6	100
23.10.01	Y. D. Turin, Madagalthura, Ratnapura./ [Baduwalakanda, Madagalthura]	3014, 3057 3060	50 each	4049, 4059 4061	50 each	62/1, 62/3, 62/6, 62/9	50 each
23.10.01	B. H. Sirisena Baduwalakanda, Madagalthura	3014, 3057 3065	50 each	4042, 4049	50 each	62/2 62/6, 62/9	50 100 each
24.10.01	D. C. Senasekara, Gangodakanda Estate Ayagama	3058	100	4049 4056 4059	100 50 50	2022, 62/1, 62/2, 62/9	50 each
29.10.01	Tamara Kumari, Farm School Karapinche [Vajira, Owittigama Rd. Pohorabawa]	3055, 3065	50 each	4049 4006, 4014 4061, 4089	100 50 each	2027 62/6	50 each
02.11.01	N. A. B. Munasinghe Edamgoda, Kirriella	3058	50	4042, 4049 4056	50 each	KEN 16/3, K. P. 204 62/1, 62/6	100 each 50 each
02.11.01	B. A. D. K. Fernando, No. 60, Veralupa Pansala Para, Ratnapura/ [Galathura Wattha Kuttigala Ayagama]	3014, 3058	100 each	4049, 4056	50 each	2016, 2027 62/1, 62/6	50 each
02.11.01	K. Jagath Priyankara Samanpaya, Kotakethana, Kahawattha	3047, 3055 3058	50 each	4053	50	KEN 16/3 62/1, 62/6 62/9, K. P 204	100 50 each
02.11.01	Thamara Gunasekera, Provident Hill Estate Amithagoda, Hiddallana					2027	100
06.11.01	Suranjan Parakrama, 314, Kambilihena, Kuruwitta	3055, 3014, 3046	100 50 each	4006, 4014	50 each	62/6 62/2, 62/9	100 50 each
16.11.01	R. A. B. Rajapaksha, Panukarapitiya, Hiddallana / [Nagoda Rd., Dodampe]					2025	500
16.11.01	W. A. Navaratne, Boralupahena Wattha, Panapola, Kalawana	3014, 3055 3058	50 each 100	4047, 4056 4059	50 each	62/9, 62/6 H1/58	50 each
16.11.01	Tamara Gunasekara, Provident Hill Estate, Amithagoda, Hiddallana			4042	100		
21.11.01	R. Chandrakumar St. Joachim Estate					2027	50
28.11.01	M. W. Jayasooriya Kalawana					H 1/58	300
29.11.01	M. W. Jayasooriya Kalawana	3060	100			2027 H1/58, 62/1 62/3	100 each 50
29.11.01	Sampath Pieris, Panadura					Mixed	500
03.12.01	D. B. Siriyawathee Galukagama					2027	50
03.12.01	M. G. Karunawathee, St. Joachim					2027	50
04.12.01	H. Somasiri, Pathagama Kuruwita					2027	100
19.12.01	A. M. U. Liyanage					2027	300
21.12.01	Sampath Peris, Panadura					2026 2027	100 each
Total			4000		3900		8350

8.2.2 Summary of issue of shoots to ADB Mother bush Project

Clone	No. of shoots
3014	500
3025	800
3047	100
4006	200
4042	3350
4053	1050
4061	350
TOTAL	6350

P.D.Upali, A.K.M.Jayasena, J.H.N.Piyasundara

9. General

9.1 Other Divisional Activities

Mr M.A.B.Ranatunge assumed duties as Research Assistant with effect from January 01.

Preparation of herbarium as a tool for identification of clones was undertaken and specimens of 62 clones were made.

Preparation of clonal album to help in the identification of clones is also undertaken.

A document on 'Distribution of cuttings of TRI 3000 and 4000 series Clones to Tea Estates in Sri Lanka for the establishment of Mother Bushes, 1979 – 2000' was published and sent to the stakeholders in July.

9.2 Visitors

Agriculture students and staff of the University of Jaffna – January 22

Advance Level students and staff of Hindu Ladies College, Colombo – February 26

Agriculture students and staff of the Eastern University – June 4

Agriculture students and staff of the University of Jaffna – September 19

Under the exchange programme, three students from Jaffna – October 17

Mr Scarborough, former Assistant Director of the Tea Research Association of Africa, visited the laboratory and the nursery and shared his experience with the staff of the Division – November 19

About 16 Middle Level Research Managers (from various countries), who were the participants at the Regional Training Programme on 'Research Management in Agriculture', sponsored by the Ministry of Foreign Affairs under the Technical Co-operation Programme - November 23

Agriculture students and staff of the Wayamba University – December 19

9.3 Workshops/ Seminars/ Training Programmes/ Meetings attended

I.D.Singh, Commonwealth Consultant, attended the following:

- Coordination Committee meeting on Molecular Marker Studies at CARP, Colombo – February 22
- Workshop on 'Problem of bush debility in the Deniyaya region' – May 30
- Seminar on 'Development and evaluation of a user friendly harvesting system for the Sri Lankan Tea Industry' held at the BMICH, Colombo – June 22
- Scientific Debate/ Discussion on 'Genetically Modified Organisms (GMOs) – Their Advantages and Concerns' organised by the Biotechnology Group of the Postgraduate Institute of Agriculture, Peradeniya – July 20
- Dickoya district Plantation Association meeting and delivered a talk on ' Operational Management in Tea Plantations with special reference to India' – August 16
- TRI and CTTA meeting on 'Quality of Sri Lankan tea', in Colombo – August 17
- Low country RSC meeting at Galle – October 5
- Mid country RSC meting at Kandy – November 13

Mr. V.Shanmugarajah attended the following:

- Commonwealth Regional Advanced Course on Tea Plantation Management at the Kothari Agricultural Management Centre, Coonoor, India – January 04 – 30
- Seminar on 'Development and evaluation of a user friendly harvesting system for the Sri Lankan Tea Industry' held at the BMICH, Colombo – June 22
- Scientific Debate/ Discussion on 'Genetically Modified Organisms (GMOs) – Their Advantages and Concerns' organised by the Biotechnology Group of the Postgraduate Institute of Agriculture, *Peradeniya – July 20*
- TRI and CTTA meeting on 'Quality of Sri Lankan tea', in Colombo – August 17
- Low country RSC meeting at Galle – October 5
- National Committee of Plant Breeders and Biotechnologists (5 meetings)

M.T.K.Gunasekare attended the following:

- 57th Annual session of SLAAS at the University of Moratuwa - November

T.M. Sarathchandra attended the following:

- Seminar on 'Cryopreservation of Plants' at Plant Genetic Resources Centre – March 19
- National Training Course on Radiation Safety in using Radio-isotopes for Research and Industrial Application at the Atomic Energy Authority – July 16 – 20
- 57th Annual session of SLAAS at the University of Moratuwa - November

Most of the Divisional Staff participated in various programmes related to their respective disciplines. Those involved were V.Shanmugarajah, M.Ratnayake, M.A.B.Ranatunga, R.Paskarathevan, B.A.Rathnagoda, P.D.Upali, A.K.M.Jayasena, J.H.N.Piyasundara and T.M.Sarathchandra.

A.K.Mudalige and J.D.Kottawa Arachchige continued to attend the Advance Certificate Programme in Laboratory Technology at the Open University of Sri Lanka and B.A.Rathnagoda commenced attending the same course at the Open University (December 19).

On a familiarization program, the Commonwealth Consultant Dr I.D. Singh and the Divisional Staff visited the Plant Breeding Division of the Rubber Research and Coconut Research Institutes on June 15 and October 12 respectively.

9.4 Publications /Posters

Gunasekare.M.T.K and Evans.P.K (2001) Isolation and culture of mesophyll protoplasts from tea (*Camellia sinensis* L.). Plant Tissue Cult., 11(1): 55-64.

Thirukkumaren.G and Gunasekare.M.T.K (2001). Use of pollen morphology and physiology to differentiate ploidy level of tea (*Camellia sinensis* L.) clones. Journal Jaffna Sci. Assoc., 9(1): 6-7.

Liyanage.A.C., Mewan.K.M.,Gunasekare.M.T.K.,Evarard.J.M.D.T and Karunanayake. E. H. (2001). Use of DNA markers for characterisation of tea cultivars. TRI UPDATE, Vol.6(1): 3-4.

Mewan.K., Liyanage.A., Gunasekare.K., Jayamanne.E., Fernando.U and Karunanayake.E (2001). Estimation of genetic diversity of tea (*Camellia sinensis* L.) genotypes in Sri Lanka using isozyme polymorphisms and RAPD markers. Proc. Int. Conf. on O-Cha (tea) Culture and Science, Shizuoka, Japan, October 5-8, 2001, 54p.

Gunasekare.M.T.K., Kottawa Arachchige.J.D., Mudalige.A.K and Peiris.T.U.S (2001). Morphological diversity of tea (*Camellia sinensis* L.) genotypes in Sri Lanka. Proc. 57th Annual Session of SLAAS, Part I, 83p.

Sarathchandra. T.M and Peiris.R (2001). Induction of mutations in *tea (Camellia sinensis* L.). Proc. 57th Annual Session of SLAAS, Part I., 44p.

Ratnayake. M (2001). Good clones for sustainable productivity. Tea News ('Theae Thathu' – Sinhala), Vol 1 (2), pp 6.

9.5 Papers submitted

Singh.I.D., Attanayake.D.P.S.T and Paskaratheven.R (2001). Use and abuse of clones in plantations of tea and rubber in Sri Lanka *(submitted for TRI Update)*

Singh.I.D., Shanmugarajah.V and Paskarathevan.R (2001). Tea seed production in Sri Lanka (submitted for Tea Bulletin).

Singh.I.D., Paskarathevan.R and Shanmugarajah.V (2000)*. Tea seeds and its handling for raising seedlings *(* Submitted for publication in the TRI Update last year and resubmitted after corrections this year)*

9.6 Training Programmes conducted

Dr I.D.Singh, the Commonwealth Consultant, continued to conduct monthly training programmes for the Divisional Staff.

Mr M.Ratnayake made a presentation on 'Identification of clones' to the Divisional staff. This was a part of the training programme – March 14

S.Kannan, an undergraduate student of the Faculty of Agriculture, University of Jaffna carried out his project work on 'Some variability in tea clones (Camellia sinensis (L.) O.Kuntze) in relation to root cation exchange capacity'. V.Shanmugarajah supervised his work.

Miss K.V.Sandamali Tennakoon, a student of the School of Agriculture, Kundasale completed her six- months training on September 19

Dr M.T.K.Gunasekare made a presentation on 'Record keeping' for the Divisional staff. This was a part of the training programme – October10.

Mr V.Sithakaran, Advisory Officer made a presentation on 'Plucking' for the divisional staff. This was a part of the training programme – November 9

Miss R.S.R.M.A.D.Rathnayake, a student of the School of Agriculture, Kundasale completed her six- months training on November 21

Miss C.L.Thilakarathne, an undergraduate student from the Faculty of Agriculture, University of Perdeniya commenced her project work with Dr M.T.K.Gunasekare as the supervisor in October.

SOILS AND PLANT NUTRITION DIVISION

L.S.K.Hettiarachchi
Acting Head of Division

APPLIED RESEARCH

Thrust A15 Development of regional and site specific fertilizer recommendations for improvement of productivity and made tea quality.

Project A15.1 Characterization of soils in tea growing areas in Sri Lanka, down to soil series level.

A detailed description of the work carried out, along with the objectives, tangible outcomes and publications etc. appeared in the Annual Reports 1996 to 2000.

The field activities in the second phase, covering soils in the Intermediate zone, have been completed and production of the book is in progress.

a) Characterization of soils in tea growing estates in mid country.

A detailed description of the work carried out, along with the objective/s, appeared in the Annual Reports 1996 to 2000.

Soil series and depth maps were prepared and digitized but incorporation of physico-chemical parameters is in progress. The operations in this project have been carried out in collaboration with a Soil Surveyor from the Environment and Forest Conservation Division of the Mahaweli Authority in Kandy, the Agricultural Economics Unit of the TRI and a trained Assistant Cartographer.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi
R.M.S.S.Rajapaksa, J.A.M.M.Jayakody

Project A15.2 Estimating crop response to macro nutrients (N, K, Mg, S and P) at regional level.

A15.2.1 Fertilization experiments.

a) Effects of application of different rates of N, K and Mg on growth, soil/plant nutrient status and yield.

1) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone PK2, Field No 15B, Court Lodge Estate, Kandapola - (1999)

The yields obtained in the 3rd year after pruning are presented in Table 1.

TABLE 1 - *Effects of different rates of N, K and Mg on the yield (3rd year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	4664	4715	4728	4702	
420	4732	4825	4664	4740	SE 53
600	4816	4776	4809	4800	
Mean	4737	4772	4733	4748	
		SE 53.4			SE 93

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	4673	4752	4681	4702	
420	4859	4611	4751	4740	SE 53
600	4847	4789	4764	4800	
Mean	4793	4717	4732	4748	SE 93

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	4874	4645	4692	4195	
210	4833	4709	4775	4187	SE 53
300	4673	4798	4730	4748	
					SE 93

Surprisingly, no significant increase in yield was observed with increasing rates of N in the 3rd year, although in the 2nd year a significant linear increase was seen with increasing rates of N. No significant effect was so far seen for increasing rates of K and Mg. There was no interaction between N and K, N and Mg, and K and Mg.

Determination made in the 3rd year (June 2000) after pruning of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 2, 3 and 4 respectively, while leaf N, K and Mg concentrations are presented in Table 5.

The soil pH levels at 0-15 and 15-30 cm depths, estimated in June 2001, did not vary significantly with increasing rates of N unlike in the previous year even though such trends were evident. So far, no variation has been seen either with increasing rates of K or Mg.

Even in 3rd year's estimation, it was shown that soil K levels increased significantly only with increasing rates of K at both depths. But it was not influenced with increasing rates of N and Mg. Soil Mg levels at both depths did not vary significantly so far, either with increasing rates of N, K, or Mg.

Nitrogen, K and Mg concentrations estimated from the leaf samples obtained this year did not show any significant influence with increasing rates of N, K and Mg fertilizers.

TABLE 2 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	4.41	4.39	4.28	0.043
15-30 cm	4.28	4.25	4.18	0.037
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	4.33	4.42	4.34	0.043
15-30 cm	4.23	4.25	4.22	0.037
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	4.33	4.33	4.43	0.043
15-30 cm	4.22	4.25	4.23	0.037

TABLE 3 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	344	350	349	12
15-30 cm	277	264	284	11
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	289	366	388	12
15-30 cm	224	273	327	11
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	356	347	339	12
15-30 cm	271	287	267	11

TABLE 4 - *Effects of different rates of N, K and Mg on the soil Mg status(mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	121	114	103	7.6
15-30 cm	102	111	107	5.5
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	112	117	109	7.6
15-30 cm	100	115	105	5.5
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	109	115	112	7.6
15-30 cm	95	108	117	5.5

TABLE 5 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration - Main effects only*

Leaf nutrient		*N Level (kg ha^{-1} yr^{-1} N)* 240	420	600	SE
N	(%)	3.38	3.43	3.48	0.038
K	(%)	1.56	1.60	1.51	0.028
Mg	(%)	0.23	0.22	0.22	0.011
		K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	(%)	3.40	3.48	3.40	0.038
K	(%)	1.52	1.57	1.58	0.028
Mg	(%)	0.22	0.22	0.23	0.011
		Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	(%)	3.43	3.39	3.47	0.038
K	(%)	1.58	1.55	1.54	0.028
Mg	(%)	0.23	0.22	0.23	0.011

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2) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2026, Field No. 1, Tokatiyamulla Estate, Galle - (1999)

Data collected over the period of May to September 2000 following pruning in May, have been analyzed for statistical significance and kept as base information. The yields obtained in the 1st year (May 2000 to April 2001) after pruning are presented in Table 6. No significant variation was yet found on yield with increasing rates of any of the treatments.

TABLE 6 - *Effects of different rates of N, K and Mg on the yield (1st year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	1350	1325	1408	1361	
420	1476	1314	1425	1405	SE 31
600	1439	1327	1381	1382	
Mean	1422	1322	1405	1383	
		SE 30.7			SE 53
N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	1360	1347	1375	1361	
420	1399	1499	1316	1405	SE 31
600	1319	1475	1353	1382	
Mean	1359	1441	1348	1383	SE 53
K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	1387	1468	1410	1422	
210	1249	1417	1300	1322	SE 31
300	1443	1437	1334	1405	
					SE 53

Determinations made in September 2001, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 7, 8 and 9 respectively, while leaf N, K, Mg and Ca concentrations are presented in Table 10.

TABLE 7 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	4.97	4.94	4.88	0.065
15-30 cm	4.99	4.91	4.88	0.068
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	4.93	4.86	5.00	0.065
15-30 cm	4.87	4.88	5.03	0.068
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	4.96	4.92	4.91	0.065
15-30 cm	4.97	4.94	4.86	0.068

No significant variation in soil pH was found with increasing rates of N, K or Mg at both the depths. Generally, pH in soil decrease with increasing rates of N primarily due to acidification caused by nitrification. Soil pH estimated in September 2001 did not show any significant variation at both the depths; this is perhaps acidity was neutralized to a greater extent following the application of dolomite in July 2000 at the rate of 2500 kg ha^{-1}. It was evident from the grand mean values of soil pH at 0-15 cm depth, estimated in May 2000 and September 2001, and they were 4.07 and 4.93 respectively.

TABLE 8 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	85	73	70	4.26
15-30 cm	71	63	60	4.02
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	64	81	83	4.26
15-30 cm	53	71	70	4.02
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	80	72	76	4.26
15-30 cm	68	64	63	4.02

There was a significant increase in soil K level with increasing rates of K at both depths, but with increasing rates of N, it decreased significantly but only at the 0-15cm depth. However, at

TABLE 9 - *Effects of different rates of N, K and Mg on the soil Mg (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	124	135	113	14
15-30 cm	122	119	105	12
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	119	117	136	14
15-30 cm	99	117	129	12
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	131	122	119	14
15-30 cm	114	125	107	12

TABLE 10 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration- Main effects only*

Leaf nutrient		*N Level (kg ha^{-1} yr^{-1} N)* 240	420	600	SE
N	(%)	2.72	2.79	2.91	0.030
K	(%)	1.01	0.99	1.00	0.024
Mg	(%)	0.28	0.27	0.25	0.005
Ca	(%)	1.02	0.92	0.95	0.029
		K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	(%)	2.78	2.81	2.82	0.030
K	(%)	0.98	1.00	1.01	0.024
Mg	(%)	0.28	0.27	0.27	0.005
Ca	(%)	0.97	0.98	0.94	0.029
		Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	(%)	2.82	2.83	2.77	0.030
K	(%)	1.01	0.99	0.99	0.024
Mg	(%)	0.26	0.27	0.27	0.005
Ca	(%)	0.96	0.96	0.98	0.029

the 15-30 cm depth, such a trend was also observed. Soil Mg level did not vary significantly with any of the treatments yet. No interactions were found between increasing rates of N and K, N and Mg, and K and Mg.

Leaf N concentration increased significantly with increasing rates of N, while Mg and Ca concentrations decreased significantly but K concentration did not vary significantly despite a decrease in available K in the soil. With increasing rates of K and Mg, none of the leaf nutrient concentrations varied significantly, although K in soil in fact increased with increasing rates of applied K. The experiment continues

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G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2027, Field No.8, Talgaswela Estate, Galle - (1999)

Data collected over the period of December 1999 to August 2000 following commencement, have been analyzed statistically and kept as base information.

The yields obtained in the 3rd year (August 2000 to July 2001) are presented in Table 11. So far, no significant variation was found on yield with increasing rates of any of the treatments.

Determinations made in June 2001, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 12, 13 and 14 respectively, while leaf N, K Mg and Ca concentrations are presented in Table 15.

At both depths, there was a significant linear decrease in soil pH with increasing rates of N not with K and Mg rates as can be expected.

At both depths, there was a significant linear increase in soil K level with increasing rate of K, but with increasing rates of N and Mg, it did not vary. On the other hand, soil Mg decreased significantly with increasing rates of N, but did not vary with increasing rates of K and Mg. No interactions were found between increasing rates of N and Mg, and K and Mg. However, an interaction was found between increasing rates of N and K, and it has to be interpreted if it occurs repeatedly.

Leaf N and Ca concentration did not vary significantly either with increasing rates of N, K or Mg. However, leaf K concentration increased significantly with increasing rates of K, but was not affected by N and Mg. Leaf Mg concentration decreased with increasing rates of both N and K, but was not affected by Mg. In fact, Mg in soil also decreased with increasing rates of N, while K increased with increasing rates of K.

TABLE 11 - *Effects of different rates of N, K and Mg on the yield (3rd year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	6088	6162	6052	6101	
420	6136	5998	6029	6055	SE 65
600	5977	6192	5951	6040	
Mean	6067	6117	6011	6065	
		SE 65			SE 113

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	6114	6040	6148	6101	
420	5959	6091	6114	6055	SE 65
600	5931	6177	6012	6040	
Mean	6001	6103	6091	6065	SE 113

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	5931	6263	6008	1422	
210	6023	6100	6229	1322	SE 65
300	6050	5945	6037	6065	
					SE 113

Plants in the experimental plots were pruned in October 2001, and fresh pruning weights taken, and dolomite was applied at the rate of 2000 kg ha^{-1}. Stem circumference at 5 cm height from the base, circumference of secondary branches 2.5 cm below the pruned cut, and number of secondary pruning sticks on the frame were measured/counted in December. Secondary branches below the pruned cut were labeled for future measurements. Data collected are being statistically analyzed.

TABLE 12 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	4.18	4.06	4.01	0.051
15-30 cm	4.16	3.97	3.92	0.044

K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	4.13	4.00	4.12	0.051
15-30 cm	4.05	3.96	4.04	0.044
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	4.08	4.13	4.03	0.051
15-30 cm	3.99	4.07	3.99	0.044

TABLE 13 - *Effects of different rates of N, K and Mg rates on the soil K status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	60	59	53	3.6
15-30 cm	44	45	39	2.8
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	52	56	64	3.6
15-30 cm	37	41	50	2.8
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	55	64	54	3.6
15-30 cm	42	46	41	2.8

TABLE 14 - *Effects of different rates of N, K and Mg on the soil Mg status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	78	57	49	6.9
15-30 cm	59	43	36	5.0
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	65	45	73	6.9
15-30 cm	51	35	52	5.0
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	50	62	71	6.9
15-30 cm	39	50	49	5.0

TABLE 15 - *Effects of different rates of N, K and Mg rates on the leaf nutrient concentration - Main effects only*

Leaf nutrient		*N Level (kg ha^{-1} yr^{-1} N)* 240	420	600	SE
N	(%)	3.05	3.12	3.09	0.040
K	(%)	1.02	1.06	1.03	0.020
Mg	(%)	0.25	0.24	0.23	0.005
Ca	(%)	0.86	0.84	0.86	0.020
		K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	(%)	3.05	3.08	3.13	0.040
K	(%)	1.00	1.02	1.10	0.020
Mg	(%)	0.25	0.24	0.22	0.005
Ca	(%)	0.85	0.88	0.83	0.020
		Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	(%)	3.10	3.06	3.09	0.040
K	(%)	1.06	1.03	1.02	0.020
Mg	(%)	0.23	0.24	0.25	0.005
Ca	(%)	0.86	0.84	0.86	0.020

The experiment continues

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4) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No.85, Houpe Estate, Kahawatte - (1999)

Data collected over the period of December 1999 to the end of April 2000, following commencement, have been analyzed for statistical significance and kept as base information. The yields obtained in the 3rd year (May 2000 to April 2001) are presented in Table 16.

TABLE 16 - *Effects of different rates of N, K and Mg rates on the yield (3rd year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	3438	3536	3413	3462	
420	3433	3504	3505	3481	SE 45
600	3402	3364	3415	3394	
Mean	3424	3468	3444	3446	
		SE 45			SE 78

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	3513	3376	3498	3462	
420	3477	3405	3560	3481	SE 45
600	3404	3392	3385	3394	
Mean	3464	3391	3481	3446	SE 78

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	3464	3390	3420	3424	
210	3528	3480	3395	3468	SE 45
300	3401	3304	3628	3444	

So far, no significant variation was found on yield with increasing rates of any of the treatments, including N.

Determinations made in June 2001, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 17, 18 and 19 respectively, while leaf N, K, Mg and Ca concentrations are presented in Table 20.

TABLE 17 - *Effects of different rates of N, K and Mg rtes on the soil pH status - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	4.43	4.60	4.52	0.091
15-30 cm	4.48	4.41	4.44	0.072
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	4.57	4.50	4.48	0.091
15-30 cm	4.37	4.44	4.52	0.072
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	4.44	4.51	4.60	0.091
15-30 cm	4.56	4.40	4.37	0.072

At both depths, so far, soil pH did not vary significantly with increasing rates of any of the treatments, including N although generally it decreased with increasing rates of N.

TABLE 18 - *Effects of different rates of N, K and Mg rates on the soil K status (mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	156	147	160	4.7
15-30 cm	137	131	134	5.5
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	143	155	166	4.7
15-30 cm	123	136	143	5.5
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	157	159	147	4.7
15-30 cm	140	134	128	5.5

At both depths, there was a significant linear increase in soil K level with increasing rate of K, but it did not vary with increasing rates of N and Mg. Also, no significant variation in soil Mg levels was found with increasing rates of any of the treatments. No interactions were found between increasing rates of N and K, N and Mg, and K and Mg.

TABLE 19 - *Effects of different rates of N, K and Mg rates on the soil Mg status (mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	62	61	61	5.8
15-30 cm	64	56	58	6.5
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	61	67	56	5.8
15-30 cm	60	60	57	6.5
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	64	64	56	5.8
15-30 cm	61	54	63	6.5

TABLE 20 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration - Main effects only*

Leaf nutrient		N Level (kg ha^{-1} yr^{-1} N) 240	420	600	SE
N	(%)	3.11	3.28	3.30	0.051
K	(%)	1.47	1.42	1.46	0.019
Mg	(%)	0.24	0.23	0.23	0.004
Ca	(%)	0.81	0.80	0.80	0.022
		K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	(%)	3.25	3.23	3.21	0.051
K	(%)	1.40	1.47	1.48	0.019
Mg	(%)	0.23	0.23	0.23	0.004
Ca	(%)	0.84	0.79	0.79	0.022
		Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	(%)	3.22	3.25	3.23	0.051
K	(%)	1.45	1.47	1.43	0.019
Mg	(%)	0.22	0.23	0.24	0.004
Ca	(%)	0.78	0.84	0.79	0.022

Leaf N concentration increased significantly with increasing rates of N, while Mg concentration decreased significantly but K and Ca concentrations did not vary significantly. In fact Mg, K and Ca in soil did not vary with increasing rates of N. Nevertheless, leaf K concentration increased significantly with increasing rates of K, but did not vary with increasing rates of either N or Mg. Leaf Ca concentrations did not show any significant variation with the treatments.

Plants in the experimental plots were pruned in July 2001, fresh pruning weights were taken, and dolomite applied at the rate of 1500 kg ha^{-1}. The new growth was tipped. Stem circumference at 5 cm height from the base, circumference of secondary branches 2.5 cm below the pruned cut, and number of secondary pruning sticks on the frame were measured/ counted in October. Secondary branches below the pruned cut were labelled for future measurements. Data collected are being statistically analyzed. The experiment continues

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

5) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2026, Field No. 4B, Lumbini Estate, Deniyaya - (1999)

Data collected over the period of December 1999 to the end of May 2000, following commencement, have been analyzed statistically and kept as base information.

The yields obtained in the 3rd year (June 2000 to May 2001) are presented in Table 21. So far, no significant variation was found on yield with increasing rates of any of the treatments.

Determinations made in August 2000, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 22, 23 and 24 respectively, while leaf N, K, Mg and Ca concentrations are presented in Table 25.

At both the depths, so far, soil pH did not vary significantly with increasing rates of any of the treatments, including N although generally it decreased with increasing rates of N.

So far, at both depths, soil K level did not vary significantly with increasing rate of any of the treatments including K, but Mg in soil decreased significantly with increasing rates of K, but did not vary with increasing rates of N and Mg. No interactions were found between increasing rates of N and K, N and Mg, and K and Mg.

So far, none of the leaf nutrient concentrations varied significantly with the treatments. However, an increasing tendency in K concentration was observed with increasing rates of applied K.

TABLE 21 - *Effects of different rates of N, K and Mg on the yield (3rdt year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	4805	4776	4969	4850	
420	5121	5096	5012	5076	SE 88
600	5005	5175	5046	5075	
Mean	4977	5016	5009	5001	SE 153
					SE 88

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	5074	4699	4778	4850	
420	4964	5222	5043	5076	SE 88
600	4935	5050	5240	5075	
Mean	4991	4990	5020	5001	SE 153

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	5192	4804	4935	4977	
210	4985	5082	4980	5016	SE 88
300	4796	5085	5146	5009	SE 153

TABLE 22 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	4.85	4.81	4.80	0.059
15-30 cm	4.72	4.72	4.71	0.050
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	4.82	4.86	4.77	0.059
15-30 cm	4.74	4.76	4.64	0.050
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	4.86	4.82	4.78	0.059
15-30 cm	4.74	4.70	4.70	0.050

TABLE 23 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	72	74	73	4.9
15-30 cm	55	58	55	3.7
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	67	72	80	4.9
15-30 cm	50	58	60	3.7
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	76	71	72	4.9
15-30 cm	59	55	54	3.7

TABLE 24 - *Effects of different rates of N, K and Mg on the soil Mg status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	96	92	93	6.1
15-30 cm	80	83	81	5.8
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	97	102	82	6.1
15-30 cm	89	87	68	5.8
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	95	92	94	6.1
15-30 cm	81	78	84	5.8

TABLE 25 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration- Main effects only*

Leaf nutrient		*N Level (kg ha^{-1} yr^{-1} N)* 240	420	600	SE
N	(%)	3.10	3.17	3.15	0.049
K	(%)	1.28	1.20	1.24	0.040
Mg	(%)	0.24	0.24	0.24	0.005
Ca	(%)	1.17	1.10	1.14	0.028
		K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	(%)	3.12	3.13	3.18	0.049
K	(%)	1.17	1.26	1.29	0.040
Mg	(%)	0.24	0.24	0.24	0.005
Ca	(%)	1.15	1.12	1.14	0.028
		Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	(%)	3.13	3.17	3.12	0.049
K	(%)	1.24	1.20	1.28	0.040
Mg	(%)	0.24	0.23	0.24	0.005
Ca	(%)	1.12	1.11	1.18	0.028

Plants in the experimental plots were pruned in November 2001, fresh pruning weights were taken, and dolomite applied at the rate of 1000 kg ha^{-1}. The experiment continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

6) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.

Clone TRI 3019, Field No.2, Ury Estate, Passara - (1999)

The yield obtained in the 4th year (September 2000 to August 2001) after pruning is presented in Table 26.

So far, no significant effect on yield was found with increasing rates of any of the treatments.

TABLE 26 - *Effects of different rates of N, K and Mg on the yield (4th year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	2519	2534	2527	2526	
420	2486	2612	2526	2541	SE 29
600	2551	2589	2561	2567	
Mean	2519	2578	2538	2545	
		SE 29			SE 50

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	2506	2634	2439	2526	
420	2554	2506	2564	2541	SE 29
600	2538	2610	2553	2567	
Mean	2533	2583	2519	2545	SE 50

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	2461	2545	2550	2519	
210	2624	2614	2496	2578	SE 29
300	2512	2591	2511	2538	SE 50

Determinations made in June 2001, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 27, 28 and 29 respectively, while leaf N, K, Mg and Ca concentrations are presented in Table 30.

TABLE 27 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	4.62	4.50	4.43	0.068
15-30 cm	4.70	4.63	4.46	0.082
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	4.55	4.51	4.49	0.068
15-30 cm	4.58	4.66	4.54	0.082
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	4.54	4.58	4.43	0.068
15-30 cm	4.62	4.63	4.54	0.082

No significant variation in soil pH was found with increasing rates of N and as well as with K or Mg at both the depths, however the decreasing trends were found at both the depths with increasing rates of N.

TABLE 28 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) - Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)				
0-15 cm	246	262	247	12
15-30 cm	209	227	210	11
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)				
0-15 cm	237	242	275	12
15-30 cm	198	227	222	11
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)				
0-15 cm	263	252	240	12
15-30 cm	212	220	215	11

Although K in soil did not significantly increase with increasing rates of K fertilizer, the trends exist particularly at the 0-15 cm depth. It did not vary significantly either with increasing rate of N or Mg fertilizer so far. Magnesium in soil did not vary significantly with any of the treatments so far.

TABLE 29 - *Effects of different rates of N, K and Mg on the soil Mg status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	110	107	101	9.7
15-30 cm	87	103	82	7.9
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	107	111	100	9.7
15-30 cm	88	97	86	7.9
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	103	110	105	9.7
15-30 cm	87	90	94	7.9

TABLE 30 - *Effects of different rates of N, K and Mg status (mg kg^{-1}) on the leaf nutrient concentration - Main effects only*

Leaf nutrient		*N Level (kg ha^{-1} yr^{-1} N)*			SE
		240	420	600	
N	(%)	3.51	3.56	3.70	0.040
K	(%)	1.21	1.19	1.20	0.029
Mg	(%)	0.25	0.23	0.23	0.005
Ca	(%)	0.91	0.86	0.89	0.023
		K level (kg ha^{-1} yr^{-1} K_2O)			
		120	210	300	
N	(%)	3.56	3.59	3.63	0.040
K	(%)	1.18	1.18	1.23	0.029
Mg	(%)	0.23	0.24	0.24	0.005
Ca	(%)	0.89	0.90	0.87	0.023
		Mg level (kg ha^{-1} yr^{-1} MgO)			
		60	105	150	
N	(%)	3.61	3.59	3.58	0.040
K	(%)	1.21	1.16	1.23	0.029
Mg	(%)	0.24	0.24	0.25	0.005
Ca	(%)	0.88	0.89	0.88	0.023

Leaf N concentration increased significantly with increasing rates of N, while K, Mg and Ca concentrations did not vary significantly. However, a decreasing trend in leaf Mg was observed with increasing rates of N. In fact, leaf K concentration did not vary significantly despite the increase of available K in soil with increasing rates of K, indicating sufficiency or even luxury consumption.

The plants in the experimental plots were pruned in the later part of September 2001, fresh pruning weights were taken, and dolomite applied at the rate of 1000 kg ha^{-1}. Stem circumference at 5 cm height from the base, circumference of secondary branches 2.5 cm below the pruned cut, and number of secondary pruning sticks on the frame were measured/ counted in November 2001. Secondary branches below the pruned cut were labelled for future measurements. The plants were tipped in December. The data collected over the pruning phase are being analyzed statistically. The experiment continues.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

7) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No.23, Rangala Estate, Karaliyadda - (2000)

Soil and leaf samples were obtained from the plots in June 2001 and analyzed for the required parameters. Plants in the experimental plots were pruned in July 2001, and the pruning weights taken, and dolomite applied at the rate of 1500 kg ha^{-1}. Stem circumference at 5 cm height from the base, circumference of secondary branches 2.5 cm below the pruned cut, and number of pruning sticks on the frame were measured/counted in September 2001. Secondary branches below the pruned cut were labelled for future measurements. Data collected over the period of June to September 2001, following pruning in July, have been analyzed statistically and kept as base information. The experiment continues.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

8) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No NC5, Midlands Estate, Ratthota - (2000)

Soil and leaf samples obtained from the plots, prior to treatment application in February 2001, have been analyzed for the required parameters. In order to find whether there was significant variation among plots, yields were recorded during

May to mid June, 2001 (after an application of N at the rate of 80 kg ha^{-1} yr^{-1}) for covariance analysis, if necessary. Data collected over the above period, following commencement, have been analyzed statistically and kept as base information. The experiment continues

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

b) Effects of application of different rates of N and K (and frequencies) on growth, soil/plant nutrient status and yield.

1) Effects of different rates of N (100, 200, 300, 400 and 500 kg ha^{-1} yr^{-1} N) and K (in 100, 300 and 500 kg ha^{-1} yr^{-1} K) on soil/plant nutrient status and yield of tea. Clone TRI 2025, St.James Estate, Hali Ela - (1990)

The plants in the experimental plots (30 per plot) were pruned in the later part of December 2000 and fresh pruning weights were recorded and dolomite applied at the rate of 2000 kg ha^{-1}. Stem circumference at 5 cm height from the base, circumference of secondary branches 2.5 cm below the pruned cut, and number of secondary pruning sticks on the frame were measured/counted in January 2001. Secondary branches below the pruned cut were labelled for future measurements.

Fresh pruning weight, base stem circumference, average circumference of secondary branches 2.5 cm below the pruned cuts, and yield obtained in the 1st year of the cycle are given in Tables 31, 32, 33 and 34 respectively.

TABLE 31 - *Effect of increasing levels of potash with N on fresh pruning weight (kg plot^{-1})*

	Weight				
	K_2O (kg ha^{-1} yr^{-1})				
N	100	300	500	Mean	
(kg ha^{-1} yr^{-1})					
100	53	54	50	52	
200	67	54	55	58	
300	62	63	61	62	SE 3.6
400	72	60	68	67	
500	72	82	62	72	
Mean	65	63		59	62
		SE 2.8			SE 6.2
					LSD (0.05) = 17
					CV % 24

The pruning weight increased significantly with increasing rate of N but not with K, and there was no interaction between N and K rates.

TABLE 32 - *Effect of increasing levels of potash with N on base circumference* (cm) *of plants*

N (*kg ha^{-1} yr^{-1}*)	*K_2O (kg ha^{-1} yr^{-1})* 100	300	500	Mean	
100	45.6	46.1	48.2	46.6	
200	46.7	47.8	49.2	47.9	
300	46.3	47.4	45.1	46.3	SE 0.88
400	47.3	48.5	46.7	47.5	
500	48.9	44.6	46.0	46.5	
Mean	47.0	46.9		47.0	47.0
		SE 0.69			SE 1.52
					LSD (0.05) 4.27

Even after the application of N and K fertilizers over 2 cycles duration, the base and secondary branch circumferences have not varied significantly either due to increasing rates of N or K. This was despite the significant increase in pruning weight with increasing rates of N.

TABLE 33 - *Effect of increasing levels of potash with N on average circumference of secondary branches (cm)*

N (*kg ha^{-1} yr^{-1}*)	*K_2O (kg ha^{-1} yr^{-1})* 100	300	500	Mean	
100	5.0	5.1	5.1	5.1	
200	5.0	5.2	4.9	5.0	
300	5.0	5.3	5.2	5.2	SE 0.15
400	5.2	5.1	5.6	5.3	
500	5.0	5.3	5.2	5.2	
Mean	5.0	5.2	5.2		
		SE 0.09			SE 0.20
					LSD (0.05) 0.56

No significant influences in yield have been observed due to increasing rates of N or K fertilizers until the last year, although an incremental rate ranging from 10 to 18 kg MT in yield per 100kg N was observed during last two years for the fitted linear response. However, yield in the 1st year of this cycle, varied significantly with increasing rates of N and the pattern was that it increased up to 200 to 300 kg N ha^{-1} yr^{-1}, and thereafter decreased.

TABLE 34 - *Effect of increasing levels of potash with N on yield of tea (kg MT ha^{-1} yr^{-1}) of tea.*

N (*kg ha^{-1} yr^{-1}*)	*K_2O (kg ha^{-1} yr^{-1})* 100	300	500	Mean	
100	213	192	229	211	
200	247	236	208	230	
300	216	212	206	212	SE 6.0
400	214	192	181	195	
500	176	183	214	191	
Mean	213	203	208	208	
		SE 33			SE 10
					LSD (0.05) = 29
					CV % 12

The effects of N and potash applications on pH and K status of soil, and leaf N and K are given in Tables 35, 36, 37 and 38 respectively. Significant linear reductions in soil pH have been observed with increasing rates of N fertilizer at both depths, although estimations made in the year 2000 did not show it clearly. This year's estimation clearly showed there was a significant decrease at both depths with increasing rates of N. This was despite adding dolomite at 2000 kg ha^{-1}, as the overall average of soil pH determined at 0-15 cm depth prior to pruning was 4.1. As observed previously, there was no influence on pH with increasing K fertilizer rates.

TABLE 35 - *Effect of increasing levels of potash with N on soil pH at two depths - Main effects only*

Level of N (kg ha^{-1} yr^{-1})	*Soil pH* *0-15 cm*	*15-30 cm*
100	5.00	5.27
200	5.00	5.09
300	4.86	5.00
400	4.83	4.93
500	4.68	4.64
SE	0.056	0.065
Level of K_2O (kg ha^{-1} yr^{-1})		
100	4.85	4.93
300	4.88	4.95
500	4.93	5.04
SE	0.043	0.05
CV %	4.9	5.5

TABLE 36 - *Effect of increasing levels of potash with N on soil ex: K status (mg kg^{-1}) at 0-15 cm depth*

N (*kg ha^{-1} yr^{-1}*)	K_2O (*kg ha^{-1} yr^{-1}*) 100	300	500	Mean	
100	193	228	212	211	
200	219	222	294	245	
300	194	247	245	228	SE 6.1
400	195	247	262	235	
500	207	241	269	239	
Mean	202	237	256	232	
		SE 4.7			SE 11
					LSD (0.05) = 30
					CV % 11

TABLE 37 - *Effect of increasing levels of potash with N on soil ex: K status (mg kg^{-1}) at 15-30 cm depth*

N (*kg ha^{-1} yr^{-1}*)	K_2O (*kg ha^{-1} yr^{-1}*) 100	300	500	Mean	
100	218	249	246	238	
200	252	262	239	251	
300	245	267	278	263	SE 6.1
400	232	269	310	270	
500	211	260	315	262	
Mean	232	261	277	257	
		SE 4.7			SE 10.5
					LSD (0.05) = 30
					CV % 10

As can be expected, this year's estimation on soil K levels also showed a significant linear increase with increasing potash rates at both depths. Although there was no significant influence with increasing N rates so far, this year's estimation showed that it varied significantly and, surprisingly, it increased with N rates. As often observed previously, leaf N concentration measured this year also increased significantly with increasing rates of N but did not vary with K fertilizer, while K concentration increased significantly only with increasing rates of K.

TABLE 38 - *Effect of increasing levels of potash with N on leaf N and K status*

Level of N ($kg\ ha^{-1}\ yr^{-1}$)	*Leaf nutrient (%)*	
	N	*K*
100	3.27	1.55
200	3.26	1.56
300	3.31	1.58
400	3.42	1.56
500	3.51	1.56
SE	0.044	0.014
Level of K_2O ($kg\ ha^{-1}\ yr^{-1}$)		
100	3.31	1.52
300	3.38	1.58
500	3.37	1.59
SE	0.034	0.011
CV %	5.6	3.8

This experiment continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of split application of N and K fertilizer in mature tea in relation to N/K antagonism.

Clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

The data collected over 2 pruning cycles (June 1990 to December 2000) are being analyzed in detail with a view to publishing the overall findings, and work continues.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 300 and 480 kg ha^{-1} yr^{-1} K_2O) and frequencies (6, 8 & 12 weekly intervals) on growth, soil/plant nutrient status and yield of tea. Clone TC9, Brunswick Estate, Maskeliya - (1998)

The yields obtained from the 4th year after pruning (i.e. October 00 to September 01) are presented in Table 39.

Surprisingly, no significant increase in yield was observed with increasing rates of N even in the 4th year similar to that in the 3rd year. In the 2nd year, it had increased significantly and linearly, in keeping with the trend in the 1st year. Also, as seen before, no significant effects have so far been found either in relation to increasing rates of K or different frequencies.

TABLE 39 - *Effects of different rates of N and K applied at different frequencies on the yield (4th year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
240	5001	5046	5021	5023	
420	5043	5058	4982	5027	SE 21
600	5054	5020	5017	5031	
Mean	5033	5041	5007	5027	
		SE 21			SE 36

N Level (kg ha^{-1} yr^{-1} N)	*Frequency (weeks interval)*				
	6	8	12	Mean	
240	5014	5068	4985	5023	
420	4959	5022	5102	5027	SE 21
600	5062	5063	4967	5031	
					SE 36

K Level (kg ha^{-1} yr^{-1} K_2O)	*Frequency (weeks interval)*				
	6	8	12	Mean	
120	5029	5030	5038	5033	
300	5023	5077	5023	5041	SE 36
480	4983	5045	4993	5007	

Determinations made in July 2001, of soil pH, K and Mg levels from 0-15 cm depth are presented in Tables 40, 41 and 42 while leaf N, K and Mg concentrations are presented in Tables 43, 44 and 45 respectively.

The decreasing linear pattern of soil pH with increasing rates of N, which has been significant so far, was surprisingly not observed in the 4th year estimation at the 0-15 cm depth, even tough a trend was present. No significant effect has so far been found in relation to increasing rates of K.

Soil K levels determined in the 4th year also showed a significant increase with increasing rates of K. Yet, a declining trend was seen with increasing rates of N like in the 3rd year although in the 2nd year's estimation, it declined significantly.

However, no significant interaction has so far been found in relation to increasing rates of N and K. On the other hand, soil Mg levels determined in the 4th year as well as in the 1st, 2nd and 3rd years were not influenced significantly with increasing rates of K. The Mg levels determined in the 4th year, did not show any significant variation with increasing rates of N, although it decreased significantly in the 2nd and 3rd year estimations.

Leaf N concentration determined in the 4th year also showed a significant increase with increasing rates of N but there has so far been no influence due to increasing rates of K. No significant interaction was also observed in relation to increasing rates of N and K. Leaf K concentration has not been influenced by the increasing rates of N, but the concentrations increased significantly with increasing rates of K. This feature was observed from the 2nd and 3rd years' estimations as well. So far, leaf Mg concentration has not been influenced either by increasing rates of N or K. This was despite the fact that soil Mg level determined in the 2nd and 3rd years, decreased significantly with increasing rates of N although it was not so in the 4th year.

TABLE 40 - *Effects of different rates of N and K applied at different frequencies on the soil pH (4th year) from the 0-15cm depth - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4th year					
240	4.61	4.71	4.50	4.61	
420	4.46	4.42	4.37	4.42	SE 0.064
600	4.43	4.42	4.43	4.42	
Mean	4.50	4.51	4.43	4.48	
		SE 0.064			SE 0.110

TABLE 41 - *Effects of different rates of N and K applied at different frequencies on the soil K (mg kg^{-1}; in 4th year) from the 0-15cm depth - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4th year					
240	261	348	369	326	
420	179	269	386	278	SE 11
600	191	306	387	294	
Mean	210	308	381	299	
		SE 11			SE 20

TABLE 42 - *Effects of different rates of N and K applied at different frequencies on the soil Mg (mg kg^{-1} ; in 4^{th} year) from the 0-15cm depth - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4^{th} year					
240	43	77	38	53	
420	49	44	58	51	SE 6.3
600	39	49	46	44	
Mean	44	57	47	49	
		SE 6.3			SE 11

TABLE 43 - *Effects of different rates of N and K applied at different frequencies on the leaf N % (4^{th} year)- Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4^{th} year					
240	3.23	3.12	3.18	3.17	
420	3.23	3.31	3.22	3.25	SE 0.027
600	3.28	3.28	3.29	3.28	
Mean	3.25	3.24	3.23	3.24	
		SE 0.027			SE 0.047

TABLE 44 - *Effects of different rates of N and K applied at different frequencies on the leaf K% (4^{th} year) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4^{th} year					
240	1.23	1.30	1.32	1.28	
420	1.25	1.25	1.30	1.27	SE 0.012
600	1.22	1.24	1.30	1.26	
Mean	1.23	1.26	1.31	1.28	
		SE 0.012			SE 0.020

TABLE 45 - *Effects of different rates of N and K applied at different frequencies on the leaf Mg % (4^{th} year) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	300	480	Mean	
4^{th} year					
240	0.14	0.13	0.13	0.14	
420	0.13	0.13	0.13	0.13	SE 0.003
600	0.13	0.13	0.13	0.13	
Mean	0.14	0.13	0.14	0.13	
		SE 0.003			SE 0.004

This experiment continues.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

c) Effects of application of different rates of K_2O at two levels of N viz. 240 and 360 kg ha^{-1} yr^{-1} as urea and sulphate of ammonia on growth, soil/plant nutrient status and yield.

1) Effects of application of 6 levels of potash (60-360 kg ha^{-1}yr^{-1}) with 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/ plant K and Mg status and yield of tea. Clone TRI 2025, Halgolla Estate, Yatiyantota - (1984)

The data collected over 3 pruning cycles (October 1984 to March 1996) are being analyzed in detail with a view to publishing the overall findings, and work continues.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K. Hettiarachchi

d) Effects of application of different levels of N with different levels of compost manure on growth, soil/plant nutrient status and yield.

1) Effects of seven different levels of N (0 to 720 kg ha^{-1} yr^{-1}) with compost manure (at 0 and 5 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea. Clone DT1, St.Coombs Estate, Talawakelle - (1992)

The yield obtained during the period August 2000 to July 2001, in the 3rd year of the cycle, soil pH, and K levels at 0-15 cm depth, and leaf N and K are given in Tables 46, 47, 48 and 49, and 50 respectively.

As observed during most of the years, yield in the 3rd year of the cycle also showed a significant increase with increasing rates of N and curvi-linearly with increasing rates of N up to 480 and then flattening out like previously, except in last year's linear pattern. So far, compost had no significant overall effect, nor was there an interaction. However, unlike earlier observations, in this year data did not show the widening pattern of yield between compost application and no compost application.

TABLE 46 - *Effect of different levels of nitrogen with and without compost on yield of tea*

Treatments N level	*Yield (MT kg ha^{-1})*			
	Compost			
	Nil	5t	Mean	
N				
0	1899	1863	1881	
120	2230	2246	2238	
240	2266	2338	2302	
360	2393	2375	2384	SE 32
480	2401	2466	2433	
600	2496	2339	2417	
720	2456	2437	2447	
Mean	2135	2223	2179	
	SE 17			SE 46
				LSD (0.05) 139
				CV% 2.8

TABLE 47 - *Effect of different levels of nitrogen with and without compost on soil pH*

Treatments N level	*Soil pH*			
	Compost			
	Nil	5t	Mean	
N				
0	4.20	4.45	4.33	
120	4.15	4.05	4.10	
240	4.10	4.15	4.13	
360	4.10	4.05	4.08	SE 0.099
480	4.00	4.20	4.10	
600	4.30	4.25	4.28	
720	4.30	4.15	4.23	
Mean	4.16	4.19	4.18	
	SE 0.053			SE 0.141
				LSD (0.05) 0.430
				CV% 4.8

Surprisingly, pH levels determined in November 2000 and July 2001 from 0-15 cm depth did not vary significantly like last year's estimation made in July 2000. But the levels determined in July 1999, from the same depth, decreased significantly with increasing rates of N, despite dolomitic-limestone application at the rate of 1500 kg ha^{-1} in August 1998.

TABLE 48 - *Effect of different levels of nitrogen with and without compost on soil exchangeable K*

Treatments N level	*Soil ex. K (mg kg^{-1})*			
		Compost		
	Nil	5t	Mean	
N				
0	163	148	155	
120	208	230	219	
240	208	169	188	
360	245	201	223	SE 21
480	210	273	241	
600	210	240	225	
720	213	215	214	
Mean	208	211	209	
	SE 11			SE 30 LSD (0.05) 92 CV% 20

TABLE 49 - *Effect of different levels of nitrogen with and without compost on leaf N concentration*

Treatments N level	*Leaf N (%)*			
		Compost		
	Nil	5t	Mean	
N				
0	3.45	3.20	3.33	
120	3.20	3.30	3.25	
240	3.05	3.40	3.23	
360	3.00	3.25	3.13	SE 0.066
480	3.25	3.15	3.20	
600	3.20	3.20	3.20	
720	3.55	3.20	3.38	
Mean	3.24	3.24	3.24	
	SE 0.035			SE 0.093 LSD (0.05) 0.284 CV% 4.1

Soil K levels, in general, are expected to drop when excessive nitrogen is applied to soil, but at this site, no such trends have so far been observed. The quantity of potash supplied for plots was 180 kg ha^{-1} except for nil N plots. Soil K levels in the nil N plots were, therefore, considerably lower compared to other treatments. As far as leaf N and K concentrations are concerned, no significant influences have so far been found with increasing rates of N fertilizer or compost application.

TABLE 50 - *Effect of different levels of nitrogen with and without compost on leaf K concentration*

Treatments N level	*Leaf K (%)*			
		Compost		
N	Nil	5t	Mean	
0	1.37	1.44	1.40	
120	1.31	1.43	1.37	
240	1.35	1.36	1.35	
360	1.38	1.38	1.38	SE 0.049
480	1.29	1.39	1.34	
600	1.44	1.40	1.42	
720	1.41	1.34	1.37	
Mean	1.36	1.39	1.38	
	SE 0.026			SE 0.070 LSD (0.05) 0.214 CV% 7.1

This experiment continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of three different levels of N (200, 400 and 600 kg ha^{-1} yr^{-1}) with different levels of compost manure (at 0, 10, 20 and 30 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Baddegama Estate, Baddegama - (2000)

Data collected before and after imposing treatments, during the period June 2000 to end December 2001, are being analyzed statistically. The experiment continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of three different levels of N (200, 400 and 600 kg ha^{-1} yr^{-1}) with different levels of compost manure (at 0, 10, 20 and 30 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2026, Anninkande Estate, Deniyaya - (2001)

A mature tea field, last pruned in February 1998, was chosen and soil and leaf samples were obtained from the field and analyzed for the required parameters. Thereafter, 36 plots, each consisting of 40 plants, were marked. The experiment, which commenced in January 2001, continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

e) Effects of application of different rates and proportions of urea and sulphate of ammonia on growth, soil/plant nutrient status and yield.

1) Effects of application of different rates of N as urea and sulphate of ammonia (240 and 360 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, St. Coombs Estate, Talawakelle (May 1979)

The yield obtained during the 1st year of the 6th cycle is given in Table 51. On the average, application of N at 360 kg ha^{-1} yr^{-1} gave 97 kg more crop than the 240 kg ha^{-1} yr^{-1}, although this difference was not quite significant. During 1st and 2nd years of the previous cycle also, application of N at the higher rate gave more crop than the lower rate and this difference became significant only in the 3rd and 4th years. During this year as well, the effects of Urea:S/A ratio and its interaction on yield were not significant.

TABLE 51 - *Effect of different proportions of Urea:S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

Proportions (%) Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 240	360	Mean	
100:0	945	1086	1016	
75:25	964	1012	988	
50:50	1055	1052	1054	SE 60
25:75	956	1119	1038	
0:100	913	1049	981	
Mean	967	1064	1015	
	SE 38			SE 85 (18 df)
				CV 14 %

The effect of application of Urea and S/A on soil pH and sulphate sulphur levels (at 0-15 and 15-30 cm), and leaf sulphur concentrations are given in Tables 52, 53, 54 and 55 respectively.

TABLE 52 - *Effect of application of different proportions of Urea:S/A at 240 and 360 N(kg ha^{-1} yr^{-1}) on soil pH at 0-15 cm depth*

Proportions (%) Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 240	360	Mean	
100:0	4.18	4.08	4.13	
75:25	4.14	3.94	4.04	
50:50	4.05	3.79	3.92	SE 0.061
25:75	4.23	3.93	4.08	
0:100	3.93	3.77	3.85	
Mean	4.11	3.90	4.00	
	SE 0.039		SE 0.087(18 df) CV 3.8%	

After applying dolomitic limestone at the rate of 1500 kg ha^{-1}, at the time of pruning in July 2000, soil pH levels determined in the 1st year (July 2001), at 0-15 cm depth where N was applied at the rate of 360 kg ha^{-1} yr^{-1}, was significantly lower compared to 240 N. At the 15-30 cm depth also it was lower, although not significant. In spite of this, soil pH levels had decreased significantly, and linearly, as the proportion of S/A increased in Urea + S/A combinations particularly at the 0-15 cm depth. At the 15-30 cm depth, it was not pronounced although a trend was observed like in the initial phase of the previous cycle.

TABLE 53 - *Effect of application of different proportions of Urea:S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on soil pH at 15-30 cm depth*

Proportions (%) Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 240	360	Mean	
100:0	4.48	4.22	4.35	
75:25	4.29	4.44	4.37	
50:50	4.25	4.14	4.20	SE 0.123
25:75	4.43	4.12	4.27	
0:100	4.03	3.99	4.01	
Mean	4.30	4.18	4.24	
	SE 0.077		SE 0.172(18 df) CV 7.0%	

TABLE 54 - *Effect of application of different proportions of Urea and S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on soil sulphate sulphur levels at the 0-15 and 15-30 cm depths*

Proportions(%)	*$(SO_4)^{2-}$-S (mg kg^{-1})*	
Urea:S/A	*0-15 cm*	*15-30 cm*
100:0	107	140
75:25	183	226
50:50	259	331
25:75	228	269
0:100	279	332
SE	16	25
LSD (0.05)	47	76
CV %	18	24
Level of N (kg ha^{-1} yr^{-1})		
240	195	242
360	227	277
SE	10	16
LSD (0.05)	30	48

TABLE 55 - *Effect of application of different proportions of Urea and S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on total Leaf S concentration*

Proportions(%)	*(Total S) (%)*
Urea:S/A	
100:0	0.38
75:25	0.39
50:50	0.38
25:75	0.37
0:100	0.38
SE	0.009
LSD (0.05)	0.027
CV %	5.9
Level of N (kg ha^{-1} yr^{-1})	
240	0.37
360	0.39
SE	0.006
LSD (0.05)	0.018

Although no significant differences were observed on most occasions in soil sulphate sulphur levels between the two N rates at either depth, a surprisingly significant difference was seen to exist at 0-15cm depth, similar to that observed in the 1999 estimation. As has been observed, there was a significant linear reduction in soil sulphate sulphur as the proportion of urea increased in the combinations, at both depths. However, leaf sulphur concentrations were not yet affected either due to Urea + S/A combinations or N rates, as can be seen from Table 55. This experiment continues as a long-term trial.

S.Ananthacumaraswamy, G.P.Gunaratne,
A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2027, Field No.8, Talgaswela Estate, Galle - (1999)

The yield obtained during the 2nd year (September 1999 to August 2000) of the cycle is given in Table 56.

No significant effect on yield was found with the application of N in different proportions of Urea:S/A, but increasing rates of N significantly increased yield and the pattern of increase was linear. Data collected are being analyzed statistically.

TABLE 56 - *Effect of different proportions of Urea:S/A at 200, 300, 400 and 500 N(kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

Proportion Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 200	300	400	500	Mean	
100:0	3664	4151	3851	3828	3874	
75:25	3372	4068	3789	4072	3825	
50:50	3829	4094	3680	4042	3912	SE 103
25:75	3795	4228	3685	3956	3916	
0:100	3824	3990	3825	4450	4022	
Mean	3697	4106	3766	4070	3910	
			SE 92			SE 206 (38 df)
						CV 9.1%

Plants in the experimental plots were pruned in October 2001 and fresh pruning weights were taken, and dolomite applied at the rate of 2000 kg ha^{-1}. This experiment is being carried out as part of a post-graduate study on S nutrition, and as such detailed investigations are underway. Samples collected from the commencement of this experiment are being analyzed statistically. The experiment continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300 and 400 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 3018, Field No.2, Ury Estate, Passara - (1999)

The yield obtained during the 4th year (October 2000 to September 2001) of the cycle is given in Table 57.

TABLE 57 - *Effect of different proportions of Urea:S/A at 200, 300 and 400 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

	Level of N (kg ha^{-1} yr^{-1})				
Proportions Urea:S/A	200	300	400	Mean	
100:0	1781	1735	1857	1791	
75:25	1822	1914	1849	1862	
50:50	1785	1813	1844	1814	SE 27
25:75	1810	1745	1832	1796	
0:100	1843	1847	1905	1865	
Mean	1808	1811	1857	1825	
			SE 21		SE 47 (42 df)
					CV 5.1%

No significant effect on yield was found either for application of N as different proportions of Urea:S/A, or increasing rates of N.

Plants in the experimental plots were pruned in September 2001, fresh pruning weights were taken, and dolomite applied at the rate of 1500 kg ha^{-1}. This experiment is being carried out as part of a post-graduate study on S nutrition, and as such detailed investigations are underway. Samples collected from the commencement of this experiment are being analyzed statistically. The experiment continues.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa,
L.S.K.Hettiarachchi

4) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2023, Field No.3, Upper Division, Mahaousa Estate, Madulkelle - (2001)

A mature tea field, last pruned in July 1999, was chosen in February 2001, and 60 plots each consisting of 30 plants were marked and the experiment was commenced. This experiment is being carried out as part of a post-graduate study on S nutrition, and as such detailed investigations are underway.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne,
A.K.N.Zoysa, L.S.K.Hettiarachchi

5) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2026, Field No.7, St. Francis Division, Millakande Estate, Horana - (2001)

A mature tea field, last pruned in July 2000 was chosen in May 2001, and 60 plots each consisting of 30 plants were marked and the experiment was commenced. This experiment is being carried out as part of a post-graduate study on S nutrition, and as such detailed investigations are underway.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne,
A.K.N.Zoysa and L.S.K.Hettiarachchi

6) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2026, Field No.13, B Division, Kiruwangange Estate, Deniyaya - (2001)

A mature tea field, last pruned in February 2001, was chosen in September, and 60 plots each consisting of 30 plants were marked and the experiment was commenced. This experiment is being carried out as part of a post-graduate study on S nutrition, and as such detailed investigations are underway.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

7) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No.3A, Lower Abbotsford Division, Dessford Estate, Nanu-oya - (2001)

An immature tea field, planted in 1996, was chosen in October 2001, and 60 plots each consisting of 30 plants were marked and the experiment was commenced.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne,
A.K.N.Zoysa, L.S.K.Hettiarachchi

g) Effects of application of different sources of organic manure on improvement of soil organic matter, growth, soil/plant nutrient status and yield.

1) Effects of application of different sources of organic manure on improvement of soil organic matter, growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Bearwell Estate, Talawakelle - (1990)

Plants (50 per plot) in the experimental plots were pruned in December 2000 and fresh pruning weights taken are given in Table 58.

TABLE 58 - *Effects of different organic manures at 5 and 10 t ha^{-1}, and N at 0 and 240 kg ha^{-1} yr^{-1} on the fresh pruning weight (kg $plot^{-1}$) - Main effects only*

N	0	240	
	99	104	SE 3.0

Organic Manure		*Compost*	*Cow dung*	*Mana grass*	*Guatemala grass*	
		101	102	99	105	SE 4.3
Rates	5 t ha^{-1}		10 t ha^{-1}			
	99		104	SE 3.0		

CV% 15
Overall mean 102

The pruning weight has not been significantly influenced by any of the treatment application over the 2 cycles, except that it was marginally higher where N was applied at the rate of 240 kg ha^{-1} yr^{-1} compared to none. Investigation in this experiment was concluded with the completion of 2 pruning cycles following the recording of pruning weight. The data collected over 2 pruning cycles are to be analyzed together in detail for overall findings and this work continues.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

h) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures on growth, soil/plant nutrient status and yield.

1) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.

Clone TRI 2025, Kiruwanaganga Estate, Deniyaya - (1993)

The data collected over 2 pruning cycles are to be analyzed in detail for overall findings and also collectively with other investigations where sul-po-mag, is being tested for its suitability for tea.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 300 kg N ha^{-1} yr^{-1}, with and without dolomitic-limestone on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Hopton Estate, Passara - (1993)

The investigations in this experiment were concluded with the completion of two pruning cycles following recording of pruning and tipping weights in April 2001. The data collected over 2 pruning cycles are to be analyzed in detail for overall findings and also collectively with other investigations where sul-po-mag, is being tested for its suitability for tea.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Waltrim Estate, Talawakelle - (1994)

The yield obtained in the 3rd year of the second cycle after commencement and the soil pH levels are presented in Tables 59, and 60 respectively.

As observed during the two years prior to last pruning, significant increases in yield were observed for the application of N at 360 kg ha^{-1} yr^{-1} compared to 240 N in this 3rd year, unlike in the 1st and 2nd years following pruning. There were no significant differences between the other fertilizer treatments.

Unlike in earlier estimations, this year (August 2001) the soil pH levels were significantly lower when N was applied at the rate of 360 kg ha^{-1} yr^{-1}, as compared to 240 N. This year's estimation also showed that pH levels at both depths were considerably lower particularly where T1130 was applied compared to U709 application, though not quite significant at 0-15cm depth. This was despite applying dolomite at 1750 kg ha^{-1} rate in August 1998.

TABLE 59 - *Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite on yield (kg MT ha^{-1} yr^{-1}) of tea.*

Treatments	*Level of Nitrogen (kg ha^{-1} yr^{-1})*			
	240	360	Mean	
U 709 (Urea)	4017	4097	4057	
U 709 + Kieserite	3876	4545	4211	
U 750 Sul-Po-Mag	4076	4549	4313	SE 109
UT Mix. (Urea & S/A)	4108	4167	4138	
T 1130 (S/A)	4052	4532	4292	
Mean	4026	4378	4202	
	SE 69			SE 155
				LSD (0.05) 460
				CV % 6.4

TABLE 60 - *Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite on soil pH levels at 0-15 and 15-30cm depths*

Soil pH at 0-15 cm	*Level of Nitrogen (kg ha^{-1} yr^{-1})*			
Treatments	240	360	Mean	
U 709 (Urea)	4.24	3.86	4.05	
U 709 + Kieserite	4.12	3.96	4.04	
U 750 Sul-Po-Mag	4.18	4.11	4.15	SE 0.114
UT Mix. (Urea & S/A)	4.21	4.72	3.97	
T 1130 (S/A)	3.72	3.66	3.69	
Mean		4.10	3.86	3.98 SE 0.161
SE		0.072		LSD (0.05) 0.479
				CV % 7.0
Soil pH at 15-30 cm				
U 709 (Urea)	4.13	3.81	3.97	
U 709 + Kieserite	3.96	3.94	3.95	
U 750 Sul-Po-Mag	4.32	4.08	4.20	SE 0.063
UT Mix. (Urea & S/A)	3.92	3.94	3.93	
T 1130 (S/A)	3.74	3.74	3.74	
Mean	4.01	3.90	3.96	SE 0.089
SE		0.040		LSD (0.05) 0.263
				CV % 4.3

Soil Mg and K estimations made this year are to be repeated as high coefficients of variations have been encountered. This experiment will continue.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

i) Effects of application of different rates of K and/or Mg on growth, soil/plant nutrient status and yield.

1) Effects of application of increasing rates of kieserite (0 to 75 kg MgO ha^{-1} yr^{-1} at 15 kg increments) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

Investigation in this experiment was also concluded with the completion of 2 cycles following the recording of fresh pruning weight in November 2001. The data collected over 2 pruning cycles are to be analyzed in detail for overall findings and work continues.

H.A.P.Warnasiri, R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of 6 levels of potash (48 to 480 kg ha^{-1} yr^{-1} K_2O) and 2 levels of Mg (0 and 60 kg ha^{-1} yr^{-1} MgO) at 240 kg N ha^{-1} yr^{-1}, on growth, soil/plant K/Mg status and yield of tea. Clone TRI 2025, Glenanore Estate, Haputale - (1991)

Investigations, in this experiment, were concluded with the completion of 2 pruning cycles following the recording of tipping weight in May 2001. The data collected over 2 pruning cycles are to be analyzed together in detail for overall findings and work continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

j) Effects of application of different rates of P fertilizer on growth, soil/plant nutrient status and yield.

1) Effects of application of increasing rates of P as ERP fertilizer (0 to 120 kg P_2O_5 ha^{-1} yr^{-1} at 20 kg increments) on growth, soil/ plant nutrient status and yield of tea Clone TRI 2025, St.Coombs Estate, Talawakelle - (1989)

The data collected over the period of 1989 to 1999 are to be analysed in detail for overall findings, and as well as collectively with other ERP fertilizer related investigations.

H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of increasing rates of P as ERP fertilizer with two methods of application (Broadcast and Incorporated) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Walahanduwa Estate, Galle - (1994)

The investigations in this experiment were concluded with the completion of two pruning cycles following recording of tipping weight in February 2001. The data collected over this period are to be analysed in detail for overall findings and also collectively with other ERP fertilizer related investigations.

H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.3 Estimating crop response to micro nutrients (Zn, B, Mn etc.) at regional level

Five trials were laid down to compare the efficacy of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with commonly used foliar spray formulations.

1) Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025 Field No.3B, St Coombs Estate, Talawakelle - (1999)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rates of N and K_2O supplied are 300 and 150 kg ha^{-1} yr^{-1} respectively. The yield obtained in the 3rd year is given in Table 61.

TABLE 61 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations on yield*

Foliar Fertilization Formulation		*Yield (MT kg ha^{-1} yr^{-1})*
Water (control)		3326
Zinc sulphate		3633
Zinc sulphate + CES		3495
Multiplex		3728
Kiecite		3347
SE	157	
LSD (0.05)	484	
CV %	8.9	

No significant variation in yield has so far been found for foliar fertilization of the different formulations. The experiment will continue.

H.A.P.Warnasiri, T.C.N.Peries, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025 Field No.3, Baddegama Estate, Baddegama - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rates of N and K_2O supplied are 320 and 100 kg ha^{-1} yr^{-1} respectively. Data collected over the period of March 2000 to end March 2001, following commencement, have been analyzed statistically and kept as base information. The trial is in progress.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025 Field No.9, Madulkelle Estate, Madulkelle - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rate of N supplied is 320 kg ha^{-1} yr^{-1} from U709. Data collected over the period of May 2000 to end October 2001, following commencement, have been analyzed statistically and kept as base information. The trial is in progress.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

4) Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025 Field No.3B, Greenwood Estate, Nawalapitiya - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rate of N supplied is 320 kg ha^{-1} yr^{-1} from U709. Data collected over the period of July 2000 to end June 2001, following commencement, have been analyzed statistically and kept as base information. The trial is in progress.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

5) Effects of application of micro nutrient foliar feeds such as Multiplex, Kiecite and Chelamin along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025, Field No.3, Upper Division, Indola Estate, Deniyaya - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rates of N and K_2O supplied are 320 and 100 kg ha^{-1} yr^{-1} respectively. Data collected over the period of March to October 2000, following commencement, have been analyzed statistically and kept as base information. The yield obtained in the 2nd year is given in Table 62.

No significant variation in yield has so far been found with foliar fertilisation of the different formulations. The experiment will continue.

TABLE 62 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with commonly used foliar spray formulations on yield* of tea.

Foliar Fertilization Formulation	*Yield ($MT\ kg\ ha^{-1}\ yr^{-1}$)*	
Water (control)	5078	
Zinc sulphate	5233	
Zinc sulphate + CES	5604	
Multiplex	5737	
Kiecite	5464	
Chelamin	4827	
	SE	310
	LSD (0.05)	984
	CV %	12

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.4 Evaluating effects of macro and micro nutrients on colour and strength of tea liquor

1) Effects of foliar application of phosphorus (0, 1, 2, 3 and 4% DAP and TSP) on plant P status, quality (biochemical parameters) and yield of tea Clones DT 1 and CY9, St.Coombs Estate, Talawakelle - (1992)

The optimum quantities of nutrients have been given by soil fertilisation. However, following the inclusion of TRI2025 clone, no attempt was made during last year for assessing made tea quality but yield records were maintained and soil and plant nutrient status assessed with a view to undertaking quality assessments. This experiment continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of foliar application of muriate of potash (MOP) and sulphate of potash (SOP) fertilizers at 2, 3 and 4% concentrations, along with a control on K-status, quality, growth and yield of tea. Clone TRI 2025, Field No. 5, St.Coombs Estate, Talawakelle - (1999)

Statistical analysis of data on some of the characters, collected over the first attempt during a dry spell (February to April 2001), revealed that it was necessary to repeat measurements and analysis. However, over the observational period no detrimental effects were seen. Treatments are to be imposed again and plans are under way to make assessments, and the experiment will be continued.

P.S.Munasinghe, T.C.N.Peries, G.P.Gunaratne,
A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of foliar application of muriate of potash (MOP) and sulphate of potash (SOP) fertilizers at 2, 3 and 4% concentrations, along with a control on K-status, quality, growth and yield of tea. Clone PK2, Field No. 13, Pedro Estate, Nuwara-Eliya - (2000)

Here again, statistical analysis of data on some of the characters, collected over the dry spell (February to April 2001) revealed that it was necessary to repeat measurements and analysis. Over the observational period no detrimental effects were seen. Treatments are to be imposed again and plans are under way to make assessments, and the experiment will be continued.

P.S.Munasinghe, T.C.N.Peries, G.P.Gunaratne,
A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A16 Development of regional and site specific dolomitic limestone recommendations, for ameliorating soil acidity and enhancing soil productivity.

Project A16.4 Establishing dolomitic limestone requirements for better growth of mature plants in different tea growing regions at soil-series levels.

1) Effects of application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & yearly basis) on growth, soil/plant nutrient status and yield of tea. Clone TC 9, Field No.4, St.Coombs Estate, Talawakelle - (1989)

The yield obtained in the 2nd year of the cycle is given in Table 63.

As observed previously, there was no significant effect this year as well on yield for the frequency of dolomitic limestone application. But, it varied significantly with increasing rates of dolomitic-limestone, the pattern of decrease being linear, even this time, and yields dropping sharply beyond 2500 kg ha^{-1} application. No interaction was found between rates and frequencies of application. But, when considering the rates of application and frequency, considerably lower yields were recorded at 10,000 kg ha^{-1} rate applied on cycle and mid-cycle frequencies, and 5000 kg ha^{-1} rate applied on cycle, mid-cycle and yearly frequencies, compared to nil dolomitic-limestone application. However, no substantial differences were found where dolomitic-limestone was applied at 1250 and 2500 kg ha^{-1} on any frequency compared to nil dolomitic-limestone application.

Pruning samples are being analyzed for nutrient status for computing statistical significance together. Plans are also under way for detailed investigations on soil and leaf samples collected over 10 years, with a view to understand the overall effects. This experiment is in progress.

TABLE 63 - *Effect of increasing level of dolomitic-limestone application on yield (kg MT ha^{-1} yr^{-1}) of tea.*

Rate of dolomite (kg ha^{-1} pruning $cycle^{-1}$)	*Frequency of dolomite application* Cycle	*Mid-cycle*	*Yearly*	Mean	
Control	2799	-	-	-	
1250	2744	2772	2690	2735	
2500	2620	2656	2660	2645	SE 44
5000	2315	2409	2402	2375	
10000	2159	2310	-	2235	SE 54
Mean	2460	2537	2584		
SE	38	38	44	SE 79	(44 df)
CV % 6.9					

H.A.P.Warnasiri, R.G.A.Wijayawardhana,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & Yearly basis) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No.2, Moragolla Estate, Imaduwa - (1990)

Investigation in this experiment was also concluded with the completion of 3 cycles plus one year in May 2001. Pruning samples are being analysed for nutrient status for computing statistical significance together.

Plans are also under way for detailed investigations on soil and leaf samples collected over 10 years, with a view to understanding the overall effects. The data collected over the period are to be analyzed in detail and also collectively with St.Coombs trial where increasing rates of dolomitic-limestone are being applied, for overall findings, and work continues.

H.A.P.Warnasiri, J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of different particle sizes of applied dolomitic-limestone fertilizer on soil pH, soil/plant Mg status and yield of tea. Clone TRI 2023, Mattakelle Estate, Talawakelle - (1991)

Investigation in this experiment was also concluded with the completion of 2 cycles following recording fresh pruning weight in December 2001. The data collected over 2 pruning cycles are to be analyzed in detail collectively with other dolomitic-limestone particle size related investigations, under applied and basic research components, for overall findings, and work continues.

H.A.P.Warnasiri, R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

4) Effects of different particle sizes of applied dolomitic-limestone fertilizer on soil pH, soil/plant Mg status and yield of tea. Clone TRI 2025, Talangaha Estate, Nakiyadeniya - (1991)

Investigations in this experiment were already concluded with the completion of two pruning cycles. The data collected over the 2 pruning cycles are to be analysed in detail and also collectively with other dolomitic-limestone particle size related investigations, under applied and basic research components, for overall findings, and work continues.

H.A.P.Warnasiri, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A17 Development of fertilizer and/or dolomite applicators for improving broadcasting efficacy and to overcome labour shortage

Project A17.1 Evaluating and improving the efficiency of fertilizer applicators

A detailed description of the work carried out, along with the objective/s was given in the Annual Reports 1998 and 2000.

The Post Graduate Institute of Agriculture (PGIA), University of Peradeniya and the TRI, signed a Memorandum of Understanding (MOU) in September 2001, to carry out the activities and required modifications to the power and mechanically operated machines. This work is being carried out, in collaboration with the Dept: of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya.

C.S.K.A.Ratnayake, N.P.S.N.Bandara, W.M.S.Wijayatunga, B.F.A.Basnayake, S.M Hulangamuwa, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A18 Development of regional analytical laboratories for soil, plant and fertilizer analysis.

18.1 Analytical laboratory service

The number of soil, leaf and fertilizer samples analyzed for advisory purposes during 2001, are given in Tables 64 and 65 respectively.

Table 64 - *Details of analysis carried out at TRI laboratory, Talawakelle*

Element	*Soil*	*Leaf*	*Fertilizer*	*Organic*	*Total*
Nitrogen	560	179	483	5	1227
Phosphorus	499	179	363	2	1043
Potassium	695	179	463	3	1340
Magnesium	775	179	281	2	1237
Zinc	49	14	4	9	76
Copper	24	-	1	8	33
‘pH	1633	-	-	5	1638
Carbon	1379	-	-	5	1384
Particle size100mesh	-	-	123	-	123
30 mesh	-	-	123	-	123
10 mesh	-	-	-	-	-
Biuret	-	-	1	-	1
Calcium	322	18	2	1	343
Manganese	24	11	3	-	38
Moisture	-	-	2	-	2
Iron	24	-	-	-	24
C.E.C.	193	-	-	1	194
Sulphur	107	3	-	1	111
E.C.	138	-	-	-	138
Sodium	36	-	-	-	36
Lead	-	-	-	8	8
Boron	-	-	-	1	1
Aluminium	-	-	-	8	8
Water solubility	-	-	2	-	2
Cadmium	-	-	-	8	8
Free acidity	-	-	-	-	-
Anion Exchange Capacity	6	-	-	-	6
Total	6464	762	1851	67	9144

Table 65 - *Details of analysis carried out at TRI laboratory, Walahanduwa*

Element	*Soil*	*Leaf*	*Fertilizer*	*Organic*	*Water*	*Total*
Nitrogen	480	34	893	36	-	1443
Phosphorus	734	80	714	13	3	1544
Potassium	852	80	889	14	-	1835
Magnesium	976	80	430	11	-	1497
Zinc	15	29	4	1	-	49
Copper	-	-	2	1	-	3
'pH	1990	-	-	51	3	2044
Carbon	1383	-	-	59	-	1442
Particle size 100mesh	-	-	110	-	-	110
30 mesh	-	-	109	-	-	109
Sulphate	40	-	-	-	1	41
Boron	-	1	-	1	-	2
Calcium	227	4	-	1	-	232
Manganese	49	-	2	-	-	51
Moisture		6	1	6	-	13
Iron	17	-	-	1	-	18
C.E.C.	181	-	-	50	-	231
Salinity as NaCl	15	-	-	-	-	15
E.C.	1	-	-	1	-	2
Sodium	40	-	-	-	-	40
Solubility	-	-	3	-	-	3
Water Retention Capacity	-	-	-	-	-	-
C/N Ratio	-	-	-	-	-	-
Total	7000	314	3157	246	7	10724

T.C.N. Peries, S.M.Dissanayake, R.G.A.Wijayawardhana, H.A.P.Warnasiri,M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha. R.P.Kulatunga, W.M.S.Wijayatunga, C.S.K.A.Ratnayake, P.L.K.Tennakoon, S.Ananthacumraswamy,G.P.Gunaratne, A.K.N. Zoysa, L.S.K.Hettiarachchi

18.2 Analytical laboratory accreditation

The Analytical Laboratory at Talawakelle participated with the international laboratory evaluating programmes on chemical analysis of soil (International Soil-Analytical Exchange – ISE) and plants (International Plant–Analytical Exchange-IPE). This activity is being carried out in co-ordination with the Department of Environmental Sciences of the Wageningen University in Netherlands. Results of routinely undertaken test methods such as pH (water and $CaCl_2$ solution), %C (Walkley and Black), E.C, C.E.C, Na, K, Mg, Ca and N in soil; and Zn, P, K, Mg, N, Ca in plant samples were subjected to evaluation over 8 quarters during 2000 to 2001. The analytical performance has been fairly satisfactory. The pitfalls in the procedures have been identified and rectified as and when necessary.

R.G.A.Wijayawardhana, S.Ananthacumraswamy,G.P.Gunaratne, A.K.N. Zoysa, L.S.K.Hettiarachchi

BASIC RESEARCH

1 Soil quality assessments in tea lands of low country wet zone of Sri Lanka

Nearly 52% of the total tea lands in Sri Lanka come under the low country wet zone. Most of these lands are less productive due to heavy erosion caused by high intensity of rainfall and inadequacy of good agricultural practices. These conditions reduce the tea land quality, and exert a strong influence on the sustainability of tea production in the region. However some tea growers plant tea directly in their tea gardens disregarding soil rehabilitation. The studies reported in literature on soil quality of tea lands are rather negligible. A field study was therefore conducted in the low country wet zone on some selected tea estates to estimate soil quality improvement in tea lands with rehabilitation.

Representative soil samples were collected from some tea fields in the low country wet zone. The field conditions were considered as the treatments. The treatments in this study were; the fields that are in the process of rehabilitation, fields that are already rehabilitated but not planted with tea, fields that are rehabilitated and planted with tea, fields that are planted with tea without rehabilitation and forest soils. The soils were tested for pH, C%, CEC, Ex. cations (K, Mg and Ca) and DTPA extractable micro nutrients (Zn, Cu, Mn and Fe) and different fractions of P. The base saturation and bulk density of the soil were also studied.

The native forest soils had significantly higher C% (43 mt ha^{-1}) and CEC (18.4 $cmol_c$+) compared to all other treatments. The soils where tea was planted without rehabilitation had the lowest C% (24 mt ha^{-1}) and CEC (11 $cmol_c$+) in the soil. The results clearly showed that rehabilitation process in tea lands had increased the C%, CEC, Ex. cations and micro nutrients in the soil. The soil pH was high in soils that are already rehabilitated and also that are in the process of rehabilitation. The mean base saturation was found to be highest in the soils that are under rehabilitation (17.5%) and lowest in forest soils (7.7%) due to non-addition of synthetic fertilizers. The base saturation has increased in the soil with increase in soil pH in all the treatments. The bulk density of the soil was low under rehabilitation and consequently it has increased soil porosity and aeration. The P fractionation revealed that the resin-P (readily available P form), Fe and Al bound-P, organic-P and Ca-P had increased with the rehabilitation of soils. Therefore, rehabilitation of tea lands is a prerequisite in tea crop husbandry.

P.D.P.S.Perera, M.A.Wijedasa, J.R.Y.Abeywardane,
K.D.Dahanayake, A.K.N.Zoysa

2 Effects of organic amendments on the fertility status of soils and yield of tea in organically farmed estates

Soil and leaf samples were collected from an on-going field trial conducted at the Stassen Bio Tea Project, Haputale of Uva region. The study consisted of five organic amendments (castor oil cake, coconut poonac, capock poonac, rubber seed meal and tea waste) as treatments to provide N at 60, 90 and 120 kg ha^{-1} yr^{-1}. A control was included as a treatment and all treatments were replicated thrice. The soils were assessed weekly for pH, NH_4-N, NO_3-N, Ex. cations for 3 months.

There was an increase in NH_4-N concentration, in the soil for all the treatments due to mineralization of organic N in the amendments. The subsequent nitrification of NH_4 increased the NO_3-N concentration in the soil. The decrease of NH_4-N concentration should be due to nitrification and plant N uptake. The mineralization of organic materials released Ex. Ca, Mg and K to the soils in all the treatments. The leaf N-concentration had increased with the increase in available N (NH_4 + NO_3) in soil. This relationship showed a typical growth curve representing the Mitscherlich type model. There were no significant differences between organic amendment and their levels on made tea yield.

S.B.Rajapaksha, S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

3 Effect of soil pH on the growth of vegetative propagated tea cuttings in the nursery

The scarcity of soil with suitable pH is an obstacle in raising tea plants in the nursery for replanting and infilling in tea plantations. The effect of soil pH on tea plant growth under nursery condition is not reported in literature. Therefore, a study was undertaken at TRI station, Kottawa in the Low country Wet Zone using five clones. The clones are TRI 2022, TRI 2025, TRI 2026, TRI 3014 and TRI 4049. The soil pH was adjusted to 3, 4, 4.5, 5, 6 and 6.5 artificially. The cuttings of tea clones were planted in polyethylene bags filled with soils having different soil pH treatments and plant growth was monitored for 5 months.

All tea clones showed the highest average of plant height, number of leaves, dry matter weight and fresh shoot weight gain in soils with pH 4.5. Out of all the clones, TRI 4049 showed the best growth at pH between 4.5-5.5. TRI 4049 could not tolerate acid conditions below pH 4.0. However, even under very acidic conditions, TRI 2022 showed some growth in the plants. The soil pH < 4 and > 6 severely affected the growth of all tea clones tested. Therefore, selecting soils having pH within the optimum range is essential for nursery management.

M.M.D.S.N.Perera, S.P.Ratnayake, K.D.Dahanayake,
M.A.Wijedasa, A.K.N.Zoysa

B15 Environmental studies

B15.1 Impact of variation of weather conditions on crop environment and productivity of tea: Assessment of the effects of wet and dry depositions from the atmosphere.

Rainwater quality monitoring continued in collaboration with the meteorological centers of the TRI stations at Talawakelle, Ratnapura, Hantane, Passara, Kottawa and Deniyaya. Parameters such as rainfall, in situ pH, NO_3-N, SO_4-S, Mg and Ca are being monitored. The data collected over the monitoring period are to be analyzed for variance for interpretation, and work continues.

P.L.K.Tennakoon, H.A.P.Warnasiri, S.M.Dissanayake, W.M.S.Wijayatunga, .P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi,M.B.A.Perera, S.L.D.Amaratunge, P.B.Ekanayake, S.T.Yatawatte,K.D.Dahanayake, J.A.S.K.V.Jayasinghe, J.C.K.Rajasinghe.

SUPPORTIVE PROJECTS

1) Adaptive fertilizer trials - TRI and TSHDA collaboration

Detailed descriptions of the trials along with the objective/s and some of important findings have been given in the Annual Reports 1996 to 1999. The results obtained from the trials collected over a period of about 4 to 5 years, are being analyzed collectively in detail in order to draw final conclusions. Operations of some of these trials still continue.

H.A.P.Warnasiri, S.M.Dissanayake, W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi,M.B.A.Perera, S.L.D.Amarathunge, P.B.Ekanayake,S.T.Yatawatte, K.D.Dahanayake, J.A.S.K.V.Jayasinghe, S.Wimaladharma

2) High forest estate problem: clone TRI 2025 - Die back of plants

Details of the problem were given in the Annual Report for 1994. Observations have been made on the general performance. However no extensive investigations were undertaken during the year.

S.Ananthacumaraswamy, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Soil and plant sulphur survey

A paper entitled "Soils and foliar sulphur status in some tea plantations in Sri Lanka." was submitted, and accepted for publication in the Sri Lanka Journal of Tea Science

PUBLICATIONS

1. Zoysa, A.K.N., Sagarika, T.W., Hettiarachchi, L.S.K., Dissanayake, S.M., and Wanniarachchi, S.D., (2001). Nitrogen nutrition of tea plants in soils amended with organic materials. Proceedings of the International Conference on Nature Farming and Ecological Balance (ICNFEB-2001), Hisar, India 94.

2. Hettiarachchi, L.S.K., and Sinclair, A.H., (2001). Effects of addition of Mg and Ca supplied in liming and non-liming materials on the growth of *Camellia Japonica* in an acid soil, its soil pH changes, nutrient uptake and availability. Proceedings of the 7th International Symposium on soil and Plant Analysis- 2001, Edmonton, Alberta, Canada, in the *Communications on Soil Science and Plant Analysis* Periodical.

3. Anadaoomaraswamy A, Ekanayake S.A.B., Ananthacumarswamy S, Chrishom A., and Jayasuriya, S., (2001) Effect of land degradation on Tea Productivity in Sri Lanka. Soil Erosion Research for the 21st Century- An international Symposium and Exhibition January 3-5, 2001, Honolulu, Hawaii.

4. Gunaratne, G.P., Jayakody, A.N., and Hettiarachchi, L.S.K (2001). Effects of Intensive cropping on potassium status of soils in tea growing areas. *Tropical Agricultural Research* **12**,138-150.

5. Zoysa, A.K.N., Loganathan, P., and Hedley, M.J. (2001) Comparison of the agronomic effectiveness of a phosphate rock and superphosphate as phosphate fertilizers for tea *(Camellia sinensis L.)* on a strongly acidic Ultisol. *Nutrient Cycling in Agroecosystems* **59**, 95-105.

6 Gunaratne, G.P., Jayakody, A.N., and Hettiarachchi, L.S.K (2001) Characterization of Sri Lankan acid tea soils in relation to soil K dynamics Accepted for publication in *Sri Lanka Journal of Tea Science.*

7 Zoysa, A.K.N. (2001) Some Aspects of Dolomite use in tea. Accepted for publication in *Tea Bulletin.*

8 Ananthacumaraswamy. S and Hettiarachchi, L.S.K. (2001) Soils and foliar sulphur status in some tea plantations in Sri Lanka. Accepted for publication in *Sri Lanka Journal of Tea Science.*

THESIS

Wijayatunga W.M.S. (2001). Effect of incorporating sulphate of potash magnesia (SPM) and Kieserite to a recommended NPK mature tea fertilizer mixture (U709) on soil nitrogen availability. MSc.thesis, University of Peradeniya, Sri Lanka.

GENERAL

Dr L.S.K.Hettiarachchi served as:

a) A member of the Working Group on Fertilizer to the Sri Lanka Standards Institute

b) A member of the Technical Committee on Organic Fertilizer to the Sri Lanka Standards Institute

Dr.A.K.N.Zoysa served as:

a) A member of the Executive Committee of the Soil Science Society of Sri Lanka

b) A member of the Publication Panel of the TRI

Mr P.S.Munasinghe, Research Assistant joined the service w.e.f. 1st January.

Messrs D.M.B.Dissanayake and O.G.K.A.Gunaratne, Technical Assistants joined the service w.e.f. 3rd Septemberr.

Mr H.A.P Warnasiri Experimental officer was granted no pay leave for a period of one year, for employment in Saudi Arabia w.e.f 21st May.

Mr W.M.S. Wijayatunga was awarded MSc degree by PGIS, University of Peradeniya, Sri Lanka for the thesis on "Effect of incorporating Sulphate of Potash Magnesia (SPM) and Kieserite to a recommended NPK mature tea fertilizer mixture (U709) on soil nitrogen availability" in March.

Mrs P.L.K Tennekoon and Mr C.S.K.A.Ratnayake Experimental Officers transferred to SPND's laboratory in Hantane w.e.f.1st August 15th November respectively.

Mr R.G.A. Wijayawardhana enrolled on a postgraduate degree Programme leading to MSc, on Environmental Science, at the PGIS of the University of Peradeniya w.e.f 14th September.

Meetings and seminars

Dr A.K.N Zoysa attended an International Conference on Nature Farming and Ecological Balance (ICNFEB2001) conducted by International Society for Nature Farming (ISNF) in collaboration with CCS, Haryana Agricultural University, Hisar, India held at Hisar, India during 7th to 10th February, where he presented a paper entitled "Nitrogen nutrition of tea plants in soils mended with organic materials"

Dr L.S.K.Hettiarachchi delivered a lecture on "Research findings for the use of ERP in tea" to a seminar on "Advantages of using ERP fertilizer in tea plantations" organized by the Lanka Phosphate Limited (LPL), held at Ratnaloka Tour Inns, Ratnapura on 31st January.

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa, and Messrs G.P.Gunaratne and P.S.Munasinghe attended the 7th and 8th E & E (Sinhala) meeting, held at TRI Auditorium, Talawakelle on 14th May and 19th October respectively.

Dr L.S.K.Hettiarachchi attended the 7th International Symposium on Soil and Plant Analysis, held in Edmonton, Canada, during 21st to 27th July where he presented a paper titled "Effects of Addition of Mg and Ca Supplied in liming and non-liming materials on the growth of *Camellia Japonica* in an acid soil, its soil pH changes, nutrient uptake and availability".

Dr A.K.N.Zoysa delivered a lecture on "Use of Eppawela rock phosphate in tea cultivation" for a seminar on "Advantages of using ERP fertilizer for tea and rubber plantations" organized by the Lanka Phosphate Limited (LPL), and held at Hotel Salika Inn Auditorium, Kegalle on 27th July.

Dr L.S.K.Hettiarachchi attended the RSC IV (Ratnapura) meeting, held at the TRI Low country Station' Sports club Hall, Ratnapura, on 31st July

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa, Messrs G.P.Gunaratne and.P.S.Munasinghe, and Mrs S.Ananthacumaraswamy attended the 202nd and 203rd E & E meeting, held at the TRI Auditorium, Talawakelle on 2nd February 27th February and December respectively.

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa attended the RSC (Galle/Deniyaya) meeting, held at Sun Shine Inn Hotel, Unawatuna, on 5th October.

Dr L.S.K.Hettiarachchi attended the RSC III (Uva) meeting, held at Orient Hotel Auditorium, Bandarawela, on 12th October.

Training programmes and workshops

Mr G.P.Gunaratne attended a workshop on "Advanced course in tea plantation management" conducted by Plantation Management Academy at Coonoor, Nilgiris, India during 1st to 30th January.

Dr L.S.K.Hettiarachchi attended a workshop on "Community Environment work plan" conducted by Community Environment work plan, held at the Sarvodaya Visva Samurdhi Auditorium, Moratuwa on 21st May

Dr L.S.K.Hettiarachchi attended training seminar on "Water Quality Management: A Need in the New Millennium", conducted by the Institute of Chemistry, Ceylon, held at the Hilton Hotel, Colombo on 30th May.

Mr C.S.K.A.Ratnayake attended a 10-month International course in Agriculture Engineering, conducted by Agriculture Training Institute, The Netherlands at the International Agricultural College, The Netherlands during 21st August 2000 to 7th June 2001.

Mr S.M. Dissanayake attended a workshop on "Radiation safety in the use of radioisotopes for research and industrial applications", conducted by Atomic Energy Authority, held at the Radioisotope Centre, University of Colombo, during 16th to 20th July.

Messrs R.G.A.Wijayawardhana and T.C.N Peries attended a workshop on "Personal computer assembly, maintenance and trouble shooting", conducted by East West Information Service's Career Training Centre at Badulla on 28th July.

Mr P.S.Munasinghe attended a 5-day training course on "Programming in Visual Basic" conducted by Institute of Computer Technology, University of Colombo held at University of Colombo during 30th September to 8th October.

Trainees

Messrs W.G.A.K.Wimalasena and M.H.A.R.Chaminda NDT (Agriculture) trainees from Hardy Institute, Ampara completed their 04-month training on "Some aspects of soil fertility and tea plant nutrition" in the end April.

Mr A.S.J.R.Mendis, Statistics special degree undergraduate trainee from University of Colombo completed his two-month industrial training on a "Feasibility study for predicting vigour" February.

Trainee Assistant Superintendents from Agalawatte, Maskeliya and Horana Plantations Ltd, underwent "Familirizing programmes on some aspects of soil fertility and tea plant nutrition" on 19th, February, 14th June and 26th July and respectively

Mr S.Gunaratne, a student from Sri Lanka School of Agriculture, Kundasale completed his 06-month training on "Monitoring rainwater quality and its analysis" in November.

Mr S.B.Rajapaksha, and Miss, P.D. P. S Perera final year students, from the Agriculture Faculty of the University of Ruhuna, Matara, successfully completed their 06-months research projects in December.

Visitors

A group of students from the Institute of Chemistry, Ceylon visited the division in order to familiarize themselves on the modern instrumentation for soil, plant and fertilizer analysis, on 5th April.

A group of students from Wayamba University visited the division in order to familiarize themselves on soil fertility and tea plant nutritional aspects on 19th December.

TECHNOLOGY DIVISION

M.T. Ziyad Mohamed
Deputy Director Research (Technology)

1. Applied Projects

Thrust No 25:

Project A 25.1 Reduction of cost of electrical energy in withering using speed controllers

Monitoring the performance of the speed controllers installed to 70' trough continued. Twenty replicates were carried out and data from few replicates are presented below;

TABLE 1: *Weight and moisture content of green leaf and withered leaf, electricity consumption,frequency of power supply and the withering period.*

	Replicate 1		*Replicate 2*		*Replicate 3*		*Replicate 4*	
Trough	T-c	T-e	T-c	T-e	T-c	T-e	T-c	T-e
Weight of G L (kg)	1057.1	1055.3	1058.4	1058.8	1058	1056	1056.1	1056
M C of G L (kg)	79.63	79.79	76.11	78.18	76.06	77.12	76.37	76.26
Weight of W L (kg)	501.5	558	638.5	635	584.5	668	553.7	576.2
M C of W L (%)	64.67	69.04	66.31	67.94	66.16	65.07	66.86	68.31
Electricity Consumed(kWh)	80.6	50.3	77	43.1	73.7	41.1	88.3	48.9
Frequency (Hz)	50	50/30	50	50/30	50	50/30	50	50/30
Withering Period (h:m)	15.35	14.37	16.03	15.34	15.32	16.05	18.05	18.01

T-c - Control trough;

T-e - Experimental trough to which the speed controller is fitted.

G L - Green leaf

M C - Moisture content

W L - Withered Leaf

During the trials, the relative humidity of the air supplied and the dry bulb temperature were maintained at comparable levels in both troughs, as far as possible.

Statistical analysis of data indicates a saving of about 39% on energy consumed due to speed controllers. Variation in moisture content of withered leaf was not significant in the experimental trough compared to control. Similar results were reported, during the preliminary trials carried out in 1998.

Another speed controller is fitted to the 100' trough (coupled to a 10 HP motor and 48" diameter fan) and the performance of the same is monitored.

M.T. Ziyad Mohamed, G.L.C.Galahitiyawa, U. Marapana

Thrust No: 26

Project A 26.1 Developing and evaluating solar energy techniques for tea drying

During the year under review, data could not be collected due to breakdown of the heat exchanger, coupled to this system.

M.T. Ziyad Mohamed, S.Koneswaramoorthy,
G.L.C.Galahitiyawa, U. Marapane

Thrust No: 27

Project A 27.1 - Evaluating new type of paper sacks

During the period under review, new packing materials from two different manufactures were tested.

Paper sacks supplied by Ceylon Paper Sacks Ltd.

The paper sacks supplied were smaller, meant to pack about 25 kg of broken grade teas, and called as "half sacks" -details are as given below. These were tested for moisture barrier properties and burst strength using the "Drop test". The sacks supplied had four plies and three plies of kraft paper and the inner ply consisting of kraft paper lined aluminium.

Grammage (g/m^2):	*Standard*	*CPS (V)*	*CPS (O)*
Ply 1	80	64	65
Ply 2	80	64	65
Ply 3	80	63	64
Ply 4 (inner)	98.7	97	98.5

CPS (V) - Ceylon Paper Sacks (valve type)
CPS (O) - Ceylon Paper Sacks (open top type)

TABLE 2 - *Dimensions of empty sack and filed sacks:*

	Empty sack (mm)				*Filled sack (mm)*		
	Length	*Width*	*Bottom*	*Valve*	*Length*	*Width*	*Sack depth*
Standard	1080±10	700±5	205±5	205±5	1120	560	210
Control	1073	696	212	211	1110	553	269
(St.Coombs)	1076	698	215	212	1092	543	259
Open (25kg)	602	634	208	210	642	465	252
	596	635	208	207	632	481	245
Valve (25kg)	602	631	201	197	646	488	246
	606	631	201	202	670	499	229

Drop test results:

	Face	Side	Butt
Control	✓	✓	✓
	✓	✓	✓
Open (25kg)	✓	x Spilt-open side	
	✓	x Spilt-open side	
Valve (25kg)	✓	x Spilt- close side	
	✓	✓	✓

Tasters' evaluation (score), moisture content and quality parameters of tea at the time of packing

Tasters score:

Forbes	16	15	17	18
John Keels	09	09	10	10
Asia Siyaka	12	15	13	15

Moisture content (MC) %	3.7 %, 3.8%
TF%	0.8416 (on dry basis)
TR%	15.4478 (on dry basis)

Tasters' evaluation (score), moisture content and quality parameters of tea one month after packing

Taster	Control	Open (25kg)	Valve (25kg)	
Forbes	15, 14	14, 15	14, 15	
John Keels	11, 09	10, 10	13, 11	
Asia Siyaka	14, 15	16, 15	13, 14	
MC%	4.3%	4.3%	4.6%	
TF%	0.7235	8018	7312	(on dry basis)
TR%	14.0677	15.1370	15.5277	(on dry basis)

Tasters' evaluation (score), moisture content and quality parameters of tea three months after packing

Taster	Control	Open (25kg)	Valve(25kg)	
Forbes	14 12	16 16	15 17	
John Keels	18 18	19 18	18 16	
Asia Siyaka	16 14	15 14	14 18	
MC%	4.5%	4.5%	5.0%	
TF%	0.7268	0.7555	0.7033	(on dry basis)
TR%	15.6749	16.2821	15.6668	(on dry basis)

Moisture barrier properties of these sacks are comparable, to that of the control. Statistical analysis of Professional Taster's score indicate that the performance of these sacks are comparable, with regard to keeping qualities of tea packed in these sacks, to that of the control. However, the burst strength properties were poor compared to control sacks.

Paper sacks supplied by St.Rigis Packaging Ltd.,

The paper sacks supplied had two plies, an outer ply of kraft paper and the inner ply consisting of kraft paper lined aluminium in one set "Rigis" (Al) and in the other metalized polyester lined kraft paper ("Rigis" (MP) - details are as given below. These were tested for moisture barrier properties and burst strength using the "Drop test".

Grammage: Outer ply - 300 g/m^2 Inner ply - 106 g/m^2

TABLE 3 - *Dimensions of empty and filled sacks*

	Empty sack (mm)				*'Filled sack (mm)*		
	Length	*Width*	*Bottom*	*Valve*	*Length*	*Width*	*Sack depth*
Standard	**1080±10**	**700±5**	**205±5**	**205±5**	**(According to SLS 1068:1995)**		
Control	1073	696	212	211	1110	553	269
(St.Coombs)	1076	698	215	212	1092	543	259
"Rigis" (MP)	1110	500	205	205	1134	530	268
	1111	499	203	197	1132	535	257
"Rigis" (Al)	1112	503	200	200	1124	520	288
	1108	498	197	201	1120	529	268

Drop test results:

	Face	Side	Butt
Control	✓	✓	✓
	✓	✓	✓
"Rigis" (MP)	✓	✓	✓
	✓	✓	✓
"RIGIS" (AL)	X (spilt- valve side)		
	✓	✓	✓

Tasters' evaluation (score), moisture content and quality parameters of tea at the time of packing

Tasters score:

Forbes	16	15	17	18	
John Keels	09	09	10	10	
Asia Siyaka	12	15	13	15	
MC%	3.7 %,	3.8%			
TF%	0.811675		(on dry basis)		
TR%	16.1623		(on dry basis)		

Tasters' evaluation (score), moisture content and quality parameters of tea, one month after packing

Control	"RIGIS"(MP)		"Rigis"(Al)	
Forbes	15, 14	14, 15	14, 15	
John Keels	11, 09	14, 11	12, 11	
Asia Siyaka	14, 15	14, 15	14, 14	
MC%	4.3%	4.0%	4.1%	
TF%	0.69923	0.7290	0.7030	(on dry basis)
TR%	13.9454	15.2449	14.4874	(on dry basis)

Tasters' evaluation (score), moisture content and quality parameters of tea, three months after packing

Control	"RIGIS"(MP)		"Rigis"(Al)	
Forbes	14 12	15 17	14 16	
John Keels	18 18	18 19	18 16	
Asia Siyaka	16 14	15 15	14 14	
MC%	4.5%	4.2%	4.3%	
TF%	0.6940	0.7635	0.7290	(on dry basis)
TR%	15.5512	15.8451	15.7290	(on dry basis)

Moisture barrier properties of these sacks are comparable, to that of the control. Statistical analysis of Professional Taster's score indicate that the performance of these sacks are comparable, with regard to keeping qualities of tea packed in these sacks, to that of the control. However, the burst strength properties of the Rigis (Al) sacks were poor compared to control sacks.

M.T. Ziyad Mohamed, W.S.Botheju, S.H.Priyanthi, L.Jayasinghe

Half sacks supplied by M/s Ceylon Paper Sacks Ltd were tested for its suitability for packing leafy grades of tea. These sacks were tested for moisture barrier properties, burst strength, breakage of tea particles due to packing etc. The data collected are as follows:

TABLE 4 - *Moisture content of samples before packing and five months after packing*

Grade	Moisture Content				
	Before Packing		After five months		
	Bulk	*Chest 1*	*Chest 2*	*Full sack*	*Half sack*
BOP 1	9.3	10.9	10.8	9.45	10
OP 1	8.22	10.55	9.45	8.2	8.85
OP A	8.18	9.6	9.45	8.5	8.9

TABLE 5 - *Particle size distribution of samples before packing and after transportation (Grade BOP1)*

Sample weight 100 g

Amplitude 10 Shaking duration 10 min

Amount retained on the sieve (%)

Aperture Mm	*Before packing*	After transportation		
		Chest	*Half sack*	*full sack*
4.00	0.02	0.01	0.01	0.04
3.35	0.14	0.10	0.09	0.07
2.80	0.20	0.29	0.24	0.28
2.36	0.55	0.43	0.52	0.54
2.00	2.34	2.39	2.11	2.22
1.70	26.20	26.87	27.14	26.28
1.40	36.67	31.52	31.04	33.07
1.20	19.14	18.49	18.15	17.49
1.00	9.12	14.10	14.99	14.75
0.85	4.01	3.73	4.11	3.72
BP	1.59	2.06	1.60	1.53
(1.2-BP)	33.86	38.38	38.85	37.49

BP - base pan in the sieve shaker

(1.2-BP) - denotes the total quantity of tea collected below 1.2 mm mesh.

TABLE 6 - *Particle size distribution of samples before packing and after transportation- (Grade OP1)*

Amplitude 10 *Shaking duration 10 min*
Sample weight 100 g

Amount retained on the sieve (%)

Aperture Mm	*Before Packing*	*After transportation*		
		Chest	*Half sack*	*full sack*
3.35	0.35	0.23	0.30	0.22
2.80	0.97	0.84	0.79	1.00
2.36	8.17	6.32	6.20	7.34
2.00	30.70	27.40	28.76	26.02
1.70	30.71	32.99	31.79	34.39
1.40	15.86	17.54	17.50	16.78
1.20	7.10	7.31	7.43	6.55
1.00	5.06	6.06	5.99	6.37
0.85	0.78	0.89	0.89	0.95
0.71	0.19	0.27	0.25	0.24
BP	0.13	0.16	0.12	0.13
(1.4-BP)	29.12	32.23	32.18	31.02

(1.4-BP) - denotes the total quantity of tea collected below 1.4 mm mesh.

TABLE 7 - Particle size distribution of samples before packing and after transportation- (Grade OPA)

Amplitude 10 *Shaking duration 10 min*
Sample weight 100 g

Amount retained on the sieve (%)

Aperture mm	*Before Packing*	*After transportation*		
		Chest	*Half sack*	*full sack*
6.70	0.22	0.25	0.24	0.32
5.60	3.56	3.28	3.05	2.91
4.76	16.29	14.84	14.71	15.85
4.00	27.72	26.29	26.97	27.42
3.35	32.04	31.10	30.41	32.51
2.80	13.02	14.03	15.28	13.38
2.36	3.97	4.88	4.73	4.26
2.00	1.85	2.43	2.70	1.97
1.70	0.88	1.31	1.09	0.87
1.40	0.25	0.68	0.55	0.28
BP	0.18	0.93	0.27	0.21
(2.8-BP)	20.15	24.26	24.62	20.97

(2.8-BP) - denotes the total quantity of tea collected below 2.8 mm mesh.

Analysis of data indicates that, the breakage due to transportation is not significant, when teas are packed in these paper sacks.

Drop test results.

Grade	Full sack	Half sack
BOP 1	Failed	Failed
OP 1	Failed	Failed
OP A	Passed	Failed

M.T. Ziyad Mohamed, G.L.C.Galahitiyawa, M.A.Chamindra

Thrust No 28:

Project A 28.1 - Optimum condition for best grade mix in Hatton District

Project A 28.2 - Optimum condition for best grade mix in Uva

An Environmentally Controlled Miniature manufacturing unit was procured from Tea craft (UK) Ltd., To become familiarized with the instrument, a few trials have been carried out. During these trials, rolled leaf, after separating the first dhool from St.Coombs factory practicing orthodox -rotorvane type of manufacture was passed through 2 CTC miniature rollers and fired using a miniature FBD dryer, after allowing sufficient fermentation to take place. Different gap settings between the rollers were tried. During the first CTC pass, jamming of rollers was observed with closer gap setting. This experiment is in progress.

M.T. Ziyad Mohamed, W.S. Botheju, S. Koneswaramoorthy,
S.H.Priyanthi, A.M.M.V. Abeykoon

2. Basic Projects

B 41 - Identification of TRI 3000 and 4000 series clones for better CTC manufacture

No new clones were tested during the period under review.

B 48 - Designing a Dust Collector

Fabrication of the prototype unit was completed. It was fixed above the FBD-4 drier at St.Coombs. Separation of the particle from exhaust air was poor, as the airflow sucked by the fan was not sufficient. It was decided to install a bigger fan, to improve the suction.

However, this project was terminated as the Division has entered into an agreement with Department of Chemical Engineering, University of Moratuwa to fabricate a commercial scale dust collector, through a collaborative project.

Preliminary data on airflow to each section of the drier was collected. Drier blow out samples were collected and analyzed for particle size distribution etc. This is in progress.

M.T.Ziyad Mohamed, K.Raveendran ,S.Koneswaramoorthy and staff
from University of Moratuwa

2. Divisional Projects

D 31 - Computer Aided Tea Manufacture

A project was initiated to check the feasibility of using load cells to monitor the withering process. A specially designed metal basket with 4 ft^2 area was placed on middle of a trough, with a view to monitoring the loss of moisture during withering, at St.Coombs factory. Another four sided cage, to prevent leaf from outside touching the basket, was installed. A load cell with digital display to indicate the instantaneous weight of the leaf inside the basket, coupled to an un-interrupted power supply (UPS), was also installed.

The basket was fixed to the load cell in such a way as to record only the weight of the leaf in the basket. The following problems were encountered with preliminary trials:

(i) Due to the up lift of the airflow from the fan, the load cell indicated a lower figure than actual.

(ii) There was a severe air leak between the basket wall and the outside cage.

Initial trials showed leaf inside the basket was under withered compared to leaf outside the basket, mainly due to the air pocket created as described above. Attempts were made to seal the air leaks between the inner basket and the cage. Vertical walls of the basket and cage were made out of metal sheet, in place of wire mesh. Improvements were noticed.

If the leaf inside the basket could be withered to the same extent to what is outside, a correction factor to calculate the actual weight inside the basket from load cell reading could be developed. This experiment is in progress.

M T Ziyad Mohamed, S Koneswaramoorthy, D L D H Dahanyake,
L Jayasinghe, A M M V Abeykoon, U D Alagiyawadu

Testing new moisture meters

New types of moisture meters were not received for testing during the period under review. However, moisture meters from the following factories were calibrated.

Grate Western	-	Infrared type moisture meter
Campion	-	Infrared type moisture meter
Troup	-	Infrared type moisture meter
Glasgow	-	Aquasearch 600 moisture teller.

Moisture determination by Infra Red Bulb method is very popular in tea processing factories. However, calibration of this meter is cumbersome and the readings are not reliable when there is voltage fluctuation in the power supply.

Development of a moisture meter based on capacitance principle

Moisture meters based on the capacitance principle are used in the tea industry. However, with such meters, reproducibility is very poor. Through work carried out at the TRI in the past, a theoretical model for moisture measurement by the capacitance method was established. This model was verified using four different grades of made tea and a final equation was arrived at as follows:

$$C_0/C_s = A_0 - A_1 q_s - A_2 q_s Z_s$$

Where:
- C_0 - empty cell capacitance
- C_s - cell capacitance with tea
- q_s - bulk density of tea
- Z_s - moisture percentage of tea sample
- A_0, A_1, A_2 - constants

But designing an instrument to measure the moisture content in all grades using this equation was difficult, as the bulk density varies from one tea grade to another and one factory to another. Therefore, currently experiments are carried out, to device a mechanism to make the equation independent of bulk density, by compressing a known weight of sample in a fixed volume. This is in progress.

M T Ziyad Mohamed, D L D H Dahanayaka, L Jayasinghe, A M M V Abeykoon & U D Alagiyawadu.

Determination of Net Outturn of Made tea to Green leaf in Up country

Trials were carried out to determine the net outturn, made tea to green leaf achievable at St.Coombs Tea Factory of the TRI, located in Up country. The results indicate that:

i. the Nett out-turn depends only on moisture content in green leaf and not on leaf standard, under Up-country conditions, , as found in Low country and Mid country

ii. a linear relationship exists between net outturn and moisture content in green leaf, as explained by NOT = 111.75 -1.17 x MC, where NOT - nett outturn, MC - Moisture content

Some of the data collected are presented below:

TABLE 8: *Moisture content in green leaf, good leaf standard, gross outturn, nett outturn, refuse tea percentage, predicted net outturn etc.*

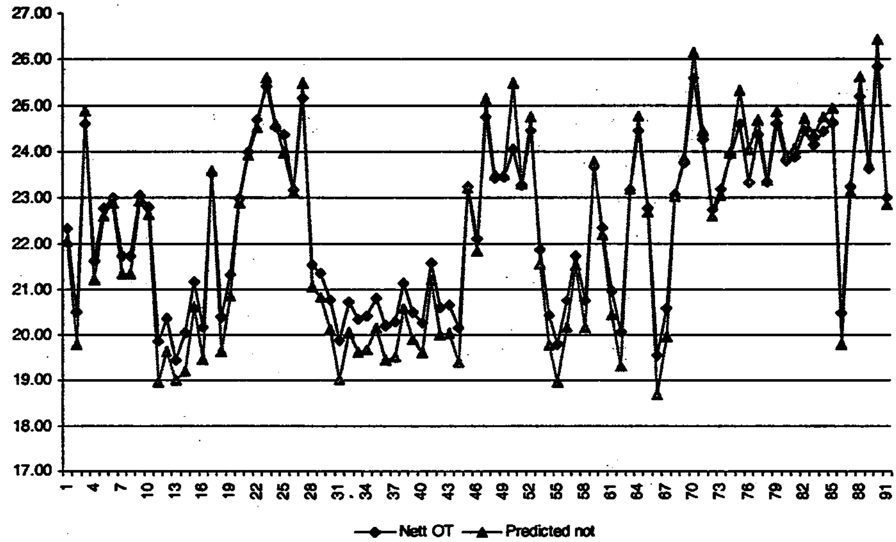
Replicate	*MC %*	*LS %*	*GOT*	*NOT*	*RT*	*Pred NOT*	*Resid*
1	77.76	64	23.64	20.64	12.16	20.0146	0.62544
2	79.89	44	18.50	17.58	4.97	17.7324	-0.15237
3	79.15	41	21.82	19.24	9.60	18.5252	0.71476
4	78.60	31	21.50	19.06	9.25	19.1145	-0.05454
5	80.24	40	19.00	17.64	5.23	17.3574	0.28264
6	75.40	52	24.57	23.68	7.20	22.5432	1.13681
7	76.42	39	25.28	23.63	12.09	21.4503	2.17970
8	79.80	42	20.30	17.91	10.39	17.8288	0.08120
9	72.93	48	27.06	25.64	7.22	25.1897	0.45033
10	76.72	43	22.66	20.68	8.90	21.1289	-0.44887
11	81.20	30	17.99	16.60	8.90	16.3288	0.27123

MC - moisture content in green leaf   LS - good leaf standard (on weight basis)

GOT - Gross outturn,   NOT - nett outturn   RT - refuse tea

Comparing the predicted as well as actual nett outturn recorded in the factory further validated the equation established. This was done by calculating the average moisture content in green leaf from gross outturn figures (and by correcting the figures for zero moisture content) available from the tea book and using the equation established, Results are presented in the Figure below.

M.T. Ziyad Mohamed, G.L.C. Galahitiyawa
W.S. Botheju, K. Raveendran, S.H. Priyanthi,
A.M.M.V. Abeykoon, U.D. Alagiyawadu



Shear plucking Vs Hand plucking Experiment at St Clair Estate

A new experiment was designed at St. Clair estate to study the effect of plucking, using TRI Selective Tea Harvester (TSTH), on quality of tea as against manual plucking in up-country region. Fields were selected with seedling and two popular clones *viz* TRI 2025 and K145. Twelve plots (4 plots each from two clones and seedling) were demarcated. The number of replicates were taken as blocks. Plucking, using TSTH and hand plucking, were the treatments. Experimental design used was RCBD.

Before initiating the trial, pre-plucking yields of these fields were recorded. Leaf harvested was brought to TRI and manufactured separately, using the experimental scale manufacturing unit available in the Division. Samples were graded and sent to professional taster's for their evaluation. Three replicates were completed. This experiment is in progress.

W. S. Botheju, K. Raveendran, S.H. Priyanthi, A.M.M.V. Abeykoon,
U.D. Alagiyawadu, L. Jayasinghe and M. T. Ziyad Mohamed

Shear plucking Vs Hand plucking Experiment at St Joachim Estate

Commercial scale experiments were carried out at St Joachim Factory, Ratnapura, to check the effect of using TRI Selective Tea Harvester (TSTH) for plucking against the conventional hand plucking on the quality of made tea, under Low Country conditions. The leaf standard, grade percentage etc. were recorded. The graded tea samples were sent to professional tasters for evaluation. They were asked to comment on dry leaf appearance, degree of twist, tip content, stalk, fibre content etc. and valuation. The amount of main grades produced, as a percentage (wt %), valuations from the two brokers (B1 & B2) as well as the average, total amount (AMT) generated and the nett sale average price of tea are as follows:

TABLE 9: *The amount of main grades produced, as a percentage (wt %), valuations from the two brokers (B1 & B2) as well as the average, total amount (AMT) generated and the nett sale average price (NSA) of tea etc.*

SHEAR PLUCKING					MAIN	HAND PLUCKING				
WT %	B 1	B 2	AVE.	AMT.	GRADES	WT %	B 1	B 2	AVE.	AMT
8.4	160.00	165.00	162.50	1368.83	BOP 1	8.5	165.00	165.00	165.00	1401.84
8.8	170.00	175.00	172.50	1515.34	BOP 1 (NSJ)	7.5	165.00	175.00	170.00	1268.66
6.7	160.00	170.00	165.00	1111.91	OP 1	8.0	150.00	165.00	157.50	1265.79
4.3	144.00	145.00	144.50	625.99	OP	5.9	138.00	140.00	139.00	813.89
1.9	125.00	110.00	117.50	226.23	OP (SJ)	1.0	120.00	110.00	115.00	118.83
10.0	160.00	178.00	169.00	1687.97	PEKOE	10.9	155.00	180.00	167.50	1826.92
2.0	160.00	178.00	169.00	345.73	F PEKOE	2.3	155.00	180.00	167.50	384.62
4.8	165.00	170.00	167.50	806.26	FBOP	4.8	155.00	175.00	165.00	795.64
0.8	142.00	135.00	138.50	116.67	F OP	1.5	145.00	135.00	140.00	208.96
1.7	200.00	220.00	210.00	353.79	FF (sp)	3.3	175.00	190.00	182.50	607.63
5.8	155.00	165.00	160.00	924.19	FBOPF	4.9	150.00	165.00	157.50	777.55
5.5	160.00	160.00	160.00	885.68	FBOPF 1	6.2	155.00	165.00	160.00	991.96
60.9					TOTAL	64.9				
NSA		163.71			Rs / Kg			161.29		

This study is in progress.

G.L.C.Galahitiyawa,, M.A.Chamindra, M.T.Ziyad Mohamed, and M. A. Wijeratna (Agronomy Division)

Computer model for drawing a rolling program

Application of this model in tea factories was demonstrated at the Experiments and Extension Forum held in February. The Tea Research Board granted officers involved in developing this model two merit increments in recognition of their contribution. The Tea Research Board also decided to make this model available to the end users free of charge, as it is expected to improve the quality of tea produced. Introduction of this model to tea factories was selected as an activity under the **"Hundred day - Revolutionary Program"** proposed by the new Government for implementation in year 2002.

M.T. Ziyad Mohamed, D.L.D.H. Dahanayaka L. Jayasinghe

Monitoring the standard of leaf at St. Coombs Factory

It is a well-established fact, that to produce good quality tea, the percentage of good leaf should be above 65%, as per recommendation of the Institute. The standard of green leaves coming to St. Coombs factory was monitored twice a week. Leaves were obtained from two Divisions, St. Coombs and Lamilliere, and the leaf samples were tested according to the following method:

After spreading the leaf, samples of approximately 100g of leaves were collected at every 10 feet length along the trough randomly, after spreading the leaves on the trough separately. The respective samples were bulked and 250g samples taken to monitor the leaf standard. The leaves were divided as standard and sub-standard leaf.

TABLE 10 - *Average standard of good leaf brought to St. Coombs Factory.*

	St. Coombs		***Lamilliere***	
	Count (%)	*Weight (%)*	*Count (%)*	*Weight (%)*
January	50.8	61.3	45.0	40.5
February	47.5	45.7	47.2	41.4
March	50.0	43.6	42.7	37.5
April	49.9	44.7	49.9	44.9
May	49.5	48.4	49.0	47.1
June	51.9	43.7	52.3	46.9
July	52.7	50.8	47.7	48.8
August	60.6	61.8	59.9	63.7
September	55.4	59.6	57.8	61.2
October	57.0	62.7	54.4	60.8
November	58.6	58.3	56.6	59.3
December	55.6	57.0	58.7	60.3

The acceptable standard of leaf should be about 65% (minimum) good leaf (on count basis) to produce good quality tea. The standard of leaf received from St.Coombs and Lamiliere Divisions of the estate was poor through out the year.

M.T. Ziyad Mohamed, S.H. Priyanthi, L. Jayasinghe,
A.M.M.V. Abeykoon, U.D. Alagiyawadu

Development of a Sand Separator

Cleaning of tea contaminated with sand/grit using the machine developed was satisfactory, as reported in the previous years. However, during the year under review, frequent breakdown of this machine was observed and hence, the machine needs some modifications to overcome this problem.

ISO 11286 : Tea - Classification of grades by particle size analysis

Sieve analyses of several samples of leafy grade tea were carried out and a method was developed to classify leafy grades of tea according to either oversize or undersize fractions retained on standard meshes when a grade is subjected to sieve separation/analysis. Results were presented at the International Organization for Standardization (ISO) Technical Committee on Tea (ISO/TC 34/SC 8) meeting held in Mombasa, Kenya. Based on that presentation, leafy grades of tea produced in Sri Lanka were exempted from the above type of classification. Results from this study could be summarized as follows:

- The oversize fractions of leafy grades when subjected to sieve analysis too are found to be log-normally distributed as found with earlier studies for broken grades.

- A linear relationship between cumulative per cent undersize and particle size when plotted on logarithmic probability paper indicates, that oversize fractions in leafy tea grades to be log-normally distributed. Maximum likelihood equations were worked out using Chi-square test. This equation could be used to judge whether any sample confirms to acceptable size standards. However, this equation will vary with factory, grade and invoice.

- For the particles to be analyzed, the amplitude in the shaker should be increased to 10minutes, as against 5 minutes, recommended by ISO for broken grades. Time duration could be 10 minutes as per ISO recommendation.

- Distribution of oversize/undersize fractions from grade to grade is so vast that different sieves (i.e. larger sieves for larger grades and smaller sieves for smaller grades) have to be used. This is in contrast to what was proposed by ISO for broken grades (ISO 11286).

Based on a recommendation by the Steering Committee appointed to evolve a system of classification for leafy grades, more samples from other estates and exporters were analyzed, along with samples from St Joachim. Maximum likelihood solutions were also worked out for each grade. The results are presented in Table below:

Main grades

GRADE	NAMES OF ESTATES/ BUYERS WHERE SAMPLES ARE COLLECTED FROM											
	St. JOACHIM	NEW St. JOACHIM	VITHANA KANDA	NEW VITHANA KANDA	DELWALA	AKBAR BROTHERS	DANLANDA 1	DANLANDA 2	MORAWAKA	T.S.K. DENIYAYA	PATTIGALA	RASSA
OP A	y=0.66z-4.66		y=0.50z-2.29		y=0.54z-2.32	y=0.45z-1.25	y=0.38z-1.75	y=0.61z-3.90	y=0.58z-3.44	y=0.49z-2.28	y=0.52z-2.73	y=0.62z-4.17
OP1	y=0.66z-2.43		y=0.68z-3.08		y=0.62z-2.04	y=0.69z-2.4	y=0.81z-3.42		y=0.74z-4.28	y=0.72z-2.89		y=0.74z-3.10
BOP 1	y=0.74z-3.26	y=0.74z-2.46	y=0.73z-3.10	y=0.79z-3.08	y=0.61z-2.46	y=0.61z-1.48	y=0.64z-1.63		y=0.65z-1.84	y=0.69z-2.14		
OP	y=0.64z-3.54	y=0.73z-4.85	y=0.63z-3.17	y=0.69z-3.75		y=0.58z-1.70	y=0.66z-3.27	y=0.60z-3.54		y=0.60z-1.64	y=0.48z-1.28	y=0.72z-4.02
PEKOE	y=0.56z-3.07	y=0.82z-6.36	y=0.65z-4.35	y=0.79z-5.70		y=0.59z-2.34	y=0.64z-3.48	y=0.67z-3.58	y=0.76z-5.32	y=0.78z-5.61	y=0.70z-4.85	y=0.77z-5.35
FOP	y=0.70z-4.61			y=0.56z-0.76								
FP	y=0.79z-5.10		y=0.75z-4.06	y=0.75z-3.99		y=0.73z-4.84	y=0.76z-4.70		y=0.75z-4.65		y=0.70z-3.73	
FBOP 1	y=0.73z-2.36	y=0.73z-1.97	y=0.69z-2.34	y=0.70z-2.60	y=0.61z-2.40	y=0.59z-1.06	y=0.63z-1.62		y=0.77z-3.11			y=0.62z-1.82
FBOP	y=0.69z-1.95	y=0.56z-1.09		y=0.72z-2.41	y=0.55z-1.72	y=0.67z-1.79	y=0.57z-0.95	y=0.69z-2.34	y=0.68z-2.15	y=0.61z-1.69	y=0.60z-0.1	y=0.60z-1.88
FF	y=0.74z-0.63		y=0.74z+0.3	y=0.59z+0.53		y=0.73z-0.57	y=0.74z-0.33		y=0.77z-0.89	y=0.73z-0.54		y=0.70z-0.27
FF 1	y=0.71z-1.62					y=0.65z-0.72	y=0.73z-1.15		y=0.83z-2.78	y=0.62z-1.13	y=0.57z-0.67	y=0.76z-2.35
FF Ex sp						y=0.70z-0.15						
FF Ex sp1						y=0.66z-0.69						
FF sp						y=0.59z-0.48	y=0.71z-0.98	y=0.73z-1.09			y=0.73z-1.01	y=0.83z-1.75
OFF GRADES												
BOP	y=0.48z+1.35		y=0.81z+0.08	y=0.77z+0.11		y=0.43z+1.65						
BOPF	y=0.66z+1.84					y=0.58z+1.66						
BOP 1A	y=0.49z-0.40	y=0.58z-0.77				y=0.46z+0.07	y=0.52z-0.61					y=0.46z-0.16
FNGS	y=0.53z+2.02											
BM	y=0.42z+1.24		y=0.58z-0.31									

4.0 General

Dr. Ziyad Mohamed served as :

- a member of panel of teachers/examiners of the Post Graduate Institute of Science(PGIS) University of Peradeniya.
- A member of the Technical Commetee appointed by Chairman, Sri Lanka Tea Research Board, to advice on Tea Factory Development Subsidy Schemes for Orthodox Factories.
- A member of the panel of the Proffesional Examination in Tea Manufacture and Factory Practices, appointed by the Chairman, National Institute of Plantation Management.
- The Chairman of the Technical Committee on Tea, appointed by the Sri Lanka Standard Institute.
- A member of the Academic Committee of NIPM
- The Convenor/Secretary of the Cosultative Committee on Research of the Tea Research Board.
- A member of the Consultative Committee on Estates & Advisory Services of the Tea Research Board.

4.1 Seminars/ Workshops

Dr Ziyad Mohamed

1. attended a Workshop on Research Management organized by PGIA in collaboration with NSF at Peradeniya.
2. proceeded to India on December 25th , to follow a Four-week full time residential Commonwealth Executive Management Development Programme in Tea Plantation conducted by the Kothari Agricultural Management Centre, Coonoor, India.

4.2 Meetings

Dr Ziyad Mohamed attended the following meetings:

January
8th - Consultative Committee on Estates and Advisory Services meeting.
12th - Tea Sector Review meeting

February
02nd - Experiments and Extension Forum at TRI
20th - Workshop organized by Energy Forum
26th - Tea Sector Review meeting

March

1st & 2nd - Seminar Organized by Tea Commissioners Division, Ratnapura Branch

29th - Workshop at Open University

April

2nd - Technical Committee Meeting on Tea at SLSI and Tea Sector Review meeting

06th - Consultative Committee on Estates and Advisory Services meeting

17th - Advisory Officers Forum at Talawakelle

May

14th - Experiments and Extension Forum for small holders at TRI

18th - Brain storming session to review energy and environment policies applicable to SMI's organized by Industrial Service Bureau at Marawila

22nd - Application of HACCP in tea industry at SLSI

23rd - Discussion on Tea Manufacture with Managers attached to Agrapatana Plantations Limited at TRI

27th - Tea Sector Review meeting

28th - ISO 11286 meeting in Colombo

June

04th - Consultative Committee on Research Meeting at Hantane

22nd - Seminar on "Development and evaluation of a user friendly harvesting system for the Sri Lankan tea industry" at BMICH.

26th - Seminar on SMI project & biofuel research

July

02nd - Consultative Committee on Research Meeting at CARP

09th - Tea Sector Review meeting

12th - Discussion with members of CTTA on quality decline in Sri Lankan tea

16th - Professional Exam in tea manufacture and factory practices -panel meeting, NIPM

23rd - Advisory Officers Forum at Passara

27th - Experiments and Extension Forum at TRI

August

02nd - Consultative Committee on Estates and Advisory Services meeting

31st - Technical Committee on Tea meeting at SLSI

September

03rd - 04th - Workshop on Research Management organized by PGIA in collaboration with NSF at Peradeniya

06th - Consultative Committee on Estates and Advisory Services meeting

07th - Meeting organized by Ministry of Industrial Development and Consumer Affairs to discuss packaging of tea

October

11th - 13th - ISO Technical Committee on Tea Meeting, in Kenya

19th - Experiments and Extension Forum for small holders at TRI

29th - Consultative Committee on Research Meeting at Talawakelle

November

02nd - Consultative Committee on Estates and Advisory Services meeting

13th - RSC seminar in Kandy

December

18th - Advisory Officers Forum in Galle

21st - Technical Committee on Tea Meeting at SLSI.

4.3 Training programs

W S Botheju was awarded an M Phil degree in Food Science and Technology from Post Graduate Institute of Agriculture, Peradeniya in June.

K Raveendran proceeded to the Asian Institute of Technology, Thailand to pursue an Masters in Engineering (M. Engg) degree

U D Alagiyawadu continued his Diploma course in "Laboratory Technology" at the Open University of Sri Lanka.

4.4 Publications / Paper presentation:

M T Ziyad Mohamed and D L D H Dahanayake (2001). A simple computer model for drawing rolling programme in black tea processing, Proceedings of the 202nd Experiments and Extension Forum, Tea Research Institute of Sri Lanka, held in February

M T Ziyad Mohamed, (2001) Steam boiler/radiator system for tea drying, TRI Update, Vol 6, No 1, June 2001, Pp 3

M T Ziyad Mohamed and S.Koneswaramoorthy (2001) Health hazards due to air borne particles in tea factories. TRI Update, Vol 6.

W S Botheju, I S B Abeysinghe and C K Illeperuma (2001). Effect of plucking standard on quality and profitability of tea produced in the Up country Dimbulla region during the cropping season. This paper was presented at the 13th PGIA annual congress at held in November at PGRC, Gannoruwa and published in Journal of Agriculture Science. W S Botheju, I S B Abeysinghe and C K Illeperuma (2001). Effect of plucking standard on quality and profitability of tea produced in the Up country Dimbulla region during the cropping season. S. L. J. Tea Sci. 66 (1&2) 36-41.

4.5 Visitors

The number of visitors during the above period to the Technology Division was 9.

4.6 Advisory Reports

During the period under review, 60 advisory visits, to following factories, were made by the members of the Technology Division. These include factories in Mid country and Up country, but excluded the seminars and the Factory Officer training programs conducted and coordinated by NIPM.

Date	Estate	Purpose of the Visit
January		
11th	Galphele	Drier test
22nd	Haldummulla	Drier test
25th	Bandarapola	Machinery Inspection
26th	Mayfeild	Drier test
29th	Invery	Drier test
February		
06th	Deenside	Drier test
15th	Downside	Drier test
22nd	Waverly	Drier test
26th	Stockholm	Drier test
March		
23rd	Uva Halpewatte	Manufacture
26th	Adawatta	Drier test
29th	Kellebokka	Drier test
April		
04th	Mattakelle	Drier test
06th	Imboolpitiya	Drier test
10th	North Meddecoombra	Drier test
23rd	Vellaioya	Drier test

May

02nd	Waltrim	Withering demonstration
03rd	Clarendon	Drier test
13th	Eildon Hall	Airflow – Withering troughs

June

08th	Deenside	Manufacture
15th	St Clair	Drier test
19th	Robgill	Drier test

July

09th	Stockholm	Drier test
12th	Annfield	Drier test
16th	Albion	Drier test
23rd	Wootton	Drier test
26th	Ingestre	Drier test
30th	Fordyce	Drier test

August

06th	Hapugastenna	Drier test
09th	Halgolla	Drier test
13th	Tillyrie	Drier test
16th	Strathspey	Drier test
21st	Orangefield	Manufacture
23rd	Welimada	Drier test
24th	Brunswick	Manufacture
27th	Pedro	Drier test
28th	Balangoda Group	Manufacture
30th	Nuwara Eliya	Drier test

September

03rd	Robgill	Drier test
06th	Rothschild	Drier test
10th	Mocha	Drier test
13th	Radella	Drier test
20th	Troup	Drier test
24th	Dambatenna	Drier test
26th	Eildon Hall	Testing trough unit
27th	Enderapola	Drier test

October

04^{th}	Great Western	Drier test
08^{th}	El-Teb	Out-turn
09^{th}	Mocha	Drier test
11^{th}	Mayfield	Drier test
15^{th}	Kew	Drier test
23^{rd}	New Gamini	Drier test
24^{th}	Kanneliya	Drier test
29^{th}	Roberry	Drier test

November

01^{st}	Duckwari	Drier test
06^{th}	Eildon Hall	Airflow – Withering troughs
07^{th}	Mayfeild	Drier test
08^{th}	Kirkoswald	Drier test
11^{th}	Mousakelle	Drier test

December

13^{th}	Drayton	Drier test

AGRICULTURAL ECONOMICS UNIT

J.A.A.M.Jayakody
Officer-in-Charge

Thrust A 31 - Identification of appropriate labour use pattern to improve profitability in plantations

Project A 31.1 - Evaluating and determining ways and means of reversing the factors that influence migration of workers from low country estates (for outside work).

The result of this study was presented at the 203rd E & E forum held in 27th July 2001, under the title of " Labour migration from tea estates; with reference to the southern region of Sri Lanka".

The TRI was requested to undertake a similar study on a tea estate in the mid-country (Doteloya estate) managed by Kegalle Plantation Limited. A case study was undertaken and the final report was submitted to the plantation company. The above property has 100% VP tea and further it has one of the best tea factories in the region producing good quality tea that fetching top prices regularly. However, productivity of the estate has been affected by poor labour outturn. Considering the agronomic and economic potential of the estate, an incentive scheme was proposed with the objectives of improving labour out turn and preventing declining of total labour force any further. The Officer In charge /AEU was requested to discuss this proposal with the managers of the Kegalle plantation Limited at a meeting going to be held in early 2002.

It was decided to revise this Research Thrust to continue the study to Uva, Mid country and part of the Low country (Kalutara, Ratnapura & Kegalle districts) during the year 2002.

J.C.K. Rajasinghe, J.A.A.M. Jayakody, H.W. Shyamale,
J.A.S.K.V. Jayasinghe, W.M.J.C. Bandara, R.M.S.S. Rajapakse,
S.T. Yatawatte and K.R.W.B. Kahandawa

Project B 1 .1 Development of a Tea Area Overview Map in GIS

Development of Tea estate maps in digital form, by using digital land use maps (1:10,000 scale) available at the Survey Department, was tested and this method proved to be unsuccessful due to the limitation in identifying tea land-use boundaries.

A research proposal on " Estimation of drought damages in the mid country tea growing districts using remote sensing and GIS" was submitted to the National Science Foundation for funding during the year 2002.

J.A.A.M. Jayakody

Project B. 5 Estimation of cost of tea cultivation

Data collection and analysis of cost of tea cultivation, from Nursery to the field have been completed for all elevations. The first draft of the report has been prepared and final editing is in progress prior to submission for publication.

J.A.A.M. Jayakody, H.W. Shyamalie

Project B. 8 Work studies (ergonomics) for efficient labour use in tea lands

A collaborative project was undertaken with the Agronomy Division of the TRI and the Department of Agricultural Extension, University of Peradeniya. Plucker efficiency is being evaluated with the use of TRI shear, Great Western plucking basket and a mobile weighing system. Field observation and survey data collection was started in June at Great Western Estate, Talawakelle and in July at Hapugastenne Estate, Ratnapura. Data analysis was completed and the mobile weighing system was found to be economical with all harvesting systems at both locations. Gross margin of worker per day was analysed and it was found that the conventional harvesting system with mobile weighing and harvesting with TRI shear using the Great Western plucking basket and the mobile weighing system were the most economical.

J.A.A.M.Jayakody & H.W Shyamalie

Project D 35.1 Tea Information

Computation of national and international tea data was continued. "Performance of the Sri Lankan Tea Industry" from 1995 – 2000 was produced and published in the TRI UPDATE Vol(1) of 2001.

J.A.A.M.Jayakody & W.M.J.C. Bandara

Project D 35.2 Alternative energy sources for tea sector

A collaborative project has been initiated with the Energy Forum and St Coombs Estate, with the objective of assessing feasibility of having Biogas units for estate workers houses. The Field Program Co-ordinator of the Energy Forum visited and identified a suitable site for the establishment of a Biogas unit (demonstration unit) for estate workers.

J.A.A.M.Jayakody

Project D 35. 3 Other projects

35.3.1 Socio-Economists and Policy Analysts Group Meeting of CARP

Mrs. J.A.A.M.Jayakody continued to participate for the above meeting held at the CARP every two months. It is planned to undertake an analysis of the effect of Macro economic variables on Agriculture by the above group jointly with the Macro Economists of the Central Bank. Socio-Economists and Policy Analysts group has decided to present the result of the above analysis in January 2002. Data collection and analysis was started on "Effect of Macro economic policies and its implications on Agriculture – An analysis of tea sector".

General

1. Seminar, Meetings and Training programmes

- Mrs.J.A.A.M.Jayakody attended a Mini workshop on Environmental Impact Assessment conducted by the Central Environmental Authority, at the National Institute of Plantation Management, Athurugiriya from 30th March to 1st April 2001.
- Mrs. J.A.A.M. Jayakody attended for a Seminar and workshop conducted by the National Remote Sensing Agency (Dept. of Space, Government of India) and the Geoinformatics (Pvt) Ltd Sri Lanka on "Use of Indian Remote sensing data" at the BMICH on 15th and 16th June 2001.
- Mrs. J.A.A.M.Jayakody attended a Seminar conducted by the TRI on "User friendly harvesting System" held at the BMICH on 22nd June 2001.
- Mrs. J.A.A.M. Jayakody presented a paper on "Labour migration from tea estates: with special reference to the southern region of Sri Lanka" at the 203 rd E & E forum held on 27 th July 2001 at the TRI auditorium.
- Mrs. J.A.A.M. Jayakody attended a RSC Seminar at Ratnapura on 31 st July 2001.
- Mrs. J.A.A.M.Jayakody attended a RSC Seminar held at Passara on 12th October 2001.
- Mrs. J.A.A.M. Jayakody attended a Tea Small Holder E&E Seminar at TRI, Talawakelle on 19th October 2001.
- Mrs. J.A.A.M. Jayakody attended a RSC Seminar held in Kandy on 13th November 2001.

2. Staff Changes

- Miss. R.M.S.S. Rajapaksa was transferred from the Agronomy Division of TRI Hantane to AEU, TRI Talawakelle.

3. Overseas Training

- Mr.G.Ganewatte was granted an extension of six months leave to complete his PhD programme at the University of Latrobe, Australia.
- Mr.D.P.B Herath was granted an extension of six months leave in October, to complete his PhD programme at the University of Guelph, Canada.

4. Publications

- J.A.AM. Jayakody, W.M.J.C. Bandara; Performance of the Sri Lankan Tea Industry, TRI Update, Vol.6 No. 1, June 2001.
- R.M.S.S. Rajapakse; "Potential Use of Remote Sensing Technology in Tea Industry" TRI Update, Vol.6 No. 2, December 2001.
- A Review report of the work of AEU "Agricultural Economics and Tea Research" was submitted for publication in the TRI diamond Jubilee issue.

ADVISORY AND EXTENSION SERVICES

S. Wimaladharma
Head / Senior Advisory Officer

1. General

- Mr.S.Wimaladharma was promoted to the selection grade on 1st January 2001, and confirmed in the post of Head, Advisory and Extension Services with effect from 22nd May 2001.
- M/s S.Wimaladharma and B.A.D.Samansiri proceed to Kothari Agricultural Management Centre in India in January (4th to 30th) to follow a training programme on advanced Tea plantation Management sponsored by the Commonwealth Fund for Technical Cooperation,London.
- Mr.S.T.Yatawatta covered up the duties of the Head of the Advisory & Extension services during the period, he was on overseas study leave.
- Mr. B.A.D.Samansiri Advisory Officer was promoted as a Senior Advisory Officer with effect from 22nd May.
- Mr. M.B.A.Perera Advisory Officer was transferred to Advisory and Extension Division, Talawakele with effect from 3rd April.
- Mr. M.B.A.Perera Advisory Officer resigned from the TRI services from 1st September.
- Mr. J.C.K. Rajasinghe Advisory Officer was transferred to Passara Sub Station as Actg. Officer-in-Charge.
- Mr. M.K.S.L.D. Amarathunga was promoted and appointed as Advisory Officer with effect from 1st January.
- Mr. M.K.S.L.D. Amarathunga continued to cover up duties at Deniyaya Advisory and Extension Centre up to 24th September.
- Mr. J.A.S.K.V. Jayasinghe, Advisory Officer completed his post graduate studies (MSc) in September and returned to Deniyaya Station.
- Mr.T.G.N.Mahinda Extension Officer was transferred from Talawakele to Low-country Station Ratnapura with effect from 1st April.
- Mr. M.A.J.S.Fernando Extension Officer was transferred from Deniyaya to Advisory and Extension Division Talawakele with effect from 9th July.
- The following Extension Officers were appointed during the year.
  Mr. L.A.M.R.C. Liyanaarachchi w e f., 5th January (Talawakele)
  Mr. K. K. P. Katulanda w e f., 22nd January (Deniyaya)
  Mrs. Hiromi Nishanthi w e f., 1st February (Talawakele)

- These Extension Officers were provided with 3 months familiarisation training in the various Divisions on all aspects of tea cultivation and processing prior to commencement of their work at the stations mentioned.
- Supporting activities in the Advisory and Extension Divison in the Low Country Station and Passara stations were carried out by casual employees.

2. Land Use Information of Regional Stations

TYPE OF LAND USE	PASSARA	KOTTAWA	DENIYAYA
Seedling tea (ha)	-	-	-
VP tea -mature (ha)	-	9.50	6.41
VP tea - young (ha)	0.30	1.30	0.38
Mother bushes (ha)	1.15	3.00	0.24
Tea Nursery (ha)	-	0.70	0.46
Tea Seed Garden (ha)	-	1.00	-
Under Grasses (ha)	-	1.60	-
Fruit trees (ha or Nos)	-	-	-
Coconut and Paddy (ha or Nos)	-	1.40	0.13
Forestry (ha)	6.85	7.30	1.92
Marshy land (ha)	-	-	0.50
Buildings,gardens, Roads (ha)	0.50	9.80	1.44
Pepper (ha)	-	-	0.05
Encroachment (ha)	-	-	1.12
Uncultivated area)ha)	-	-	0.57
Area under rehabilitationgrass(ADB Funded)	1.51	-	-
Clearing (ADB Funded)	0.55	-	-
Total Extent (ha)	**10.86**	**35.60**	**13.22**

Mr S. Wimaladharma Head/Advisory and Extension Services continued to serve in the following committees and attended the meetings held during the year.

- Tea Sector Review meetings at the Ministry of Plantation Industries.
- Steering Committee meetings of the Tea Development Project
- Training needs meetings of the Tea Development Project
- Co-ordinating Committee meetings of the MPI on the TDP.
- Plantation Reform Project Committee meetings and the Media Unit of the Open University of Sri Lanka on AV materials preparation
- Estate Affairs meetings of TRI
- TRI/TSHDA interaction meetings
- Research/Advisory linkage meetings of the TRI.
- TRI Advisory Circulars Meetings

Mr.S.Wimaladharma Head/ Advisory and Extension Services continued to serve as a resource person to the NIPM and conducted 65 training programs for Superintendents, Assistant Superintendents, Field Staff and other workers on nursery practices, plucking, other cultural practices etc and also conducted training programs for Plantation Monitoring Officers.

Mr.S.Wimaladharma served as a resource person to the Training of Trainers Program conducted by the NIPM at their regional centre in Bogowantalawa for the staff of tea related institutions under the ADB project.

Mr. S.Wimaladharma conducted a nursery skills training program at TRI Kottawa centre (hands on training) for the Advisory and Plant Breeding staff for the first time.

Mr.S.Wimaladharma conducted a series of Training of Trainers skill program on Tea Nursery techniques for the entire extension staff of the TSHDA under the ADB Tea Development Project.

Mr.S.Wimaladharma addressed the Experiments & Extension Forum of the TRI for the tea smallholder sector.

Mr. S. Wimaladharma was also associated with the following activities:

- Preparation of video programmes on plucking, nursery management Parts one and two, land preparation, shear harvesting and pruning, with funds from the Plantation Reform Project.
- Co-ordinated the clonal mother bush program of the ADB to establish 80/ha of clonal mother bushes in 6 TRI stations and 16 TSHDA sites from its inception upto 15th November.This activity was handed over to the newly appointed full time Project Co-ordinator in November.
- Participated and addressed the RSC seminars held during the year.
- Addressed small holder extension programmes on nursery plant quality and good tea husbandry techniques.
- Associated with the TSHDA and NIPM on the production of training manuals.
- The booklet on "Tea & Rubber Inter-cropping System" has been printed. (Produced by SLD)
- The booklet on "Control of Stem and Branch Canker in Low Country and Uva Region" has been prepared and is ready for printing. (Produced by SLD)

- Tea Information - Leaflets on various tea related statistics were resubmitted to the PPP/TRI for final editing and publishing. (Produced by JPM and SLD)
- Booklet on Weed Identification: Subject Matter Specialist's corrections are being *done* (Produced by LDS, JCKR & JM).
- Preparation of a ready reckoner- pocket- guidebook on field practices and recommendations on tea cultivation is completed. This draft copy of the pocket guide book, a product of the Advisory Staff, is ready for final editing prior to printing.(Advisory Officers)
- Advisory & Extension Staff have contributed by writing articles to "*Tea thathu*" and TRI Update Publications
- A model nursery was maintained at the Hantana centre for demonstration purposes and to prepare a growth index of nursery plants under mid country conditions.

3. Projects Handled

Project 1 Adaptive Research and Demonstration

Adaptive research trials on fertilizer continued in 5 locations such as Kalawana, Horana, Pelawatte and Deraniyagala.

Project 2: Information Desks

Arrangements were made to equip the information Desks with the following;

- Wall charts containing regional profile, Tea statistics and regional specific information.
- Hot-line telephone Service (045-32348) which will facilitate small holders-planters and other interested person for direct access to the Advisory and Extension Services to get required information or advise.
- Estate data such as weather, yield and other field parameters are being collected and initial arrangements have been made to produce the computer database for low grown region.
- Ready-reckoners, is in progress

Project 3: Upgrading Tea Museum and "AV" Saloons

Upgrading the tea Museum is in progress.
"AV" saloons in some stations where adequate space is available is in progress.

Project 4: Establishment of Mother Bush Areas

Establishment of 80 ha of clonal mother bushes of TRI 3000/4000 series clones in six TRI stations and sixteen TSHDA sites, under the ADB clonal mother bush project, is in progress. (Co-ordinated by S.W.)

Project 5: Monitoring of Agricultural Performance of Tea Plantations and Smallholders

Several regular visits and field observations were made, along with arrangements to produce data base on yield, weather, and cultural practices adopted by the Plantations and smallholders.

Project 6: Production of Extension Materials for the Effective Dissemination of Research Findings

The "Te Thathu" 2nd issue was published for distribution of technical infomation to the tea smallholders.

The production and updating of advisory leaflets are in progress All video programmes converted to CD formats.

Six discussion programmes were telecast on the Eye Channel of Rupavahini, with the sponsorship of the Plantations Reforms Project.

The Advisory Officers and Agronomists participated in this program.

Island wide potash survey is in progress.

4. Special Problems

The sudden death and decline in yield of clone TRI 2026 in the tea fields in Deniyaya, Ensalwatte and Hanford Estates and a few proprietary and small holding lands were recorded. The Director/TRI appointed a research team from the different disciplines of Agronomy, Advisory, Plant Breeding, Plant Pathology, Entomology and Nematology to investigate the reasons and propose strategies to overcome the situation.

Symptoms similar to those of the Highforest problem were recorded in a few fields on Dambatenne Estate, Haputale. Plant Physiology Division is studying this condition.

Die back of young tea was observed in machine pruned fields in some tea plantation in the Uva region.

5. Infrastructure Development of Regional Stations

5.1 Passara Centre

- Expansion work of the office building was completed in July 2001 after which work commenced in the new building
- Replacement work of old water supply line was completed in February
- New water storage tank was built in the year in order to increase the present storage capacity of the supply system.
- Access to the office from the main road was resurfaced, with tar, towards the end of the year.
- CEB transformer located in the office premises was shifted to another location and work was completed by the beginning of the year.

5.2 Kottawa Centre

- Construction of a water tank
- Construction of 2 Nos. twin worker's cottages were completed
- Renewal of portion of the main supply pipe line
- The proposed building expansion programme was differed due to lack of resources.

5.3 Hantane Centre

The expansion work on the existing Advisory Division building commenced, But was differed due to lack of resources.

5.4 Deniyaya Centre

The proposed extension to the existing building and the construction of the auditorium was temporarily suspended due to lack of funds.

6. Advisory & Extension Activities:

	Talawakele	Ratnapura	Hantane	Passara	Kottawa	Deniyaya
Advisory correspondences	503	512	263	186	211	371
Advisory visits	128	67	121	69	64	83
Extension visits	-	70	21			
Visitors to the Division						
-Estate management & Small holders	293	490	281	147	913	410
-University /Diploma students & others	2808	587	134		26	
Advisory & Extension programmes (Total)		132	11	-		01
Skill training for nursery management	02			-	02	
Seminars	11		02	02	18	10
Field days	07	06	02	-	12	
Educational programs for University Student	03			-	-	
Educational Programs for Diploma/Technical Student	04	06		02	-	
Educational Programs			03	04	16	
Awareness programs	-	04		-	11	
Diploma NAITA Trainees	03			-		
Training Programs	03			-	36	10
Familiarisation programs for planter trainees	-			-	-	
NIPM programs	03	31	02	-		05
Informal discussion	01	118		-	45	72
Video programs		25		-	18	
RSC seminars	-	01	02	-	01	
Meetings Attended	43	74		01	29	05
Commercial nursery inspections	19	24	90		13	25
Advisory publications distributed	1930	767	500	-	455	176
Planting materials distributed	-	19825		33990	145550	29450
Soil samples tested for pH		355	623	1103	327	194
Soil samples tested for carbon				458		
Exhibitions	02	-		-	01	

ADVISORY & EXTENSION DIVISION - TALAWAKELE

B.A.D. Samansiri
Acting Officer in-charge/Senior Advisory Officer

1. Visitors to the Division

293 visitors including estate management personnel, smallholders and private estate and 2808 University students/Diploma students and other students visited the Division.

2. Advisory & Extension Activities

- Two sessions of National Diploma in Plantation Extension Management (Tea Module) programs were conducted.
- Nine one-day seminars for the special project activities of students were conducted.
- 4.Four 1-day familiarisation and introductory seminars were conducted for the Diploma Students of Aquinas College, Labuduwa, Technical College Dambulla, and Agricultural College Dambulla.
- Three 1-day programs, with demonstrations, were conducted for the Undergraduate students of the Sabaragamuwa, Peradeniya, and Eastern Universities.
- Two familiarisation programs with demonstrations were conducted for groups of tea smallholders selected from societies of Kegalle and Eheliyagoda region.
- Two familiarisation programs were conducted for the trainee Assistant Superintendents of Maturata Plantations and Maskeliya Plantations Ltd.
- Two Field days were conducted for Assistant Managers of Kelani Valley Plantations Ltd.
- One day was devoted for special lectures for Naval Officers from Trincomalee. Two lectures were delivered for the NIPM Diploma program on mature tea up keep/management and Rural sociology and on culling and infilling
- Two plucking seminars were conducted for the pluckers from Dessford and Radella Estates.
- Nineteen commercial nursery inspection were done for small holder societies

3. Extension and Teaching Material

(a) The "Te Thathu" 2nd issue of 1st volume was issued.

(b) All video programs were converted to CD formats

(c) Two models of "Tea growing areas in Sri Lanka" were completed, and placed in the museum and progress centre.

4. Special Events:

As NDT trainee conducted a weed survey at St.Coombs estate in order to an effective weeding program.

Monitoring of leaf standard at St.Coombs Estate was carried out with a NDT trainee.

Mr. V.S. Sidhakaran co-ordinated the activities relating to the revision of Advisory Circulars.

Updating work was under taken at the National History Museum.

Photographs were taken of drought affected tea estates (Kirklees, Alagolla, Luckyland and Gampaha Estates).

The staff participated at the "Vidhartha" & "Shrema Abbimani" exhibitions at Central College Badulla.

- Mr B.A.D Samansiri, Acting. OIC, served on the following committees/ meeting during the year.
- Editor of the "තේ තතු" newsletter
- Co-ordinated production of TV programs and telecasting them on TV.
- Co-ordinated the National Diploma program on Extension Management, for the NIPM.

5. Other Services

- Forty three video programs were distributed
- Twenty five Multi-media and computer facilities were provided for seminars/training programs
- 1,930 publications were distributed free of cost.

ADVISORY AND EXTENSION SERVICES LOW COUNTRY STATION, RATNAPURA

S. Wimaladharma
Senior Advisory Officer
Head, Advisory & Extension Services

1. Advisory Correspondences

- 512 letters were sent on routine Advisory matters, and preparation of development plans.
- Approximately 400 telephonic requests and 212 letters pertaining to advisory matters wer received and the necessary advises were given.

2. Visits made by the staff

2.1 Advisory Visits

67 Advisory visits were made to Company Estates, Private estates and small holdings pertaining to the following subjects Land suitability assessment for new/ replanting of tea. Problems related to Nursery management. Yield decline studies and productivity assessment.

- Problems related to water logging condition, drought etc.
- Preparation of pruning programs.
  Monitoring aspects shade trees and wind belts.
  Preparation of Manuring programs.
- Identification of problem related to pests and diseases.
  Establishment and management of mother bushes

2.2 Extension visits

70 Extension visits were made to estates and small holdings for purpose of evaluating and monitoring the TRI 3000 & 4000 series clonal blocks, carrying out surveys on Shear harvesting, fertiliser/ dolomite/ Zn usage in small holdings, monitoring fertiliser trials and shear plucking demonstrations.

2.3 Commercial Nursery Inspections

24 Commercial nursery inspections were undertaken. Only 15 of them had quality plants fullfilling the requirements specificed in the commercial nursery agreement. Almost all plants in the other nurseries (10) were poor quality and could not be recommended for planting.

3. Visitors to the Station

490 visitors including estate management personnel, small holders and proprietors of private estates visited the station seeking advise pertaining to problems such as nursery failure, pests and root diseases, drought casualties, labour shortage, productivity decline of tea lands and for formulating pruning programs.

- More than 587 students, including University Students, Diploma Students and School Children visited the station to get technical know-how and information on tea cultivation.

4. Advisory & Extension programs conducted

- A total of 132 Advisory and Extension programs were conducted by the Advisory staff. Some of the special program are given below, where the scientific staff too participated and made contributions.

4.1 RSC Activities-Ratnapura Region

- The RSC committee VI for Ratnapura Region, along with the TRI representative, continued to co-ordinate all the scientific and estate sector affairs pertaining to tea plantations in the Region. A seminar was organised for the estate sector tea planting community in Ratnapura Region in collaboration with the Advisory and Extension Services, Low Country Station on the 31st July at TRI Sports Club, Low Country Station, Ratnapura. More than 50 planters from various plantation companies in the region participated in the technical session. Three presentations were made on the following themes.(Co-ordinator.SLDA)

Theme	*Presenters*
Management strategies towards the success of new clearing program.	Mr. Andrew Samuel
New techniques in place of soil fumigation and substitutes for tea nursery soil	Mrs. S.I. Vitarana
Recent finding of problem affecting tea lands in Deniyaya Region	Dr. Balasooriya

4.2. Method Demonstrations and Field Days:

- 6 Demonstration and/ or Field days were conducted by the staff of the Division for the leaf suppliers, small holders, and field officers on various aspect of nursery management, pruning, plucking and Shear harvesting.

4.3 Educational programme

- 6 educational programs were conducted for the Agriculture Diploma students and school children on tea cultivation.

4.4 Empowering Workers through Awareness Programs:

4 Four seminars were conducted for the small holders and field staff of proprietary and company estates.

4.5 Training Programmes

Mr S Wimaladharma, Head/ Advisory and Extension Services, conducted 65 NIPM training programs for Superintendents, Assistant Superintendents, Field staff and other workers etc.

Mr.S.L.D.Amarathunga, served as a resource person to the NIPM training program conducted for Extension Officers of the plantation sector.

4.6 Informal discussion with Individuals or Group

- Approximately 118 informal discussions with individuals or group (for Management and field staff of company or proprietary Estates, and small holders, and students) were held at TRI, Low Country Station, on their properties, on Development program, pruning Program, Manuring, Nursery failures, Plucking, control of Canker, Wood-rot. Termite and Shot hole borer, water logging, drought mitigation etc.

4.7 Video Programs

- More than 25 video programs were shown on land selection, nursery, plucking etc, for the proprietary planters and their field staff and small holders.

- Advisory staff attended the production of a program on Shade management.

4.8 Exhibitions

- Participated in "2001 Abimani "exhibition held at Wanduraba Maha Vidyalaya, Galle on October 2001.(TGN)

5. Meetings attended by the Advisory Staff.

About 74 meeting related to Research and Advisory matters, Circulars, Clonal Work, Computer related matters, CADMAR, District Agricultural Development Committee meetings, and Administration and Finance matters organised by the TRI and other organisations (Tea sector committee, Ministry, TSHDA). were attended by Head Advisory and Extension Services, Advisory Officer, and Extension Officers

6. Soil pH Analysis

355 soil samples were tested for soil pH and suitability for use in nursery work.

7. Advisory Publications Distributed - 767

- Advisory Leaflets (issue free) - 602
  Publications (sold) - 165

8. Activities under Forward Extension Program - TRI Corporate Plan 1999/2003

8.1 Project 1: Adaptive Demonstration Trial

Adaptive Research Trials on Fertilizer: - Continued Five trials in 5 locations such as Kalawana, Horana, Pelawatte and Deraniyagala. However, the trial at Horana was terminated due to completion of the pruning cycle. One pruning cycle has been successfully completed in all the trials. Kalawana, Palawatte and Deraniyagala trials will be continued up to the next prune. Beside the assessment on fertilizer performance, these trials served as centres for dissemination of various agricultural skills /practices to surrounding small holders.

- **Method Demonstration**
  A Nursery trial was conducted to determine whether there is any seasonal effect to the growth of nursery plant.(Duration: 2001April - 2002March) (JPM) A Nursery trial was also started to compare the root growth and shoot growth of some selected TRI 3000/4000 clones recommended for low country region. (Duration: 2001October -2002 May/June) (JPM/PDU/JHNP)

8.2 Project 2: Information Desk

Arrangements have been made to equip the Information Desk with thefollowing :-

- Wall Charts containing regional profile, Tea statistics and regional specific information.

A hot-line telephone service (045-32348) to facilitate the small holders, planters and other interested person to have access directly to the Advisory & Extension Services for their required information or advice.

- Estate data such as weather, yield and other field information, work is in progress and initial arrangements have been made in the preparation of a computer database for low grown region.

  Ready- reckoner work is in progress.

8.3 Project 3: Upgrading Tea Museum and "AV" Saloons:

- Upgrading the tea museum is in progress.
- *"AV" saloons*-Arrangements have been made to collect necessary AV materials to initiate the services for tea growers.

8.4 Project 4 : Establishment of Mother Bushes :

8.5 Project 5 :Monitoring the Agricultural Performance of Tea Plantation & Smallholdings.

- Several routing Advisory visit to the Estates sector as well as & small holding sector have been done to monitor the agricultural practices adopted by them and collect the field information to produce data base.

8.6 Project 6:Production of Extension Materials

TV Programs - Advisory & Extension staff contributed to produce a series of TV programs, which have been telecast on Rupavahini.

9. Leaflets, Booklet & News letters

The booklet on *"Tea & Rubber Inter-cropping System"* has been printed *(Produced by SLD).*

- The booklet *on "Control of Stem and Branch Canker in Low country and Uva Region"* is ready for printing. *(Produced by SLD)*
- *Tea Information* - Leaflets on various tea related statistics were resubmitted to the PPP/TRI for make necessary arrangement for publishing. *(Produced by JPM and SLD)*

  Booklet on *Weed Identification:* Subject Matter Specialist's corrections are being made *(Produced by LDS, JCKR & JM).*

- Advisory & Extension Staff have contributed by writing articles to ***"Tea thathu"*** and TRI Update publications.

Collection of Photographs on Tea

Photographs were taken on tea related information to produce extension materials for upgrading the Museum

10. Presentation of Research papers:

The following research paper based on the Agro-Ecological survey on "*Impact of Ecological Factors on Crop Environment and Productivity of Tea Lands in Sri Lanka*" was presented by Mr. M.K.S.L.D. Amarathunga at *the Annual Session of the SLAAS* at the University of Moratuwa on 29th November.

"Impact of variation of soil properties on the Bush stand and productivity of tea lands in Sri Lanka"

11. Survey on Small Holdings :

The following Extension surveys have been conducted in small holdings:

a) *Znso$_4$ usage in smallholdings.(JPM)* (With the assistance of Diploma Student *from Agric School, Karapincha)*

b) *Shear Harvesting (JPM & SLDA).*

c) *Assessment of performance of TRI 3000 & 4000 series planting material which have been given to the small holders by TRI Ratnapura(JPM/PDU). I*n this survey it was revealed that most of the small holders have not properly used these planting material.

ADVISORY AND EXTENSION CENTRE, PASSARA

J.C.K. Rajasinghe,
Acting Officer- in-Charge/ Advisory Officer

1. General

1.1 Infrastructure development.

- The office building expansion program was completed and the refurbished office was info mally declared open on 23rd July, the day the Advisory Officers meeting was held.

- Main access to the office from the main road was resurfaced with tar at the end of the year.

  CEB transformer located in the office premises was shifted to another location and work was completed by beginning of the year.

2. Special assignments

- Radio program and TV program : Advisory Officer participated in "series of radio program" broadcast on " Lakhanda Radio" on various aspects of tea Tea cultivation.

  Advisory Officer participated in two TV programmes on harvesting of tea, telecast on channel " Eye" of Rupavahini Corporation.

3. Crop

Green leaf sold in 2001

Month	Sold (Kg)	Price SLRs./Kg.	Income Rs.
January	1522	19.04	28,978.88
February	1593	19.61	31,238.93
Arch	2164	19.10	41,332.40
April	2174	17.86	38,827.64
May	3612	16.69	60,284.28
June	3263	17.62	57,494.06
July	776	16.10	12,493.60
August	1783	14.72	26,245.76
September	2377	16.26	38,650.02
October	1624	17.82	28,939.68
November	2286	21.24	48,554.64
December	1636	20.58	33,668.88
TOTAL/AV	24810	18.05	446,708.77

The income given above excludes deduction for leaf transport charges paid to Gonakelle Estate. The total amount paid as transport charges was Rs.8,683.50 and, the net income realised from the sale of green leaf for the year was Rs.438,025.27

4. Income

Income from sale of VP cuttings	Rs.	8,497.50
Income from sale of V P. Plants		Nil
Income from green leaf	Rs.	438,025.27
Soil Analytical charges	Rs.	83,470.00
Sale of publications	Rs.	4,855.00
Guesthouse accommodation charges	Rs.	3,275.00
Other income	Rs.	12,071.50
(Sale of firewood and sale of old GI sheet)		
TOTAL INCOME	**Rs.**	**550,194.27**

5. Check-roll workers (as at 31st December 2001)

No. of check-roll workers	-	*20*
Out turn (Women)	-	*36.1%*
Out turn (Men)	-	*47.3%*

Most of the workers who are from near-by villages keep away from work during the paddy cultivation and festive seasons. Very poor out turn of workers hindered scheduled field operations.

6. Field Trials

- Demonstration trials on the use of tea fertiliser mixtures T-1130 and U-709, for mature tea under smallholder conditions are being continued in three locations in the region in selected smallholder properties. The Soil and Plant Nutrition Division carries out these trials in collaboration with TSHDA. The 2nd cycle of these trails is in progress.

- The Plant Breeding and Propagation Division commenced the second phase of the clonal observation trial 2/VP37/UVA at the Centre. Planting under the trial was completed in December 1998. Monitoring of this trial is in progress.

- The Plant Breeding and Plant Propagation Division laid down a field trial in the station, in January 2000, to develop seed varieties. This trial is in progress.

- A field trial to evaluate the drip irrigation system for mature tea was laid down on Dammeria Estate, Passara with the assistance of Brown &

Company Ltd. The Advisory staff of Passara station is monitoring it under the supervision of the Agronomy Division, Talawakele. These plots were pruned in mid December 2001.

- A trial was initiated to evaluate the performance of U 709 against VP/ UVA 945 Mixture at the station.
- Manual plucking was replaced by shears harvesting (TRI Selective Tea Harvester) from January 2001 in the centre.

7. Special Uva Problems

- Symptoms similar to those of the High Forest problem were recorded in a few fields on Dambetenna Estate, Haputale. Plant Physiology Division is studying this condition.
- Die back of young tea was observed in machine-pruned fields in some tea Plantation in the region.

ADVISORY & EXTENSION CENTRE KANDY

S.T.Yatawatte
Advisory Officer

1. General

Mr.S.T.Yatawatte acted for the Head, Advisory and Extension Services during the month of January when Mr.S Wimaladharma was away from the Island, on overseas training.

Mr.S.T.Yatawatte acted for the Officer in Charge, Mid Country Station during January and February when the Officer in Charge was on medical leave.

2. Advisory & Extension Service:

2.1 Routine Service

- Letters were written to estates and small holders - 242
  Advisory visits were made during the year - 192
- Local and foreign visitors and 246 small holders visited the Station - 88
- Soil samples were tested for pH - 626
- RSC Seminars were held for Superintendents & Assistant Superintendents in the region. - 02
  Field days were held for Estate Field staff at the Station and in several estates in the Mid Country. - 02
- Seminars/demonstrations were held for small holders in the region - 02

2.2 R. S. C. Activities

Officers from the Tea Research Institute continued to co-ordinate the work of RSCs. Two seminars were held during the year for Managers and Assistant Managers of company estates, J.E.D.B., S.L.S.P.C., and proprietary estates in the mid country. These two seminars were conducted in a novel way where two Assistant Superintendents presented the problems on specific subjects after the subjects were introduced by the TRI Scientists followed by group discussions and this made it possible for a higher participatory opportunity to the participants.

Two Assistant Superintendents were selected on their participation at the RSC activities and general performance and sent to South India to observe the Indian practises in tea plantations. The tour was sponsored by the RSC 4, Mid country.

The Advisory Officer participated at the RSC seminars held in Galle, Ratnapura and Bandarawela for the planters in the respective districts.

2.3 Training Programs

Two field demonstrations/training programs were held for smallholders and field officers of estates on the correct use of the TRI selective Tea Harvester.

One training program was held at Hantane for the Advisory Officers and Extension Officers on the use of road tracer in marking contours.

Students from Schools of Agriculture, Puliyankulama and Kundasale and Industrial Training School Naiwela visited the Centre for practical Training on tea cultivation.

2.4 Extension and Teaching Materials

A model tea nursery was maintained at the centre for demonstration purposes and to prepare a growth index of nursery plants under mid country conditions.

2.5 Video Programs

Mr.S.T.Yatawatte participated in the preparation of Video films on Nursery practices and harvesting tea, using TRI Selective Tea Harvester, which was telecast over the television " Channel Eye".

2.6 Training Programmes conducted with NIPM

Mr. S.T.Yatawatte participated as a resource person in a training programme organised for Assistant Superintendents of Bogawantalawa Plantations. He also served as a resource person in a diploma course conducted by the NIPM for Extension Officers of Coconut Development Authority.

2.7 Adoptive Trials/Method Demonstrations.

One trial was conducted at Rikillagaskada on fertilizer use with the collaboration of SPND. A method demonstration trial was conducted at Mooloya on collar pruning and related development work in old seedling tea fields with the help of Agronomy/Plant Physiology Divisions.

2.8 Other Activities.

Mr.S.T.Yatawatte served as Convenor/Secretary of Experiment and Extension Forum meeting for smallholder sector. Two meetings of the forum were held during the year and over 100 participants, both Extension Officers of the TSHDA and representatives of smallholder societies attended each meeting.

Mr Yatawatte also served as convenor/ secretary of Advisory Officers Forum meeting where problems and work plans of the Advisory & Extension Services were discussed with the management. Four meetings of the above forum was held during the year.

2.9 Training.

Mr K.R.W.B.Kahandawa, Extension officer, attached to the centre followed a one week training course on tea manufacture at TRI,Talawakele. He also followed a course on Training of Trainers conducted by the NIPM at Bogowantalawa.

ADVISORY AND EXTENSION CENTRE
KOTTAWA, TALGAMPOLA

K.D.Dahanayake
Advisory Officer/Officer in Charge

1. General

Construction of a new water tank, renewal of portion of the main supply pipeline and the Construction of 02 nos. Twin workers' cottages were completed. Repairs to workers' cottages & staff quarters were also commenced. A new telephone (09-37669) and facsimile facility was installed as per the development activities, of the TRI Co-operate Plan.

2. Advisory & Extension Service

2.1. Advisory correspondences

211 Advisory letters were written by the Advisory and Extension staff for the year 2001.

2.2. Advisory visits

The total number of advisory visits made by the Advisory and Extension staff was Sixty four (64) which included routine visits to the estates and the smallholdings.

2.3. Visitors to the station

The number who visited the station personally seeking advice and collection of VP shoots.

- Estate management and Smallholders - 913
- University/Diploma students and others - 26

2.4 Educational Activities

- A study was undertaken by an undergraduate of the Ruhuna University on the effect of pH on tea nursery soils. This study was supervised by Dr.A.K.N.Soyza.
- A student of the University of Sabaragamuwa was trained and furnished with a set of data on new trends in tea economics by Mr.K.D.Dahanayake and Mr.S.P.Ratnayake.
- Three projects of Agriculture diploma students from Labuduwa and Aquinas College of Agriculture, relating to tea nursery as well as land preparation and soil conservation in tea cultivation were carried out at Kottawa under the supervision of Mr.S.P.Ratnayake.

- Twelve (12) Advance level students gained information and completed their project reports under the supervision of Mr.S.P.Ratnayake.

2.5 Seminars/Field days

- Mr.K.D.Dahanayake and Mr.S.P.Rathnayake conducted 18 seminars at Kottawa station as well as outside, in collaboration with Central bank of Sri-Lanka, Forest Department, Ministry of Indegenous Medicine and Tea Commissioners Division. The target groups were tea smallholders, green leaf suppliers and Factory owners.
- Twelve (12) field days were held for Superintendents, Assistant Superintendents, participants from CIC Company and Smallholders on demonstrations relating to nursery works, weed management, plucking, pruning and pest/diseases control methods.

2.6 Training Programmes

- Sixteen (16) Educational programs related to the new fertilizer policy recommended for low country, shear harvesting and new plucking basket were conducted by the Advisory and Extension staff.

- Mr.S.Wimaladharma conducted two skill development training programmes at Kottawa for Advisory and Extension staff of TRI and Tea Inspectors of TSHDA.
- Eleven (11) awareness programmes were organized by the Advisory and Extension staff for school children.
- Advisory and Extension staff was able to organize and conduct 36 training programmes targeting estate and smallholding sector on Shear harvesting, pruning, plucking, weed management and nursery practices.
- Fourty five (45) informal discussions were held in finding solutions for various problems such as labour shortage, pest/diseases control which encountering in tea industry.

2.7. Video shows/Exhibitions

- Eighteen (18) video shows were presented on plucking, land preparation and soil conservation of tea in and outside Kottawa station.
- Participated at the "Abhimani" exhibition at Wanduraba Central College organized by the Ministry of Vocational Training.

2.8. RSC Meetings

One RSC meeting was organized and held at Unawatuna Sun-Shine hotel.

Mr.Godfry Tissera chaired the seminar and Dr.W.W.D Modder made the keynote address. Mr.S.Wimaladharma addressed the group on Assessment of Nursery Plants Using the Growth Index, Mrs.J.

A.A.M.Jayakody spoke on Labour migration with Special Reference to the Southern Region of Sri-Lanka.

2.9 Other Meetings

Mr.K.D.Dahanayake and Mr.S.P.Ratnayake attended 29 meetings including Heads of Divisions, Advisory Officers' forum, Grade I-V meetings, E and E meetings, Advisory Circular revision meetings, DDC meetings and Advisory and Research linkage meetings.

2.10 Commercial Nursery Inspections

Mr.K.D.Dahanayake inspected 13 commercial nurseries.

2.11 Advisory Publications

455 .Advisory and extension publications were distributed.

2.12 Planting Materials Distribution

Distribution of cuttings (TRI 2022,2025,2027) - 145,550

2.13 Soil samples for pH

No. of soil samples tested for pH - 327

3. Mother Bushes Project

01 ha planting tea and 02 ha land preparation and planting Gautemala was completed. 01 ha land area was earmarked for land preparation under the same project.

4. Experiments & Observation trials at the station

- The effect of different mulches on microbial activity of tea lands
- The effect on burial of pruning
- Shear plucking observation block
- Hedge planting observation block
- TRI 4000 series observation block
- Calliandra plants block
- 200 plants Cinnamon in boundaries (Intercropping)
- Growth performance of Grevillea – reported by Talawakelle & Ratnapura
- Growth performance of young tea - reported by Ratnapura
- Lopping high shade - Albizzia
- Clonal Mother Bush Project - TRI 3000 & 4000 clones
- Adaptive research trials (U-709 and T-1130) at Akuressa and Elpitiya

5. Special problems in Southern Province

327 soil samples were tested for pH and the results showed that most of the soil samples were having low pH values (3.9 -4.3) This is mainly due to inadequate supply of dolomite or not applying of dolomite over the past few years. This situation exists in most of the smallholdings.

a. Low Country Live wood Termite, and Stem and Branch Canker were found in a number of tea fields (Specially in smallholdings), which is as a result of planting of susceptible clone TRI-2026 .

b. The rate of spread of Horse hair blight disease was noticed in Nagoda, Hiniduma, Baddegama and Akuressa areas and reported to the TRI Pathology Division who started an experimental trial at Nagoda.

6. Special Assignments

Mr.K.D.Dahanayake overlooked the field activities of Walahanduwa TRI unit in addition to his normal duties.

7. Check-roll worker

Number on check-roll	56
Outturn	40 average

8. Crop

Green leaf harvested

Month	*Harvested Kg*	*Sold kg*	*Rate paid/kg Rs. Cts*	*Total income Rs. Cts.*
January	8553	8553	25.12	214,911.23
February	7123	7123	25.49	181,593.76
March	7315	7315	23.75	173,716.62
April	4833	4833	23.07	111,516.64
May	7703	7703	25.02	192,729.06
June	5515	5515	24.09	132,856.35
July	5292	5292	24.07	127,378.44
August	5841	5841	24.40	142,520.40
September	4246	4246	24.33	103,313.67
October	8152	8152	26.20	213,566.10
November	7963	7963	25.56	203,534.28
December	7312 appr.	7312 appr.	26.50	186,456.00
Total Average	79848	79848	24.80	1,984,092.55

9. Total income -

Income from sale of green leaf	-	Rs.1,984092.55
Income from sale of VP shoots	-	Rs. 29,110.00
Miscellaneous income	-	Rs. 46,358.00
Total		Rs 2,059,560.55

10. Income

Income from supply of VP shoots	-	Rs.29,110.00
Miscellaneous income	-	Rs.46,358.00

11. TRI Estate, Walahanduwa

Extent	VP Tea	5.99ha.
	New clearing	0.25ha.
	Total	5.74ha.
Labour force		17 nos.

12.1 Crop

	Green leaf Sold	*Price/Kg/(Rs)*	*Income (Rs)*
January	4186	25.69	107,538.34
February	3843	25.19	96,805.17
March	5096	24.37	124,189.52
April	3154	24.07	75,916.78
May	3366	24.07	81,019.62
June	3539	24.00	84,936.00
July	2919	24.51	71,544.69
August	3371	23.15	78,038.65
September	23	24.75	57,989.25
October	4003	25.43	101,796.29
November	3962	24.34	96,435.08
December	4423	24.97	110,442.31
Total/AV	44205	24.55	1,08,6651.70

ADVISORY AND EXTENSION CENTRE
DIYADAWA, DENIYAYA

J.A.S.K.V. Jayasinghe
Acting Officer-in-Charge

1. General

Mr.J.A.S.K.Jayasinghe resumed duties after completing his course work on M Sc.in Agriculture Extension program at the Post Graduate Institute of Agriculture,Peradeniya. The activities of the station continued as usual and the work was overlooked by Mr.S.L.D.Amaratunge, Advisory Officer, TRI, Ratnapura.

2. Crop

Month	*Kgs*	*Rate/ Kg*	*Amount*
			Rs Cts
January	3756	23.85	89,569.33
February	3636	24.47	88,958.38
March	3874	27.81	88,350.44
April	4231	22.08	93,412.02
May	4158	21.87	90,918.83
June	3998	20.59	82,330.81
July	3306	18.83	62,251.98
August	3358	22.12	74,299.11
September	1993	22.50	44,846.49
October	4873	23.54	114,710.42
November	4060	23.73	96,360.04
December	4258		
Total	**45,501**	**251.4**	**926,007.85**

3. Income

No of cuttings sold	145,100
Sale of cuttings	Rs. 36,275
No of plants sold	430
Sale of plants	Rs. 2,150
Crop harvested (Kgs)	45,501
Miscellaneous income	Rs. 50,290.99

4. On - going Experiments

4.1 . Experiments at Deniyaya Station

- LVP 74 phase II – This trial which commenced on August 1997 is still in progress. It is being conducted with the Plant Propagation and Breeding Division. The Physiology and Pathology Divisions also commenced the evaluation of growth performances and resistance to the region specific diseases according to the project proposed under the Corporate Plan.

- Evaluation of Aislaby and Hugoland Seedlings in collaboration with Plant Propagation and Breeding Division at Deniyaya is in progress.
- Evaluation of Plucking-in vs Tipping trial commenced in collaboration with Plant Physiology Division, using clonal block of TRI 2027, was started with effect from December.2000
- Basic research project. No. 15 under Corporate Plan : Assessment of the effect of wet and dry depositions from the atmosphere. Monitoring of rain water quality using the Meteorological Centre, TRI-Deniyaya, continues in collaboration with the Soil & Plant Nutrition Division.

4.2 Experiments outside the Station.

- MethylBromide - To test alternatives for eradication of Nematodes in tea fields/- Hanford Estate (Nematology Division)
- Evaluation of different methods and times of pruning on productivity of tea bushes - Deniyaya Estate (Agronomy Division)
- Determination of effective time and methods of pruning in reducing shot-hole borer damage- (E-284) - Kiruwanaganga Estate, (Agronomy Division)
- Evaluation of *Grevillea provenance* in Deniyaya Estate

5. Advisory and Extension Service

5.1 Correspondence

371 letters were sent out on regular advisory matters and problems.

5.2 Advisory / Extension Visits

- 47 Advisory and routine visits were made by the Advisory staff to company estates and small holdings.
- 36 Extension visits were made to monitor the experiment plots and adaptive research trials.

5.3 Visitors

- 410 visitors, including estate management personal, small holders and private Planters, come to the station.

5.4 Field days

One programme was held for Tea inspectors attach to the Matara Regional Office on Tea nursery Management at Mawarala Tea Shakthi estate

5.5 Seminars:

The following seminars were conducted during the year:

3 Seminars on "Quality leaf for better price" (RAN DALU) conducted for leaf suppliers and collectors in collaboration with Tea Commissioner's Division, Matara

3 Seminars on plucking for small holders organised by private tea factory, Samurdhi & Praja Shakthi Fund

2 NIPM Programs conducted for Field Officers on planting

2 NIPM Programs on scientific plucking for small holders

1 NIPM program on Nursery for field staff of the Maturata Plantations in Deniyaya region

4 seminars on Agricultural aspects for small holders.

5.6 Group Discussion

Special group discussion were held at Morawak Club and Handford Estate on the "Deniyaya Problem" for Superintendents, Asst: Superintendents and Proprietary planters with TRI scientists on 30th May 2001.

5.7 Training Programmes:

2 Training Programmes were conducted in TRI-Deniyaya Agro-met Station on collection of weather data for the students.

3 Programmes were conducted for Southern Development Officers on Nursery & Tea Cultivation..

3 Programmes were conducted for small holders

One Programme was held for University student

One Programme was held for Diploma Holder

5.8 Informal discussions:

These discussions involved the following:

15 informal discussions were held with proprietary and company estate management personals to provide advice on nursery management, pests and diseases control, pruning and development program.

54 informal discussions were made with smallholders to provide advice on nursery management, pests and diseases control, pruning and development program.

Informal discussions were held for Students on tea cultivation.

5.9 Demonstrations

1. In order to identify the reasons for yield decline and bush debilitation of tea in the small holding sector in Deniyaya area , a demonstration block was organised with the collaboration of small holders at Beteyaya Deniyaya.

2 A demonstration block was laid down at TRI Deniyaya station to investigate the different type of mature Tea fertiliser (U 709, T1130, U 880) their effect on yield of Tea

5.10. Meetings attended

Advisory Officer's Forum:- The meetings held at Talawakelle, Kottawa and Passara were attended by the Officer in-Charge and Extension Officer.

- The Officer -in-Charge and Extension Officer attended experiments and Extension forum- Five meetings held at Talawakelle.
- Regional Scientific Committee Seminars: Four RSC seminars attended by the Officer-in-Charge/Advisory Officer & Extension Officer held at Kandy, Ratnapura, Uva and Galle.
- The Officer-in-Charge also attended one work shop organised by CARP at Kandy
- Two inservice training- the Officer-in-Charge participated to inservce training on Land Preparation (Kandy), Nursery management (Kottawa)

5.11 Commercial Nursery Inspections

25 Commercial nurseries were inspected by the Advisory officer during the year.

5.12 Soil Sample for pH

194 samples were analysed

5.13 Advisory Publications

Advisory Leaflets	-	92
Priced Publications	-	84

5.14 Planting materials distributed

VP shoot	-	29,020
VP plants	-	430

6. Activities under Forward Extension Programme under Corporate Plan 1999-2003

6.1 Project 1:- Upgrading Museum and 'AV' saloons

- The upgrading is in progress.

Project 2:-Establisment of mother bush areas

- ADB Clonal Mother Bush Project under the Corporate Plan involves the following

Phase I	-	**2000**	Planted of 3000 VP plants TRI 3025, 3055 and 4052
Phase II	-	**2001**	Planted of 4000 series plants TRI 4046, 4042, 4052, 4053 and
Phase I11	-	**2002**	Work is in progress
Phase IV	-	**2003**	Work is in progress

7. Special Problems Encountered in Deniyaya Region.

The sudden death and decline in yield of clone TRI 2026 on tea fields in Deniyaya, Enselwatte and Hanford estates and a few proprietary and smallholding lands were recorded. The Director /TRI appointed a research team from different disciplines such as Agronomy, Advisory, Plant Breeding, Pathology, Entomology and Nematology to investigate the reasons and propose strategies to overcome the situation. After making individual visit by each scientist, final discussion was held at Handford estate and Planter's Club Deniyaya on 30 May 2001 with the participation of superintendent Asst. Superintendents, proprietary planters and TSHDA Regional manager. Further investigations are in progress.

MID COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE, KANDY

P.B.Ekanayake
Officer-in-Charge

1. General:

Miss.R.M.S.S.Rajapakse, Experimental Officer, Agronomy Division was transferred to Agricultural Economics Division, Talawakele in July, Ms.P.L.A.Tennakoon and Mr.C.S.K.A.Ratnayake, Experimental Officers were transferred to Soils & Plant Nutrition Division from Talawakele in August and November respectively.

Mrs.P.Marapona, Stenographer was transferred back to Talawakele in March.

2. Hectarage as at 31st December 2001

Type of land use	*ha*
Seedling tea	2.00
VP tea (mature)	6.00
VP (young)	1.00
Mother bush	2.00
Nursery (tea)	0.20
Under mana grass	3.00
Fruit trees	0.40
Coconut	0.81
Forestry	1.20
Marshy land	0.62
Buildings, gardens, paths & roads	5.77
Total	**23.00**

3. GROP

Month	*Crop harvested (kg)*	*Crop sold (kg)*	*Rate paid/kg Rs. cts*	*Total Rs. cts*
January	3,491	3,459	15.21	52,611.39
February	2,848	2,844	18.59	52,869.96
March	2,201	2,175	18.73	40,737.75
April	1,548	1,537	17.19	26,421.03
May	4,345	4,315	15.02	64,811.30
June	1,702	1,696	15.02	25,473.92
July	2,518	2,299	15.63	35,933.37
August	1,769	1,758	15.12	26,580.96
September	1,182	1,177	12.63	14,655.51
October	1,950	1,949	14.65	28,552.85
November	3,045	3,018	14.33	43,247.94
December	2,332	2,326	14.25	33,145.50
Total	**37,643**	**37,443**		**445,041.48**

4. Income

No:of cuttings sold		864,625
Income from sale of cuttings	Rs.	216,156.25
No:of VP plants sold		20
Income from sale of plants	Rs.	100.00
Total crop harvested (kg)		37,443
Income from sale of green leaf	Rs.	445,041.48
Guest House occupation charges	Rs.	27,050.00
Soil testing (pH) charges	Rs.	18,480.00
Sale of TRI publications	Rs.	6,000.00
Miscellaneous (Sale of pepper,cloves & trees)	Rs.	43,271.00
Total income	**Rs.**	**756,098.73**

5. Special Scientific Visitors

1. Prof R.B.Mapa, University of Peradeniya in April
2. Mr.Azmal Hussain, FMC, USA in May.
3. Mr.D.T.S.L.Bogahawatta in May
4. Ms. Misuyo Suehiro, Journalist, Japan in June
5. Dr.Jayantha Gunatilaka. Coconut Research Institute, Lunuwila in July
6. Ms Ursula Eastech, Switzerland in July
7. Ms.Barbara Butscher, Switzerland in July
8. Mr.P.M.B.Ekanayake, Ministry of Plantation Industries in August
9. Mr.M.Willocks, Monsanto in October

LOW COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE, RATNAPURA

Sushila I Vitarana
Officer-in-Charge

1. General

Construction work of a new Hostel Complex and Improvements to the Administration building commenced on17th May and 27th September respectively. Both are being financed under the ADB Tea Development Project. Designing and documentation for tendering for Circuit Bungalow and the Auditorium-Plant Breeding Lab complex were completed by the end of the year.

2. Appoiments, transfers, retirements and resignations

Appointments - Messrs G.V.S.Jayalath, P.G.Amarathunga, W.S.G.W.Perera were appointed as drivers on 2nd May 2001 and were trained for 3 months at the TRI Head Office, prior to deployment at this station from 3rd September.

Transfers - Mr.R.Nandasena, Station Assistant of TRI Advisory and Extension Centre, Passara was transferred to this station with effect from 2nd April. Mr.T.G.N.Mahinda, Extension Officer was transferred from the Head Office with effect from 2nd April. Mr.H.I.Mettananda, Driver was transferred out to TRI Advisory & Extension Centre, Kottawa with effect from 1st May. The drivers Mr.K.M.T.Seneviratne, Mr.U.K.A.B. Uduwella, and Mr.W.Samarasekera, were transferred from the Head Office to this station with effect from 16th May. Mr.M.W.Padmakumarade Silva, Assistant Storekeeper was transferred from the Head Office with effect from 26 th June. Mr.K.Chaminda, Driver was transferred from the Head Office with effect from 3rd September.

Retirements - Mr.C.Gunasekera, Experimental Officer retired from the services of the TRI with effect from 25th October.

Resignations - Mr. M.W.Padmakunara de Silva tendered his resignation with effect from 2nd September.

3. Overseas Training/Conferences

Mrs S.I.Vitarana was on study leave to attend two scientific conferences, one in Cairo, Egypt from 10th February and the other in San Diego, California from 2nd to 12th November. She presented papers at both conferences.She also was selected by the Council of Agricultural Research Policy to follow a 2-week training in Research Management, in Hyderabad, India, from 22nd February.

4. No Pay leave

Mr.G.Galahitiyawa, Research Officer was on no pay leave for a period of 164 days from 6th June for employment abroad.

5. External Training

5 Apprentice trainees from NAITA and Technical College, Ratnapura underwent on-the-job training at this station. Two of them trained in Agronomy and Advisory & Extension Division for the National Diploma in Technology(Agriculture) and 2 were trained in English Stenography and one in accounting works.

6. Maintenance of Roads Buildings and Water Supply

Renovation of the C type quarter No.16 was in progress. Repairing of roof and ceiling, fixing of gutters and colour washing of B-Type House No.3 and C Type Quarters No.7,9,10,11, 14,8,5, & 16, and D type quarters 1,5,7 & 8 were completed. One security guard room was newly constructed.

Renovations at the Technology Division workshop were in progress. Construction of toilets and a bathroom for workers at the Filtration Plant were completed. The general maintenance of the buildings, roads, workshop and water supply was carried out satisfactorily according to schedule.

7. Electrical maintenance

Aerial bundle cable was purchased during the year and laying down the cable was scheduled for the 1st quarter of the year 2002.

8. Security Services

The cadre of the Junior Security Guards was enhanced by 6 additional shifts per day to strengthen the security service.

9. External Activities

The Officer-in-Charge or her representative attended the monthly meetings of the Agriculture Committee of the Sabaragamuwa Provincial Council, and quarterly regional meetings of the Planters Association, Ratnapura.

10. Scientific Services

Scientific staff of Agronomy, Entomology, Plant Breeding and Technology carried out research work which have been reported elsewhere in this report. Staff of Advisory and Extension Division collaborated with the research staff in some studies in addition to advisory and extension work reported elsewhere in this report.

11. Meteorological Station

Mr.A.K.Prematunga attended to maintenance and record keeping of the Meteorological station at this centre. The records have been submitted to the National meteorological department. A summary of meteorological data is given in Annexure I.

12. Constraints

The staff strength is inadequate in the administration section, scientific divisions and the Advisory and Extension Services Division. A proposal to increase the cadre, submitted in 1997, was awaiting Ministry approval.

LIBRARY

Wasantha Illangantilake
Librarian

Collecting & disseminating information on tea and allied areas were carried out throughout the year.

The total number of the new accessions during the year was 49.We subscribed to 44 journals and about 22 journals were also received on a gift / exchange basis.

The library continued its normal routine work such as classification, cataloguing indexing , lending materials and maintained a news clipping collection. Compiled the Cumulative Index for the Journal of Tea Science for the period of 1983-1997.

Inter-library loan activities continued satisfactorily. On request 105 articles were sent to various agricultural libraries while 72 articles were received for our users.

Twenty two literature surveys were carried out using CD-ROM database & Internet facilities available at the CARP.

The Library continued to maintain its relationship with AGRINET (Agricultural Information Network) with a view to resource sharing. We received 123 journals content pages according to our user requirements and we forwarded 556 content pages to AGRINET Libraries on SDCP services. We received 12 articles from other Libraries & 7 sent articles to other libraries through AGRINET.

The computerized bibliographic data for the year 2001 were sent to the CARP for compiling of Sri Lanka Agricultural Bibliography, Bibliography of Goat and Bibliography of Organic Farming.

In addition, reference services were made available to students, out side scientists etc., on request.

Librarian attended the AGRINET meetings on 19.07.2001 and 11.10.2001at CARP.

ST. COOMBS / LAMILIERE ESTATE

S.G.Ekanayake
Superintendent

1. General

Mr.D.H.Wickramasooriya , continued as Visiting Agent of St.Coombs Estate . He visited the estate on 10th May .

M/s. Forbes & Walker Tea Brokers (Pvt.) Ltd. and Asia Siyaka Commodities (Pvt.) Ltd. continued as Brokers.

Computerizing estate accounts is in progress.

2. Weather and Rainfall

A rainfall of 1,949.3 mm was recorded over 181 wet days as against 1,887.6 mm over 184 days in 2000.

3. Hectarage Statement as at 31st December 2001

	Total (ha)	*St.Coombs (ha)*	*Lamiliere (ha)*
Old Seedling Tea in Bearing	15.4	15.4	-
V.P.Tea in Bearing	121.6	76.6	45.0
V.P.Tea Immature	4.0	3.0	1.0
ADB Project	12.6	9.6	3.0
Nurseries	1.3	1.2	0.1
Total in Tea	**154.9**	**105.8**	**49.1**
Labour Housing	1.0	1.0	-
Ravines & Grass Land	32.0	31.0	1.0
Buildings, Roads, Workers' Gardens etc.	49.8	35.1	14.7
TOTAL	**237.7**	**172.9**	**64.8**

4. Crop and Yield

	2001		*2000*	
	Crop (kg)	*Yield (kg/ha)*	*Crop (kg)*	*Yield (kg/ha)*
St.Coombs	168,219	1,828	189,406	1,994
Lamiliere	103,841	2,308	98,652	2,122
Total	272,060	1,986	288,058	2,036
Bought Leaf	8,369	-	-	-
Grand Total	280,429	1,986	288,058	2,03

5. Tea Prices

St. Coombs Estate recorded an all time highest price.

6. Working Results

The approximate profit for the year was Rs.6,169,438/-

7. Nursery

65,987 plants of T.R.I. 4000 series clones were raised in the estate nursery for the ADB Project.

8. Cultural Operations (See tables 3 –7)

9. Labour / Labour Accommodation

1. Re roofing was completed in St.Coombs Lower Division and Lamiliere Division.
2. Water supply scheme provided to St.Coombs Lower Division workers.

The health condition of the work force was satisfactory.
1/3 of the labour force on strike for 6 days demanding profit share bonus.

10. Factory and Manufacture

ISO 9002 work in progress.
Wall tiling work is in progress.

11. Replanting

Block No. 10 , 2nd year upkeep Field No.12 & 10 St.Coombs
Block No. 11 , 2nd year upkeep Field No.5 Lamiliere

Routing work was undertaken after re-supplying was done during the year.

12. Vehicles

1 New ambulance was purchased
1 New motorcycle was purchased.

13. SUPPORT STAFF

Mr.L.B.Nimal De Silva was promoted as Field Officer
Mr.E.M.Dayaratne was promoted as Head Factory Officer
Mr.A.D.C.Premalal was appointed as a Junior Assistant Factory Officer
Miss. H.M.B.P.K.Jayathilake was appointed as a Junior Assistant Clerk
Mr.K.Ramesnath was appointed as Estate Medical Practitioner.
Mr.S.Fernando was terminated from service, from December 2001, on disciplinary grounds.

TABLE 1 - *Working Results of St.Coombs / Lamiliere Estate for 2001 compared to previous years*

Year	Total Crop kg (MT)	Bought Leaf (kg)	Yield (MT kg/ha)	Nett Sale Average Actual (Rs/kg)	Cost of Production Estimated Rs/kg	Cost of Production Actual Rs/kg	+ Profit - Loss Rs.
1997	279,718	104,319	1,915	120.30	85.79	99.49	+ 7,922,124.19
1998	218,264	35,063	1,509	152.85	102.76	119.10	-746,355.40
1999	266,001	13,872	1,840	121.60	94.95	116.14	-14,031,161.11
2000	288,058	-	2,036	148.50	103.29	115.74	+ 9,431,018.92
2001	272,060	8,369	1,986	160.00	152.00	130.00	+ 6,169,438.00
				(Approximately)			(Approximately)

TABLE 2 - *Monthly Yield (kg/ha), Rainfall and Average 'N' applied from 1996-2000 St.Coombs Estate - St.Coombs Division*

Month	*1997*	*1998*	*1999*	*2000*	*2001*
January	161	176	190	165	176
February	86	118	168	179	154
March	58	66	173	182	123
April	69	48	193	201	165
May	403	95	118	244	209
June	140	156	73	144	195
July	203	60	130	98	87
August	115	135	168	183	123
September	109	112	120	133	118
October	190	83	166	101	108
November	196	168	127	192	171
December	193	196	199	172	199
Total	1,923	1,413	1,825	1,994	1,828
Rainfall (mm)	2,395.9	2,292.0	2,032.0	1,887.6	1,949.3
No. of wet days	199	170	190	184	181
Average N (kg ha^{-1} yr^{-1})	226	220	170	225	270

TABLE 3: **Monthly yield (kg/ha) of fields and amounts of "N" applied – St.Coombs Division (2001)**

Field No.	**Extent (ha.)**	**Total (N/ha.)**	**MONTHS**													
			Mixture	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
1	6.5	270	VP/UM	177	224	248	171	332	263	130	145	178	122	200	214	2,404
1A	0.6	200	ST/UM	142	146	90	100	190	119	148	153	122	113	340	102	1,765
1B	0.6	270	VP/UM													
2	2.6	270	VP/UM	93	132	12	102	P	2	9	-	-	33	64	175	622
3A	7.0	270	VP/UM	296	247	142	222	347	380	111	203	189	148	254	313	2,852
3B	6.7	270	VP/UM	227	237	271	186	276	233	150	147	161	118	210	280	2,496
4	9.1	270	VP/UM	169	150	112	194	310	217	93	149	119	132	265	253	2,163
4NC	1.0	200	T 750													
5	7.4	270	VP/UM	130	163	62	143	10	6	4	7	26	44	108	201	904
6A	3.0	270	VP/UM	207	230	24	203	352	210	121	136	127	117	162	114	2,003
6B	2.9	270	VP/UM	114	111	122	178	175	180	97	87	123	139	113	104	1,543
7	4.7	270	VP/UM	140	121	122	126	204	149	129	173	211	126	120	193	1,814
8	5.2	270	VP/UM	153	133	143	225	215	345	109	187	145	178	283	264	2,380
9	7.8	270	VP/UM	146	109	67	180	201	223	83	158	145	115	180	187	1,794
10	2.0	270	VP/UM	182	131	99	113	201	274	211	182	189	195	214	145	2,136
11A	2.0	270	VP/UM	369	101	112	311	199	212	121	144	139	117	162	244	2,231
11B	1.0	200	ST/UM	256	143	140	135	143	115	108	170	134	124	138	196	1,802
12A	1.2	270	VP/UM	388	199	119	140	92	138	129	188	152	101	265	135	2,046
12B	1.0	200	ST/UM	160	157	131	128	140	158	96	124	21	-	-	-	1,115
13	9.0	200	ST/UM	136	120	99	143	182	166	P.4	8	6	44	46	160	1,114
13A	1.4	270	VP/UM	163	86	81	139	116	112	-	-	-	47	53	104	901
13NC	2.0	270	VP/UM													
14	7.3	270	VP/UM	228	130	115	137	192	188	111	201	163	145	232	180	2,022

TABLE 4 : **Cultural Operations - St.Coombs Estate - St.Coombs Division**

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2000	Yield (kgha) 2001	Shade	Experiments
1	-	6.5	T R I 2016,2023 2025 & DN	Sep.1999	1953-1959	1920	2404	Dadaps & Grevillea	Nil
1A	0.6	-	-	Aug. 2000	Before 1935	1832	1765	Grevilliea	Nil
1B	-	0.6	T R I 777	Sep.1999	1993	760	-	Dadaps	ADB Mother Bush Area
2	-	2.6	T R I 2043,2142 2025 DT 1 & DT 95	May 2001	1964	1791	622	Dadaps, Grevillea & Calliandra	Plant Breeding
3A	-	7	T R I 2027,2043 2025	June 1998	1965 - 1968	3169	2852	Dadaps, Grevillea & Calliandra	Agronomy & Agri Chemistry
3B	0.4	6.3	WT 26	June 1998	1965-1968	3119	2496	Dadaps, Grevillea & Calliandra	Agronomy & Agri Chemistry
4		9.1	T R I 62/9,2025,3016 DN, N2 & CY9	May 2000	1978-1981	1029	2163	Dadaps, Grevillea & Calliandra	Agronomy & Agri Chemistry & Plant Physiology
4NC	1	-	3000 & 4000 Series	-	1997	1715	-	Nil	ADB Mother Bush Area
5	-	7.4	T R I 2142,2025 2023,TC9,DT95 &N2	May 2001	1970	2664	904	Dadaps, Grevillea & Calliandra	Agronomy & Agri Chemistry & Plant Breeding
6A	-	3	T R I 2025, DN	June 1997	1985-1986	2489	2003	Dadaps, Grevillea	Agronomy & Agri Chemistry
6B		2.9	N2 & T R I 4061	June 1997	1985-1986	1519	1543	Dadaps, Grevillea	Plant Breeding
7		4.7	T R I 2024,2025,62/9 DT1,DT95 & 3019	April 2000	1962-1964	866	1814	Dadapas, Grevillea	Nil

TABLE 4 : *Contd..*

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2000	Yield (kgha) 2001	Shade	Experiments
7		4.7	T R I 2024,2025,62/9 DT1,DT95 & 3019	April 2000	1962-1964	866	1814	Dadapas, Grevillea	Nil
8	-	5.2	T R I 2024,2025,4052 4072 & DT 1	June 1999	1962-1964	2404	2380	Dadaps, Grevillea & Calliandra	Agronomy
9	4.8	3	TR I 3000 & 2043	Dec. 1995	1986	1803	1794	Dadaps, Grevillea & Calliandra	Agronomy
10	-	2	SALT area	Mar-99	1993	1655	2136	Dadaps, Grevillea & Calliandra	Agronomy
11A	-	2	T R I 2025,62/9	June 1998	1988	2546	2231	Grevellia & Calliandra	Nil
11 B	1	-	-	June 1998	1935	1563	1802	Dadaps, Grevillea & Calliandra	Plant Breeding
12A	-	1.2	T R I 2025, KO 145	June 1999	1985	1879	2046	Dadaps, Grevillea	Plant Breeding & Pathology
12 B	1	-	-	June 1999	1935	1316	1115	Grevellia	Nil
13	9	-	-	July 2001	1935	1890	1114	Dadaps, Grevillea & Calliandra	Agri Chemistry
13A	-	1.4	T R I 2025,2043 DT 1	July 2001	1986	1496	901	Grevellia & Calindra	Nil
13 NC	-	2	T R I 3000 Series 2025, DT 1	July 2001	1996	1228	-	Grevellia & Callindra	Entomology
14	-	7.3	T R I 777, 2023 2024,3000 Series & N2	Oct. 1999	1961	2193	2022	Dadapas, Grevillea & Calliandra	Plant Breeding & Pathology

TABLE 5 : **Monthly yield (kg/ha) of fields and amounts of "N" applied - Lamiliere Division (2001)**

Field No.	Extent (ha.)	Total (N/ha.)	MONTHS													
			Mixture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
4A	5.1	270	VP/UM	363	213	187	287	376	208	-	8	-	23	59	51	1775
4B	1.9	270	VP/UM	181	228	147	191	291	329	134	172	181	97	332	222	2505
5	0.5	270	VP/UM	282	296	126	130	230	218	182	212	138	248	260	212	2534
6B	3.0	270	VP/UM	185	159	181	166	190	231	103	203	195	163	232	158	2166
7	4.5	270	VP/UM	123	219	172	183	159	251	98	144	136	171	125	189	1969
8A	5.0	270	VP/UM	215	198	287	127	436	391	230	253	249	213	251	301	3151
8B	4.0	270	VP/UM	207	195	248	157	168	-	9	-	55	96	177	275	1587
9A	4.0	270	VP/UM	194	194	170	157	264	221	141	132	256	148	213	168	2258
9B	4.0	270	VP/UM	194	173	168	185	295	272	124	83	148	125	253	262	2282
10	6.6	270	VP/UM	282	230	157	159	217	215	101	127	160	145	285	207	2285
11	6.4	270	VP/UM	231	194	154	191	306	274	130	122	203	130	226	257	2418

TABLE 6 - *Monthly yield (kg/ha) and average 'N' applied from 1996-2000 St.Coombs Estate – Lamiliere Division*

Month	**1997**	**1998**	**1999**	**2000**	**2001**
January	149	197	176	175	230
February	76	170	178	174	206
March	58	65	196	203	197
April	76	75	174	200	185
May	311	185	139	261	280
June	186	189	84	125	244
July	196	122	126	93	113
August	111	117	134	193	128
September	142	114	131	133	161
October	191	95	172	127	137
November	209	153	134	218	213
December	193	225	227	220	214
Total	**1,898**	**1,707**	**1,871**	**2,122**	**2,308**
Average N ($kg\ ha^{-1}\ yr^{-1}$)	213	219	169	220	270

TABLE 7: **Cultural Operations - St.Coombs Estate - Lamiliere Division**

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2000	Yield (kgha) 2001	Shade
4A	-	5.1	T R I 2025	July 2001	1984	2930	1775	Dadaps & Grevellia
4B	-	1.9	T R I 2025	Aug 1998	1986	2895	2505	Dadaps & Grevellia
5	-	0.5	Mixed Clones		1999	-	2534	Dadaps & Grevellia
6B	-	3	DT 1, WT 26 & T R I 2025	Aug 1997	1990-1991	1990	2166	Dadaps & Grevellia
7	-	4.5	T R I 2025	July 1998	1983	2256	1969	Dadaps & Grevellia
8A	-	5	T R I 2025 & CY 9	June 2000	1979	1538	3151	Dadaps & Grevellia
B	-	4	T R I 2025 , DN N2, WT 26 & CY 9	June 2001	1989 - 1990	2555	1587	Dadaps & Grevellia
9A	-	4	T R I 2025	Aug-96	1979	2250	2258	Dadaps & Grevellia
9B	-	4	T R I 2025, DN, CY 9	Aug-97	1980	2342	2282	Dadaps & Grevellia
10	-	6.6	DN & T R I 2025	June 1999	1967-1969	2277	2285	Dadaps
11	-	6.4	DN & T R I 2025	May 2000	1970-1971	1003	2418	Dadaps

ST. JOACHIM ESTATE

M. S. E. Perera
Superintendent

1. General

Mr. H.S. Ratwatte who functioned as Actg. Superintendent of St.Joachim Estate since 22.06.1999, retired with effect from 15/12/2001 and the new Superintendent, Mr. M.S.E. Perera was appointed to the vacant position from 15/12/2001. Handing over and taking over of the estate was done on 26/12/2001.

Mr. D.H. Wickramasooriya continued as Visiting Agent of St .Joachim Estate. He visited the estate on 12th May.

Messrs. De Silva Abeywardena & Peiris, Forbes & Walker and Bartleet Co.Ltd continued as Brokers.

Mr.W.M.W.L.Perera was appointed to the post of Chief Clerk with effect from 15/10/1999 and letter of appointment to this effect was received on 04/12/2001.

Mr. P.G.H.Bandara was appointed to the post of Head Factory Officer with effect from 15/10/1999 and here too the letter of appointment was received on 04/12/2001.

Mr.S.P.Warnasooriya , Field Officer, reported back for duty on 15/02/2001 following his sickness from August 2000.

2. Hectarage as at 31st December 2001

	Ha	
Mature V.P.tea	6.09	
Immature V.P.tea	8.67	
Land under rehabilitation	16.25	
Nursery	1.58	
Timber clearing	3.34	
Abandoned tea		
Land under coconut	3.89	
Land under rubber	12.30	
Land under paddy	8.74	
Intercropping - Tea/rubber	7.28	118.14
Other Lands		
Acquisition by Government		
Buildings/roads/ravines and jungle		23.84
Total extent		141.98

3. Crop (made tea kg)

The production on St. Joachim Estate in 2001, compared to previous year was as follows:-

Year	*Estate Crop (Kg)*	*Bought Crop (Kg)*
2000	75,336	711,325
2001	66,459	609,732

The production on the estate registered a decrease of 8,877 Kgs or 11.78 % comparied to the previous year.

3.1 Bought Leaf

The bought leaf manufactured at St. Joachim factory showed a decrease of 101,593 kgs or 14.28% in comparison to previous year. This is mainly due to the severe competition for bought leaf with private factories in Ratnapura District.

4. Prices

All teas produced at St.Joachim factory were sold at the Colombo Auctions in the Low Grown catalogue. M/s Bartleet & Co.Ltd, Forbes & Walker and De Silva Abeywardena and Peiris sold the teas in equal proportions.

The Nett sale average for the year was Rs.136/99, and when compared with last year, showed a decrease of Rs. 85/-.

The working of St. Joachim Estate resulted in a profit of Rs.3,638,000/- (approximately).

5. Nursery

The supply of planting materials to small holders in the district continued this year too. Sale of Planting materials compared to the previous , year was as follows :-

Year supplied	*Short Supplied*	*Income (Rs.)*	*Plants supplied*	*Income (Rs)*
2000	-	-	17,787	271,095
2001			12,650	273,438

Table 1 : *Working Accounts of St. Joachim Estate for 2001 in Comparison with previous years*

Year	*Total crop Sold Made Tea –Kg*	*Yield (Made)tea Kh/ha*	*Nett Sale Average Rs/kg*	*Estimated (COP) Rs/kg*	*Actual (COP) Rs/kg*	*+Profit - Loss Rs.*
1995	*887,732 55,643	1097	78/89	68/80.25	75/88.38	+2,827,076/-
1996	*1094,941 63,330	1248	113/81	87/06.38	102/30.88	+17,978,620/-
1997	*996,106 66,847	1236	120/61	98/24.30	111/60	+19,325,357/-
1998	*890,131 73,473	1359	133/64	94/25.00	87/43	+16,605,650/-
1999	*746,768 78,197	1446	120/22	100/30.00	117/33	+8,262,014/-
2000	*711,325 75,336	1393	138/70	82/98.00	75/62	+9,360,576/-
2001	* 609,732 66,459	1164	136/59	89/47.00	75/90	+3,638,000/- (Dec. approx)

* Bought Crop

2001 Production - 66,689 kgs of made tea unsold as at 09/01/2002

6. Cultural Operations

Field No.1

V.P.tea	5.85 ha
Clones	TRI 2023,2025,2026,2027 & S 106
Last pruned	May 1999
Yield 2000	1986 kg/ha
Yield 2001	1590 kg/ha
Shade	Albizia and Gliricidia
Experiments	Machine plucking, irrigation system and weedicide experiments were carried out by TRI Low Country Station.

Regular upkeep of the tea was done during the year.

Field No. 1 A

V.P.tea	1.20 ha
Clones	TRI 2025,2027,S 106 & KEN 16/3
Last pruned	May 1998
Yield 2000	2825 kg/ha
Yield 2001	2131 kg/ha
Shade	Albizia and Gliricidia
Experiments	Nil

Regular upkeep of the tea was done. Upkeep of mana grass was undertaken during the year.

Field No. 2

V.P.tea	4.12 ha
Clones	TRI 2025,2026,2027,S 106
Yield 2000	318 kg/ha
Yield 2001	286 kg/ha
Shade	Albizia and Gliricidia

This field is under the supervision of the TRI and is used for clonal proving trials.

Field No. 2 A

V.P.tea	0.93 ha
Clones	TRI 2025,S 106
Last pruned	June 1998
Yield 2000	3225 kg/ha
Yield 2001	3428 kg/ ha
Shade	Albizia and Gliricidia

This intercropping area is planted with coconut in tea. Regular upkeep of tea and coconut was done during the year.

Field No. 2 F

V.P.tea	6.78 ha
Clones	TRI 2025,2026,2027 & S 106
Last pruned	May 1999
Yield 2000	1131 kg/ha
Yield 2001	933 kg/ha
Shade	Albizia and Gliricidia

Regular upkeep of the tea was done during the year.

Field No. 3

V.P.tea	8.40 ha
Clones	TRI 2023,2025
Last pruned	June 2000
Yield 2000	800 kg/ha
Yield 2001	833 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Nil

Regular upkeep of tea was undertaken during the year.

Field No.4

V.P.tea	5.85 ha
Clones	TRI,2023,2025,2026,2027, H 1/58 & S 106
Last pruned	June 1998
Yield 2000	1591 kg/ha
Yield 2001	739 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Plucking experiments were carried out by TRI Low Country Station .

Regular upkeep of tea was undertaken during the year.

Field No.5

V.P.tea	6.80 ha
Clones	TRI 2023,2025,2027, H 1/58
Last pruned	May 1998
Yield 2000	1250 kg/ha
Yield 2001	762 kg /ha
Shade	Albizia and Gliricidia
Experiments	Weedicide and cover crop experiments were carried out.

Regular upkeep of tea was undertaken during the year.

Field No.5J

V.P.tea	1.40 ha
Clones	TRI 2023,2025,2027, H 1/58
Last pruned	May 1998
Yield 2000	—
Yield 2001	385 kg /ha
Shade	Albizia and Gliricidia

Regular upkeep of tea was undertaken during the year.

Field No.6

V.P.tea	1.50 ha
Clones	TRI 2025,2026 & 2027
Last pruned	May 1999
Yield 2000	5040 kg/ha
Yield 2001	3877 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Nil

Regular maintenance was undertaken during the year in tea area as well as in the area under grass.

Field No. 8 A

V.P.tea	6.00 ha
Clones	TRI 2025,2026 & 2027 KEN 16/3 S 106 and 3063
Last pruned	June 2000
Yield 2000	—
Yield 2001	1530 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Nil

Routine upkeep was done during the year

Field No. 8 B

V.P.tea	2.02 ha
Clones	TRI 2025,2026 & 2027 KEN 16/3 S 106 and 3063 .
Last pruned	June 2000
Yield 2000	—
Yield 2001	1102 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Nil

Routine upkeep was done during the year.

Field No. 8 C

V.P.tea	1.90 ha
Clones	TRI 2025,2026 & 2027 KEN 16/3 S 106 and 3063
Last pruned	June 2000
Yield 2000	—
Yield 2001	2417 kg/ ha
Shade	Albizia and Gliricidia
Experiments	Nil

Routine upkeep of tea was undertaken during the year

Field No.10 Rubber Area

Tapping was undertaken during the year and the latex sold to M/s Rubber Manufacturing and Exporting Corporation of Sri Lanka Ltd, Kuruwita. During the latter part of the year , the above named Ltd., did not buy the latex company refused to as a result of this, steps were taken to make smoke sheets using the latex through a local contractor.

Regular maintenance was carried out during the year.

Field No.10 - Rubber Area (Part)

Regular maintenance was undertaken. With the refusal of acceptance of latex by M/s Rubber Manufature and exporting co-operation of Sri Lanka Ltd., Kuruwita, arrangements were made to make smoke sheets through a local contractor

Field No.6 C - 4.08 ha Intercropping Tea and Ruubber (Planting 1998)

Tea :

Replanting was undertaken in the field using TRI clones 2027,S/106, H 1/58 3000 & 4000 series. Regular upkeep after planting was done during the year.

Rubber :

Normal upkeep was undertaken during the year

Field No.6A - 1.20 ha 5th year upkeep (1996 planting)

Regular upkeep was undertaken during the year. Weeding, manuring and normal upkeep were also done.

Field No.6B - 2.00 ha - Intercorpping Tea/Rubber-4th year upkeep (1997 planting)

Regular upkeep was undertaken during the year.

Field No.1 -4.25 ha - Area under rehabilitation

Upkeep of mana., lopping, weeding and manuring were done during the year.

Field No.8D- 2.83 ha - Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were done during the year.

Field No.1 -3.80 ha - Area under rehabilitation

Upkeep of mana, lopping,weeding,manuring were done during the year.

Field No.5 - 5.60 ha - Area under rehabilitation

Upkeep of mana, lopping,weeding and manuring were done during the year.

Field No.4 - 4.14 ha - Area under rehabilitation

Upkeep of mana, lopping,weeding and manuring were done during the year.

Field No.8C - 4 .30 ha - Area under rehabilitation

Upkeep of mana, lopping,weeding and manuring were done during the year.

7. Factory

Routine upkeep of factory building and machinery was done during the year. Part of the roof was painted.

8. Buildings

All buildings on the estate were well maintained during the year

9. Labour

The health condition of the population was satisfactory. Workers went on a strike in March for two days for demands of a minor nature, and this was settled after two days.

Reroofing was undertaken in line No. 02.

The monthly yield of St. Joachim Estate for 2001 in comparison with that obtained from 1996 to 2001 is given in Table 2.

The monthly yield of each field is given in Table 3.

TABLE 02 *Monthly Yield (kg/ha) rainfall and average of N applied from 1995 to 2001 St. Joachim Estate*

Month	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
January	82	112	146	122	117	123
February	86	42	99	94	105	115
March	83	61	81	132	139	122
April	90	118	131	133	141	113
May	96	111	104	108	143	118
June	75	147	123	113	118	87
July	119	113	103	102	95	86
August	112	95	98	101	100	88
September	108	99	120	135	101	56
October	125	90	127	121	100	88
November	126	122	107	138	110	78
December	146	126	120	147	124	90
Total	**1248**	**1236**	**1359**	**1446**	**1393**	**1164**
Total Rainfall (mm)	3655.0	4552.3	4579.9	4526.4	3740.6	3593.5
No.of Wet Days	188	199	220	224	211	189
Average N (kg-1 Ha-1 Yr - 1)	119	143	158	164	162	163

TABLE 3: Monthly yield (kg/ha-1) of fields with fertilizer mixture used and amounts of N applied at St. Joachim Estate

Field No.	Extent (ha.)	Total (N)	Fert Mixture	MONTHS												
				Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	5.85	240	U/235	182	153	161	150	201	154	109	119	49	102	88	122	1590
1A	1.20	140	U/235	267	346	257	232	185	-	-	57	106	254	196	231	2131
2	4.12	TRI Exp		46	40	13	14	20	23	35	22	1	20	25	14	273
2A	0.93	160	Block U/235	431	464	561	2153	495	260	347	373	225	-	-	19	5828
2F	6.78	240	U/235	83	86	103	98	88	60	65	68	56	84	72	70	933
3	8.40	180	U/235	86	72	56	82	66	57	49	78	46	56	3	92	743
			U/300													
4	5.85	120	U/235	120	98	109	103	102	57	83	43		1	1	22	739
5	6.80	120	U/235	112	81	62	74	104	69	76	68	43	51	22	-	762
5 J	1.40	120	U/235	117	80	82	40	66	-	-	-	-	-	-	-	385
6	1.50	300	U/235	445	453	377	389	362	509	273	213	193	248	309	106	3877
8A	6.00	300	U/235	131	100	146	132	142	101	97	116	101	146	131	187	1530
8B	2.02	240	U/300 U/235		113	233	170	114	-	-	-	9	151	120	192	1102
8C	1.90	300	U/235	175	205	249	249	198	296	199	219	144	261	98	124	2417
			U/300													
3A	3.34	240	U/235	68	82	80	51	45	7		4	11	14	50	60	472
Total	56.09			123	115	122	113	118	87	86	88	56	88	78	90	1164

METEOROLOGICAL OBSERVATION
RESEARCH, ADVISORY AND EXTENSION CENTRE, DENIYAYA
(Elevation 250 m. amsl)

Month 2001	Mean Temperature (^0C)		Soil at 30 cm		Total Rainfall (mm)	Wet Days	Total Wind (km)	Sunshine Hours	Total Evaporation (mm)
	Min.	Max.	8.30 h	15.30 h					
January	29.9	15.2	28.6	27.6	403	19	559	136.5	1.97
February	30.9	14.7	28.2	28.3	248.7	9	665	197.4	2.64
March	31.9	15.3	29.0	29.1	179.8	13	1021	220.9	3.26
April	31.6	16.4	28.9	29,6	345.1	24	701	170.4	2.18
May	31.1	18.2	29.5	29.8	102,1	13	2265	218.4	3.32
June	30.2	17.9	28.9	29.0	108.7	17	2908	184.2	3.70
July	29.8	17.3	28.5	28,8	143.4	17	3487	186	3.56
August	29,6	17.6	28.5	28.7	97.8	17	3053	196.9	3.64
September	30.5	17.0	29.4	29.5	242.9	15	2231	191.4	3.41
October	29.9	17.2	28.5	28,6	277	27	2270	167.9	2.55
November	30.5	15.9	28.6	28,6	217.6	20	881	155.7	3.76
December	30.9	15.1	28.5	28.5	187.1	15	671	175.6	2.9
Total					2553.2	206			
Mean	30.6	16.5	28.7	28.8	2128	17	1726	83.4	3.07

METEOROLOGICAL OBSERVATIONS

MID-COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE KANDY

(Elevation 762 m amsl)

Month	Mean Temperature (^{0}C)		Relative Humidity %		Mean Sunshine (hrs/day)	Cum.Rainfall (mm)	No:of Wet days	Cum. Evaporation (mm)
	Min	Max.	8.30h	15.30h				
January	19.45	26.30	80.00	80.89	3.38	136.80	11	59.20
February	19.10	28.35	96.90	78.76	6.63	88.33	04	112.60
March	19.90	30.65	95.62	71.13	7.25	2.59	02	25.70
April	20.80	30.40	91.80	79.10	5.34	280.40	17	78.30
May	20.80	28.55	89.74	87.68	7.25	27.90	04	108.30
June	21.25	27.20	91.74	91.40	5.86	103.20	14	89.60
July	20.00	25.80	95.74	95.83	2.50	142.40	13	109.80
August	20.25	26.50	97.02	92.08	5.50	22.80	04	82.70
September	20.60	26.75	88.30	95.10	3.30	246.10	13	92.80
October	20.60	26.75	94.08	90.49	5.00	178.20	15	68.10
November	19.50	28.95	80.98	88.83	3.13	198.70	15	70.50
December	20.10	25.85	80.07	86.75	4.00	269.00	11	83.20
Mean	**20.20**	**27.70**	**90.20**	**86.50**	**4.92**	**-**	**-**	**81.70**
Total	**-**		**-**		**-**	**1696.40**	**123**	**908.80**

METEOROLOGICAL OBSERVATIONS

UVA ADVISORY AND EXTENSION CENTRE PASSARA

(Latitude 6^0 56'N, Longitude 81^0 07'E, Elevation 1120 m amsl)

Month	Mean Temperature (^{0}C)		Relative Humidity (%)		Mean Sunshine (hrs/day)	Mean Wind Speed km / h	Total Rainfall (mm)	Cum. Evaporation (mm)
	Min	Max.	9.00	16.00				
January	16.8	23.2	87	90	3.9	2.67	197.5	51.36
February	16.0	25.1	74	72	6.8	1.26	122	83.86
March	17.6	27.4	68	62	8.0	1.03	19.2	116.42
April	18.6	26.2	75	77	5.0	0.86	444.5	68.87
May	19.3	27.7	73	82	5.9	1.15	88.1	97.11
June	18.8	26.9	70	68	5.6	2.20	89.9	100.44
July	18.6	26.9	70	79	4.4	1.44	140.9	84.55
August	18.6	27.2	73	70	5.2	1.29	27.7	94.72
September	18.9	26.9	70	68	4.7	1.04	84.4	72.88
October	18.3	25.4	81	82	3.9	0.69	333.4	53.72
November	17.7	24.9	79	85	3.9	1.39	257.2	58.78
December	16.9	23.8	85	87	4.0	2.20	246.6	61.62
Total							2051.4	944.33
Mean	18.0	25.9	75	77	5.1	1.43	171.0	78.7

METEOROLOGICAL OBSERVATIONS
LOW COUNTRY RESEARCH, ADVISORY & EXTENSION CENTRE, RATNAPURA

(Lat 6^{0}41'N, Long 80^0-40^{0}E, 29 m amsl)

Month	Meen Temperature (^{0}C)		Relative Humidity %		Mean Sunshine	Total Rainfall	Difference from	Wet Days	Difference from	Pan Evaporation
	Min	Max	9.00 hrs	16.00 hrs	hrs/day	mm	30 years		30 years	mm
January	22.49	32.16	90	71	3.88	385.4	+274.3	18	+9	2.17
February	21.72	34.18	90	59	6.40	140.2	+ 3.2	5	-4	3.73
March	23.11	34.73	87	46	7.06	234.3	+22.1	11	-3	4.21
April	23.77	34.31	87	67	4.37	446.5	+107.6	18	-2	3.04
May	24.47	33.35	89	87	5.36	325.1	-150.7	20	—	Not recorded
June	23.96	32.04	87	75	5.77	208.5	-203.7	15	-6	Not recorded
July	23.46	31.40	86	76	4.37	322.6	+29.8	19	-1	2.33
August	23.87	31.97	85	68	5.30	55.5	-248.6	11	-9	3.08
September	22.93	33.11	86	62	4.88	368.6	- 52.8	15	-5	0.52
October	24.02	32.15	87	63	4.00	400.7	- 36.1	23	+2	2.31
November	23.05	32.67	87	64	4.92	240.7	-130.67	16	-2	3.20
December	22.48	33.25	88	63	5.08	153.80	- 81.50	12	-2	2.82
Total	—	—	—	—	—	3281.9	—	183	—	—
Mean	23.27	32.94	87	67	5.11	—	—	—	—	2.74

METEOROLOGICAL OBSERVATIONS

TRI - ST.COOMBS, TALAWAKELLE

(Lat.6"54768'n,Long.80"4239'e,1382m Amsl)

Month	Mean Temperature (⁰C)		Soil at 20 cm under grass		Rainfall Humidity (%)		Wind travelled (miles)	Mean Sunshine (hrs/day)	Total Rainfall (mm)	Wet Days	Total Evaperation (mm)
	Min.	Max.	09.00hrs	16.00hrs	09.00hrs	16.00hrs					
January	13.6	23.3	20.4	21.5	93.5	92.8	1802.81	5.0	126.6	14	64.75
February	9.6	25.4	19.9	22.2	89.9	89.9	1643.74	8.8	84.3	6	103.31
March	10.2	27.5	21.1	23.6	88.9	88.5	2049.92	9.1	8.5	2	133.49
April	13.5	26.6	21.8	23.5	93.3	93.3	1258.11	6.2	132.9	14	83.76
May	15.7	25.5	22.4	23.8	95.8	94.8	1713.97	6.0	147.9	9	81.03
June	16.3	22.5	20.6	21.7	97.7	97.1	2761.39	3.2	204.3	21	59.71
July	15.5	22.3	20.4	21.2	97.0	96.0	2239.07	2.9	349.7	19	54.76
August	15.4	21.3	20.5	21.2	97.5	96.8	2401.43	2.8	99.6	15	41.09
September	14.0	23.2	21.2	22.1	95.3	94.6	1771.25	4.6	246.6	13	53.75
October	15.4	23.5	20.9	21.7	96.8	96.8	1870.61	2.6	183.9	23	43.35
November	13.6	24.4	21.4	22.6	93.7	93.5	1297.45	4.9	118.4	13	64.14
December	12.6	25.1	21.0	22.0	93.7	94.6	1741.76	6.1	137.7	9	64.41
Average	13.8	24.2	21.0	22.3	94.4	94.1	1879.29	5.2			70.63
Total									1840.4	158	847.55

METEOROLOGICAL OBSERVATIONS

ADVISORY AND EXTENSION CENTRE, KOTTAWA, TALGAMPOLA

(Elevation-30m amsl)

Month	Mean Temperature (^{0}C)		Relative Humidity (%)		Mean Sun shine (h day^{-1})	Total Rainfall (mm)	Rainfall difference wet from 20 years	Days
	Min	Max	9.00 h	16.00 h				
January	21.9	30.3	93	79	4.7	209.8	+96.0	14
February	21.2	31.1	91	82	6.3	183.2	+92.6	11
March	21.6	32.2	90	85	8.5	54.6	-67.4	04
April	22.9	31.8	89	82	5.9	153.6	-119.5	12
May	24.2	30.9	83	87	.4	153.0	-225.5	16
June	23.3	30.4	92	88	6.6	119.8	-154.3	16
July	23.2	30.2	89	86	6.2	97.4	-98.3	11
August	23.2	30.4	89	81	6.7	66.9	-152.8	10
September	23.1	30.5	87	81	6.1	393.2	+82.3	18
October	24.1	31.1	97	85	6.3	276.9	-94.5	21
November	22.7	30.5	90	82	6.4	221.2	-75.5	17
December21.6	30.7	90	85	5.9	257.6	+80.2	11	
Total						2187.2		161
Mean			90	84	6.3	182.3	-	13