

ANNUAL REPORT - 2000
TEA RESEARCH INSTITUTE OF SRI LANKA

**TEA RESEARCH INSTITUTE
OF
SRI LANKA**

**ANNUAL REPORT
FOR THE YEAR
2000**



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REPORT OF THE CHAIRMAN TEA RESEARCH BOARD

A Memorandum of Understanding (MOU) was signed between the University of Peradeniya (UP) and the Tea Research Board (TRB) to formalise and strengthen research linkages between UP and the Tea Research Institute (TRI). Similar MOUs are to be entered into between the TRB and other local universities shortly to enable collaborative research in areas of mutual interest.

Under the MOU, the sociological impact of the new plucking basket developed in the TRI-Great Western project on leaf harvesting and leaf conveyance innovations funded by CIDA will be referred to the Post Graduate Institute of Agriculture for an implementation agreement to be signed to enlist the sociologists from UP in this study. TRB has supplemented the CIDA funding for field testing the new baskets and conveyance crates since these innovations would obviously help the entire tea industry. These innovations will be made known to the tea industry through a presentation at the end of the CIDA project.

The manufacturing of tea has undergone few changes over the years. In order to optimise the various processes sequenced in the manufacturing of tea, initial attempts are under way to computerise the withering process. A correct wither is crucial in the manufacture of quality orthodox tea. Electronic sensors and electric motors, designed to control the relative humidity during the withering process by regulating the air flow, are under installation and testing at the St. Coombs Tea Factory. Funding for this is from USAID, channelled through the Planters' Association of Ceylon. Two consultants are presently engaged in this project, one a Sri Lankan and the other a German national. Links are also to be established with the Arthur C. Clarke Centre in a move to accelerate computerisation of the entirety of the tea manufacturing process.

Till recently, no cadre was available for Heads of Divisions positions at the Tea Research Institute. As such, these positions were filled on an acting basis. Necessary approvals have now been obtained to create cadre positions for Heads of Divisions at TRI. These positions can be filled either on the permanent cadre with a specified salary scale attached to such cadre posts or on a contractual basis at higher negotiable salaries, within an approved range. The latter arrangement is expected to attract competent scientists from within the country or those who have earlier left the country in search of greener pastures and now feel morally obligated to serve the motherland.

Fertilizer is a crucial determinant in productivity increases. Yet, it is a costly input. Hence the need to optimise its use. Towards this end, regular upgrading is needed of fertilizer recommendations based on reviews of past data, present

results and current thinking. Accordingly, a “think-tank” of national experts on soils and fertilizers was appointed in 1998. It has now accomplished its task and based on its findings, TRI’s advisory circulars on fertilizers will be revised and issued subject to review six months hence following feedback from the Plantation Management Companies and the tea smallholders.

In November 1999, the International Organization for Standardization (ISO) at its 18th Technical Sub-Committee meeting held in Calcutta, India, had reported the publication of the international standard ISO 11286 on tea, namely classification of grades by particle size analysis. The standard ISO 11286 stipulates that all teas would be graded by particle size. At this meeting, Sri Lanka had argued against this standard and had by demonstration shown its inapplicability to our large leafy grades, which comprise nearly 60% of production and exports. Stemming from these protestations, Sri Lanka and its TRI are now mandated to evolve an alternative standard for these grades. Till then, ISO 11286 would not be applied to large leafy grades. Had ISO 11286 come into force, Sri Lanka would have been ‘standardized’ out of the world tea trade.

So, in pursuance of this mandate from ISO, TRI has now appointed a Steering Committee (SC) of relevant tea industry players to evolve a standard for large leafy grades. Tests are being conducted under the direction of the SC and a final report is scheduled for early next year.

The soils laboratory at the Walahanduwa Estate, taken over by the TRI recently to strengthen its services to the southern low country region, will have research as its primary objective, although soil analytical work will continue to be undertaken. A five-year development plan has now been approved by the TRB. TRB has also approved a cadre increase of 50 in research, extension and advisory and support services. This cadre increase is for the Low Country Station at St. Joachim, Ratnapura, which is now being expanded to meet the research, and extension and advisory requirements of the greater part of the low-country region.

Consistent with its policy of upgrading the knowledge and skills level of staff, the TRB ensured TRI staff participation in scientific conferences, meetings, workshops, training programmes and seminars, both locally and abroad. The scholarship programme for higher studies was also continued.

During the year, TRI staff participated in short-term trainings at the International Agricultural Centre, Wageningen, the Netherlands, in methodologies on integrated pest management; at Coimbatore, India, on computer simulation for crop growth; at the International Development Resource Centre, Philippines, on environmental and resource economics; at Kothari Agricultural Management

Centre, Coonoor, India, on an advanced course in tea tasting and quality control; in China, at the International Course on Operation and Maintenance of Agricultural Machinery; in Malaysia, on new technologies for Agricultural Research - Managing biotechnology in a time of transition; and on Agrometeorology at the Central Research Institute for Dryland Agriculture, Hyderabad, India.

TRI staff also participated at the International Workshop on Practice Oriented Results on the Use and Production of Neem Ingredients and Pheromones in Hohenahr, Germany; at the International Planters' Conference, Kuala Lumpur, Malaysia; at the 28th International Exhibition of Inventions, Geneva, Switzerland; at the Precision Agriculture Conference in USA; at the IFOAM Conference, Basel, Switzerland; at the International Conference on Microbiology of Composting, Innsbruck, Austria.

Several staff promotions were effected during the year. One officer was promoted to the selection segment from the recruitment segment of Grade I. Three others were promoted from Grade II to Grade I. All these promotions were effective from the date of qualification for promotion. The TRB approved payment of skilled wages to workers in various divisions of the TRI, including lent workers, as per regulations under the Wages Board Ordinance. Salary anomalies in TRI higher grades were rectified and interim allowances were paid according to Public Administration Circulars. The collective agreement on wages entered into between the Employers' Federation of Ceylon and the major plantation trade unions was implemented. TRB approved implementation of the Special Salary Advance to Public Officers for the year 2000 and a contribution to the new surgical unit of the Ministry Hospital, Army Headquarters, Colombo.

Certain recommendations of staff returning from visits abroad have received favour with the TRB. Thus, a cell of TRI scientists was formed to examine computer simulation techniques and their application to the tea industry. The TRI cell includes a multidisciplinary team, namely plant breeders, agronomists, soil scientists, entomologists and pathologists. Precision agriculture is the other new concept to be investigated. It is a farming system where different parts of each tea field are managed differentially as opposed to the conventional method where one standard practice is applied uniformly across a whole field. High resolution GIS maps and GPS (Global Positioning Systems) are used in precision agriculture management. TRB has approved a pilot scale study of this new concept with industry participation.

Labour shortage in plantations for harvesting tea, due to recent sociological changes in the country, is a worrisome concern to the tea industry. The TRB, as early as 1995, recognized the imminent need to address this issue. The immediate

solution was to develop a suitable harvester that could be operated in the terrain of our tea lands. The scientists at the Low Country Station, Ratnapura, were assigned this task. The outcome of this initiative was the invention of the TRI Selective Tea Harvester, a First Prize Gold Medal winner at the 28th International Exhibition of Inventions in Geneva in April 2000.

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

REVIEW OF THE DIRECTOR TEA RESEARCH INSTITUTE

The functionality and collective effectiveness of a research institution such as the Tea Research Institute of Sri Lanka are determined by the performance of scientists and extensionists working together, both psychologically and in the transdisciplinary mode.

Transdisciplinarity is well established in the Institute and we are now reaping, increasingly, its practical benefits. A transdisciplinary mind-set allows the flow of ideas across divisional boundaries, without a brake being applied by individual scientists on thinking and action, because they are chary of violating another's turf. Rather than violating divisional boundaries (set up primarily for administrative reasons), the transdisciplinarity at the TRI is now bringing scientists and extensionists together for formal, scheduled interactive sessions and, more importantly, placing them in psychological and physical juxtaposition where professional and personal misunderstandings are minimised.

Cess Allocation

Although there had been an increase of the TRI's share of the cess to 32 per cent for the latter half of 1999, this was reduced to 25 per cent for the year under review. Despite this, I am pleased to report that the momentum, which we had built up in our activities since we commenced operating our Corporate Plan (1999-2003) in July 1999, was maintained in 2000, and our staff responded well to the challenge to do more with less. I believe their response can be gauged from the present Annual Report, and perhaps somewhat more tellingly from this Review.

Achievements and Highlights

My perception of the major achievements in 2000 is given here in summary form. (The project notation used in the TRI Corporate Plan, 1999-2003, is given in parenthesis).

• Clonal Resistance and Tolerance

The clones TRI 4052 and 4019 were found to be highly tolerant to nematodes. Sixty out of 550 lines tested were highly resistant to *Macrophoma* canker. (Projects A 1.2 and A 1.4)

The clones TRI 4052, 4019 and 4088 were found to be highly tolerant to *P.loosi* and therefore are suitable for all areas where *P.loosi* is active, in the up-country, Uva and Deniyaya. TRI 4014, 4024, 4042 and 4047, on the other hand, are good hosts to *P. loosi*, and are not suitable for these areas. (Project A 1.6)

The clone TRI 4054 was pronounced resistant to shot-hole borer, *Xyleborus fornicatus*. (Project A 2.2)

Field assays have shown that TRI 4052 and 4049 are as highly susceptible to shot-hole borer as TRI 3025. The clones TRI 4071 and 3041 are even more susceptible to shot-hole borer than TRI 3025. (Project B 29)

Five volatiles extracted from the bark of TRI 2025 functioned as **kairomones** for shot-hole borer both in the laboratory and in the field. Linalool, phenyl acetaldehyde and methyl salicylate were attractants; geraniol and t-2 hexanal were not. (Project A 22.6)

Methods for extracting and screening kairomones from tea clones, in order to identify clones susceptible to low-country live-wood termite, *Glyptotermes dilatatus*, have been developed. (Project B 30)

A rapid laboratory method (the “insect cage” method) has been developed for screening clones against shot-hole borer. The clones TRI 4024, 4054 and 4034 were found to be highly resistant, TRI 4014 moderately resistant (and comparable to TRI 2023), and TRI 4052 and 4049 highly susceptible (and even more susceptible than KEN 16/3 or TRI 2025). (Project B 29)

A rapid, laboratory **olfactometric assay** has been developed for screening clones against the low-country live-wood termite. (Project B 29)

• **Soils and Fertilizer**

A laboratory for the analysis of soil, leaf and fertilizer was established at Walahanduwa. A similar laboratory at Hantana is now functional. (Thrust A18)
A computer programme for interpreting soil, plant and fertilizer data was developed. (Project B 34)

An evaluation of the effects of macro elements on colour and strength of tea liquor (using di-ammonium phosphate and triple super phosphate) was completed. (Project A15.4)

• **The TRI Selective Tea Harvester**

The TRI selective tea harvester won a Gold Medal at the 28th International Exhibition of Inventions in Geneva in April 2000. (Project A 20.1)

• **Nematode Control and Analysis**

Soil solarization, enhanced by nitrogen (urea) supplementation, and tea waste in layer arrangement (1:1 with soil), are good alternatives to methyl bromide for nematode control in tea nurseries. (Project D 17)

Mechanical uprooting lowers *P. loosi* infestation in the soil by reducing residual root matter and decreasing the *P. loosi*: free living nematode ratio. (Project A 23.4)

A laboratory for nematode analysis (80 samples per day as against 10 at present) adopting new processing technology has been designed and is being built. (Project C 12)

• **Organic Tea Culture**

Microorganisms in decomposing organic matter have been found to cause stress conditions in the tea rhizosphere when ordinary compost is used. A dual-purpose compost material (that is, one having both nutritional and pesticidal properties) was formulated to IFOAM standards. (Project A 23.4)

Cuttings have been successfully rooted in coir-rubber latex blocks. (Project A 23.4)

• **Factory Technology**

Modification of the existing trough withering system recycles more spent air and was therefore found to be less satisfactory than the existing system. (Project A 25.2)

Preliminary use of the solar field, developed for pre-heating the air used in tea drying, indicates a fuel saving of 25-34 per cent. (Project A 26.1)

Trials with the gasifier, developed by NERD, demonstrated its unsuitability for the tea industry. (Project A 26.2)

The prototype of a machine for bulking teas was designed and tested. A commercial unit has been fabricated. (Project B 47)

A dust collector for use in the factory has been designed. (Project B 48)

• **Publications and Theses**

A total of 34 peer-reviewed publications and two theses were produced in 2000.

Dr W.W.D. Modder
DIRECTOR, TEA RESEARCH INSTITUTE

TEA RESEARCH INSTITUTE OF SRI LANKA REPORT FOR THE YEAR 2000

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. 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 programmes, 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 sub-stations located in the different tea growing districts.

1.4 Members of the Tea Research Board as at 31st December 2000

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

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 G.K. Seneviratne	-	Member
9.	Mr Sivam Loganathan	-	Member
10.	Dr M.T. Ziyad Mohamed	-	Member
	Convenor/Secretary:	-	Mrs S.I. Vitharana

There were 10 members and one observer (Senior Accountant) on the above Committee, which held 4 meetings during the year. The following subjects were discussed;

- Year 1999 Performance Reports of the two TRI estates
- Monthly Performance Reports of the two TRI estates
- Visiting Agent's Reports
- Year 2001 estimates of the two estates

1.6 Consultative Committee on Research

1. Dr S.D.I.E. Gunawardena - Chairman
2. Dr W.W.D. Modder - Member
3. Dr D. Kirtisinghe - Member
4. Mr Camillus Silva - Member
5. Prof. Y.D.A. Senanayake - Member
6. Mr N.F.G.P. Athukorala - Member
7. Dr D.T. Wettasinghe - Member
8. Mr R.K. Nathaniel - Member
9. Mr M.S.B.de S. Jayaratne - Member

Convenor/Secretary: - Dr M.T. Ziyad Mohamed

There were 9 members on the Committee which held 5 meetings during the year. Projects on the following topics were reviewed and necessary recommendations made,

- Thrust - Breeding for crop improvement
- Plucking basket
- Yield decline in some TRI clones
- MeBr project
- DNA markers for molecular characterization of clones

1.7 Consultative Committee on Administration & Finance (Up to May 2000)

1. Dr S.D.I.E. Gunawardena - Chairman
2. Dr W.W.D. Modder - Member
2. Mr G.W.S.K. de Silva - Member
3. Mr C.S. Ratwatte - Member
4. Mr Lincoln Fernando - Member
6. Mr A. Somaratne - Member
7. Dr (Ms) Damitha de Zoysa - Member

Convenor/Secretary: - Mr. W.B. Herath

As per the Public Finance Circular No. PF/PE 10 the terms and references and the composition of members of this Committee had been changed and in place Audit & Management Committee was appointed from May, 2000.

1.8 Audit and Management Committee (From May 2000)

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

1.9 Senior Management Staff as at 31st December 2000

- | | | |
|---|---|-----------------------|
| 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 |
| 4. Senior Accountant | - | Mr. W B Herath |

1.10 Heads of Divisions, Administrative, Scientific and Research, Technical and Advisory Staff as at 31st December 2000**Administration Division**

Mr. C C Mawilmada - Deputy Director (Administration)

Finance Division

Mr. W B Herath - Senior Accountant

Mr. M Bowatta - Accountant

Internal Audit Division

Mr. R Kariyawasam - Internal Auditor

Library

Mrs. R W M W K Illanganthillake - Librarian

Publication Unit

Vacant - Publication/Publicity Officer

Advisory & Extension Services Division

Mrs. S. Wimaladharma - Acting Head/Senior Advisory Officer

Mr. B.A.D. Samansiri - Acting Officer-in-Charge/Advisory Officer

Mr. V.S. Sidhakaran - Advisory Officer

Mr. J C K Rajasinghe - Advisory Officer

Agronomy Division

Mrs. M S D L de Silva - Research Officer (on overseas studies)

Agricultural Economics Unit

Mrs. J A A M Jayakody - Officer-in-Charge/Research Officer

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 - Acting Head/Senior Research Officer

Dr. (Mrs.) A C Liyanage - Senior Research Officer

Dr. A M T Amarakoon - Research Assistant

Mr. P A N Punyasiri - Research Officer (on overseas studies)

Mrs. J Jayasundera - Research Officer

Entomology Division

- Mrs. S I Vitharana - Acting Head/Senior Research Officer
Dr. (Mrs.) L D Amarasinghe - Senior Research Officer
Dr. (Ms.) K M S M Nagahaula - Research Officer
Mr. R S Walgama - Research Assistant
Dr. Keerthi M. Mohotti - Research Assistant

Plant Physiology Division

- Dr. A Anandacoomaraswamy - Acting Head/Senior Research Officer
Dr. (Mrs.) A J Mohotti - Senior Research Officer

Plant Pathology Division

- Dr. A Balasooriya - Acting Head/Senior Research Officer
Mr. T A S Gunasekera - Research Assistant
Ms. N H L Pradeepa - Research Assistant
Mrs. B A P Cooray - Research Assistant

Plant Propagation & Breeding Division

- Mr. V Shanmugarajah - Acting Officer-in-Charge/Senior Research Officer
Dr. (Mrs.) M T K Amarakoon - Senior Research Officer
Mr. M Ratnayake - Research Officer

Soils & Plant Nutrition Division

- Dr. L S K Hettiarachchi - Acting Head/Senior Research Officer
Dr. A K N Zoysa - Senior Research Officer
Mrs. S Ananthacumaraswamy - Research Officer
Mr. G P Gunaratne - Research Officer
Mr. P S Mundasinghe - Research Assistant

Technology Division

- Mr. K Raveendran - Chemical Engineer
Mr. W S Botheju - Research Officer
Mr. S Koneswaramoorthy - Mechanical Engineer

TRI Sub-Station Deniyaya

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

TRI Low Country Station, Ratnapura

- Mrs. S I Vitarana - Officer-in-Charge
Mr. S Wimaladharma - Acting Head Advisory & Extension Services/Senior Advisory Officer
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

TRI Sub-Station, Hantane

- Mr. P B Ekanayake - Officer-in-Charge/Senior Research Officer
 Dr. (Mrs.) S K J Sathyapala - Research Officer
 Mr. S T Yatawatta - Advisory Officer
 Mrs. 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. M B A Perera - Officer-in-Charge/Advisory Officer

1.11 Other Administrative, Scientific & Research and Advisory Staff as at 31st December 2000**Administration Division**

- Mrs. S Jayasingham - Secretary to the Director
 Mr. K G Piyasena - Stenographer (Sinhala)
 Mrs. S Shanmuganathan - Stenographer (English)
 Mrs. P Marapana - Stenographer (English)
 Mr. B Tilakeratne - Purchasing Officer
 Mrs. Devika Ratnayake - Stenographer (English)
 Ms. D H Kalikotuwa - Stenographer (English)
 Ms. A P V Kalyani - Stenographer (English)
 Ms. C S K Kiribathgoda - Stenographer (English)
 Mr. P D S L De Silva - Clerk/Typist
 Mr. R Nadarajah - Clerk/Typist
 Mrs. I Jayawickrama - Clerk/Typist
 Mr. K R M Priyantha - Clerk/Typist
 Mrs. R Jayasinghe - Clerk/Typist
 Ms. Ramani De Silva - Clerk/Typist
 Mrs. R Wanasinghe - Clerk/Typist
 Mr. D H Jayatilake - Clerk/Typist
 Mrs. 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 Karuppiyah - 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
Mrs. N Saparamadu	- Stenographer (English)
Ms. V Pahalage	- Accounts Clerk
Mrs. G A S Gunasekera	- Accounts Clerk
Mrs. 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
Mrs. R Godage	- Clerk/Typist
Mr. M W D P De Silva	- Asst. Store Keeper
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
Mrs. L N K Udumulla	- Internal Audit Clerk
Ms. N C Jayaweera	- Internal Audit Clerk
Ms. W N K I Ariyaratna	- Audit Clerk

Library

Mrs. R W M S K Amunugama	- Library Assistant
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Advisory & Extension Services Division

Mr. R A D S Ranatunge	- Extension Officer
Mr. T G N Mahinda	- Extension Officer

Mr. L A M R C Liyanarachchi	- Extension Officer
Mr. R Rajendrakumar	- Clerk/Typist
Mr. K G N Nirosan	- Photographer
Mr. J T Thevasadan	- 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. 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
Mr. M W Silva	- Skilled Mechanic
Mr. H K M D J Kumarasinghe	- Technical Assistant
Mr. R N U Udagamage	- Technical Assistant

Entomology Division

Mr. D D Liyanage	- Experimental Officer
Mr. N Nawaratne	- Experimental Officer
Mrs. 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

Plant Physiology Division

Mrs. V Sidhakaran	- Experimental Officer
Mrs. 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

Plant Propagation & Plant Breeding Division

Mr. S W Gunadasa	- Experimental Officer
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. C S K A Ratnayake - Experimental Officer
(on overseas training)
- Mr. H A P Warnasiri - Experimental Officer
- Ms. P L K Tennakoon - Experimental Officer
- Mr. S M Dissanayake - Technical Assistant
- Mr. T C N Pieris - Technical Assistant

Technology Division

- Mrs. 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 (Electronic)

Mechanical Workshop

- Mr. A Nandasiri - Workshop Mechanic

TRI Sub-Station, Deniyaya

- Mr. M A J S Fernando - Extension Officer
- Mr. O W Jayawardana - Station Assistant

TRI Low-Country Station, Ratnapura

- Ms. S M Samarasinghe - Experimental Officer
- 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. M K S L D Amaratunga - Extension Officer
- 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. A K M Jayasena - Technical Assistant
- Mr. K A D Mervin - Accounting Assistant
- Mrs. P V G Karunanayake - Stenographer (English)
- Mr. K A S Kumarapperuma - Clerk/Typist
- Mr. J S K de Silva - Electrician
- Mrs. B S N Vithana - Experimental Officer

Mr. K Gunawardena	- Work Supervisor
Mr. J H N Piyasundera	- Technical Assistant
Mrs. E W D P Prematunga	- Technical Assistant
Mrs. 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. T M Sarathchandra	- Experimental Officer
Mr. H J M de Silva	- Extension Officer
Mr. A P D A Jayasekera	- Experimental Officer
Mr. R Nandasena	- Station Assistant
Mr. U B Herath	- Experimental Officer
Mrs. B Sureshkumar	- Experimental Officer
Mr. Saman Wijetunga	- Experimental Officer
Ms. R M S Rajapakse	- Experimental Officer
Mr. A H M L S Abeysinghe	- Experimental Officer
Mrs. U Sridaran	- Experimental Officer
Mrs. S N Wijesekera	- Experimental Officer
Mrs. K Sarathchandra	- Experimental Officer
Mr. H Jayaweera	- Experimental Officer
Mr. K R W B Kahandawa	- Extension Officer
Mrs. K M N K Ratnamalala	- Experimental Officer
Mrs. C N K Edirisinghe	- Clerk/Typist
Mrs. 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
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Walahanuwa 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. H.S. Ratwatte	- Superintendent (St. Joachim) on Contract

1.12 Retirements during the year

- (a) Mr. T S Lokuhetty, Clerk/Typist, retired after 38 years of service on 31st January.
- (b) Mr. P D Peter de Silva, Technical Assistant, retired after 36 years of service on 09th March.
- (c) Mr. D W Bartholomeusz, Administrative Officer, retired after 35 years of service on 03rd September.
- (d) Mr. S W Gunadasa, Experimental Officer, retired after 33 years of service on 21st October.

1.13 Resignations during the year

- (a) Mr. E M S L Bandara, Technical Assistant, resigned on 30th April.
- (b) Ms. P K K Vijayanthi, Technical Assistant, resigned on 30th April.
- (c) Mr. M A B Ranatunga, Research Assistant, resigned on 30th April.
- (d) Mr. B M P K Rathnatilaka, Technical Assistant, resigned on 30th June.
- (e) Mr. Ramilan Thiyagarajah, Extension Officer, resigned on 01st May.
- (f) Mr. A J Chandrapala, Extension Officer, resigned on 01st May.
- (g) Ms. D S M Senarath Bandara, Technical Assistant, resigned on 31st October.

1.14 Staff Recruitments

The following staff were recruited during the year 2000

- | | | |
|-----------------------------|---|----|
| (a) Transport Officer | - | 01 |
| (b) Clerk Typist | - | 01 |
| (c) Circuit Bungalow Keeper | - | 01 |
| (d) Photographer | - | 01 |

1.15 Overseas Training/Seminars/Conferences

- a) Dr. L S K Hettiarachchi, Senior Research Officer/Acting Head, Soils & Plant Nutrition Division proceeded to Coimbatore, Tamil Nadu, on 19th February for a International Training Programme on Computer Simulation for Crop Growth and Resource Management, which was conducted from 21st February to 3rd March.
- b) Mrs. S I Vitarana, Senior Research Officer/Acting Head, Entomology Division, proceeded to Germany on 12th March, to participate at the

- workshop on "Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones", which was held from 13th to 15th March.
- c) Dr. M A Wijeratne, Senior Research Officer, TRI Low Country Station proceeded to Geneva to participate at the International Inventors' Exhibition on 9th April, which was held from 12th to 16th March.
 - d) Mrs. J A A M Jayakody, Senior Research Officer/Officer-in-Charge, Agricultural Economics Unit, proceeded to Philippines on 1st April to participate in the EEPSEA short course in Environmental & Resource Economics at the International Development Research Centre at Los Banos, Philippines, which was held from 3rd April to 1st May.
 - e) Mrs. S H Priyanthi Waduge, Experimental Officer and Mr. L. Jayasinghe, Technical Assistant, attached to Technology Division left for Kothari Agricultural Management Centre, Coonoor, India, on 8th May to follow a four-month full-time residential course in Tea Tasting and Quality Control. They returned on 31st August.
 - f) Dr. A K N Zoysa, Senior Research Officer attached to Soils & Plant Nutrition Division, proceeded to Kuala Lumpur, Malaysia, on 16th May for the International Planters' Conference - Plantation Tree Crops in the New Millennium, The Way Ahead, which was held from 17th to 20th May.
 - g) Dr. A Anandacoomaraswamy, Senior Research Officer/Acting Head, Plant Physiology & Agronomy Division, proceeded to St. Paul, Minnesota, USA, on 14th July to participate in the 5th International Conference on Precision Agriculture and to visit Harvard University from 14th July to 03rd August.
 - h) Mr. C S K A Ratnayake, Experimental Officer attached to Soils & Plant Nutrition Division, left for the Netherlands on 18th August under the Netherlands Fellowship Programme - 2000 International Course in Agricultural Engineering, awarded by the Netherlands Government under the Netherlands Fellowships Programme for a period of 10 months.
 - i) Dr. A K N Zoysa, Senior Research Officer attached to Soils & Plant Nutrition Division, proceeded to Switzerland, on 23rd August, to participate at the 13th International IFOAM Scientific Conference at Basel, which was held from 24th to 31st August.
 - j) M/s. D W Vithana, Technical Assistant and A K M Jayasena, Technical Assistant left for South India on 8th September for a three-month full-time Residential Basic Course in Tea Plantation Management at Kothari Agricultural Management Centre, Coonoor.

- k) Dr. (Mrs.) A Janaki Mohotti, Senior Research Officer, Plant Physiology Division, proceeded to Austria on 15th October to participate and present a paper entitled "Growth and Photosynthesis of Field Grown Tea (*Camellia Sinensis*) Plants as Affected by Incorporation of Organic Soil Amendments" at the International Conference on "Microbiology of Composting", which was held from 18th to 20th October.
- l) Dr. Keerthi M Mohotti, Senior Research Officer, Entomology Division, proceeded to Austria on 17th October to participate and present a paper on the following subjects:
 - i) Histopathology of tea roots infested with *Pratylenchus Loosi* due to organic matter treatments
 - ii) Development of nematode antagonistic Potential in Organic matter amended tea soils
 - iii) A way to solve the problem associated with organic tea soils in Sri Lanka
 - iv) Growth and photosynthesis of field grown tea (*Camellia in Sinensis*) plants as affected by incorporation of organic soil amendments
at the International Conference on "Microbiology of Composting", which was held from 18th to 20th October.
- m) Dr. A C Liyanage, Senior Research Officer attached to Bio-chemistry Division, proceeded to Malaysia on 29th October to participate in the course on "Technologies for Agricultural Research: *Managing Biotechnology in a Time of Transition*", which was held from 30th October to 10th November.
- n) Mr. K Raveendran, Chemical Engineer attached to Technology Division, proceeded to Mysore, India, on 21st November, to participate at the Indian Convention of Food Scientists & Technologists 2000, which was held from 22nd to 24th November.
- o) Mr. B A D Samansiri, Advisory Officer attached to Advisory & Extension Services, proceeded to New Delhi on 1st December, for a short term training on Technology Transfer in the Work Plan under the MOA between ICAR & CARP which held from 2nd to 22nd December, at the India Agricultural Research Institute, New Delhi.

1.16 The Job Evaluation and Review Committee which was set up last year to look into the present recruitment procedure, service conditions, cadre requirements, promotional and remuneration scheme has submitted the interim report to the Director, TRI. The final report is under preparation.

1.17 Telephones

Cable network which was commenced last year for the expansion of internal telephone lines has since been completed.

1.18 Vehicles

The following vehicles were purchased during the year:

Double Cabs	-	02 Nos.
Lorry (Half Body)	-	01 No.
Motor Cycles	-	06 Nos.
12 Seater Van	-	01 No.

The following vehicle was purchased under the ADB project:

Motor Cycle	-	01 No.
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1.19 Maintenance Divisions**Buildings:**

Major repairs, renovations and constructions work at TRI Head Office and Sub-stations involved the following:

TRI Head Office, Talawakelle

- a) Barbed wire fence around the "D" type quarters – Tenders were finalized but the work could not be commenced as the boundaries have to be traced by surveying the land.
- b) Building extension for Soils & Plant Nutrition Division Laboratory – Tenders were finalized and the work will commence before 1st March 2001.

TRI Mid-Country Station, Hantane, Kandy

- a) Construction of Retaining Wall – Work was completed during the year.
- b) Construction of General Stores – Tenders were finalized and the work will commence before 1st March 2001.
- c) Construction of Toilet for workers – - do -
- d) Construction of Weighing shed – - do -
- e) Re-tarring of roads – - do -

TRI Sub-station, Passara

- a) Fixing of wire mesh for leaf shed – Work was completed during the year.
- b) Fixing of Iron Grills for Guest House, OIC's quarters and Extension Officers quarters. – - do -
- c) Replacing of main water line – 75% of the work has been completed.
- d) Re-tarring of roads – Tenders were finalized. Work will commence before 1st March 2001.
- e) Re-construction of water tank – - do -

TRI Sub-station, Kottawa

- a) Construction of 02 Nos. Twin Worker Quarters – Work was completed during the year.
- b) Roof repairs of the seminar hall – Work completed in the current year.
- c) Construction of additional bed room in OIC 's bungalow – - do -
- d) Renovation of Guest House – Tenders were finalized. Work will commence before 1st March 2001.
- e) Construction of watcher's shed – Work was completed during the year.

Electrical

The Electrical Division undertook the following work during the year:

- 385 jobs at laboratories and bungalows
- Entire wiring and installations at the following places:
 - (a) Installation of heavy electrical equipment and wiring of the Bio-chemistry Division
 - b) Re-wiring of B-10, D-39, C-21, B-16, D-31 Bungalows
 - c) Heavy electrical equipment and wiring of the Technology Division
 - d) Re-wiring installation in the Lamiliere Bungalow

- Re-construction work involving overhead line at the Junior staff quarters has been completed.
- Connection for Laboratory and Camellia Hostel supply with 250 A Panel Board at the Electrical Division, equipped with earth fault relay for the new distribution system to provide necessary protection in case of an emergency was undertaken.
- Two new 3.04 lightning Conductors for the Administration & Laboratory Buildings were fixed.
- Two new 250 KVAR Capacitor Bank in the main panel board at the Electrical Division were fixed.
- Laying and connection of 3 Phase 4 cables new 1000 KVA transformer as also the completion and installation of the 32 KVA new Generator with main panel board at Hantane Centre were undertaken.
- All street lights at Hantane Centre were installed.
- Wiring and installation of ceiling fans for Guest House, OIC, B1 & C1 Bungalows at Hantane Centre were completed.
- All street lights at the Passara Centre were replaced.
- Wiring of the Day Care Centre was completed.

**TEA RESEARCH BOARD
BALANCE SHEET AS AT 31ST DECEMBER – 2000**

1999 Rs.		Tea Research Institute 2000 Rs. Cts.	St. Coombs Estate 2000 Rs. Cts.	St. Joachim Estate 2000 Rs. Cts.	Total 2000 Rs. Cts.
	FIXED ASSETS				
332,502,369	Property, Plant, Equipment etc.	416,676,694.11			416,676,694.11
(173,513,879)	Less: Accumulated Depreciation	(206,974,219.81)			(206,974,219.81)
158,988,490		209,702,474.30			209,702,474.30
17,168,780	Capital Work in Progress	13,471,978.91		125,894.60	13,597,873.51
176,157,270		223,174,453.21	0.00	125,894.60	223,300,347.81
	CURRENT ASSETS				
10,642,374	Stocks	8,369,978.25	1,318,363.30	778,043.98	10,466,385.53
69,500,084	Debtors and Other Debit Balances	118,957,253.72	5,033,795.77	462,940.10	124,453,989.59
55,929,201	Deposits, Pre-Payments & Purchase Advances	38,614,747.38	110,190.76	1,209,977.82	39,934,915.96
19,089,872	Loans and Advances to Staff & employees	17,403,556.69	2,241,253.65	615,957.79	20,260,768.13
10,300	Other Current Assets-Patents	10,300.00			10,300.00
150,000,000	Short Term Investments-7 day Call Deposits	78,000,000.00			78,000,000.00
3,309,684	Cash and Bank Balances	2,830,139.91	21,583.79	19,281.70	2,871,005.40
308,481,516		264,185,975.95	8,725,187.27	3,086,201.39	275,997,364.61
500,558	Identified Losses	500,557.87	-	-	500,557.87
58,858	Excess & Shortages	52,336.60	-	-	52,336.60
309,040,932		264,738,870.42	8,725,187.27	3,086,201.39	276,550,259.08
	CURRENT LIABILITIES				
(73,254,947)	Creditors and Provisions	(25,611,098.46)	(6,070,911.99)	(9,551,237.75)	(41,233,248.20)
235,785,985	Net Current Assets	239,127,771.96	2,654,275.28	(6,465,036.36)	235,317,010.88
411,943,255	TOTAL ASSETS LESS CURRENT LIABILITIES	462,302,225.17	2,654,275.28	(6,339,141.76)	458,617,358.69
	REPRESENTED BY				
44,435,679	Grants and Reserves	53,063,187.28	-	-	53,063,187.28
336,508,028	Tea Research Fund	372,945,155.08			372,945,155.08
-	A/C Current St.Coombs Estate	10,133,576.93	(10,133,576.93)		0.00
-	A/C Current St.Joachim Estate	11,208,715.88		(11,208,715.88)	0.00
754,670	Long Term Liabilities-Land Reform Commission	754,670.00			754,670.00
30,235,378	Provision for Gratuity	14,186,120.00	12,787,852.21	4,869,574.12	31,843,546.33
9,500	Petrol Deposit Refundable	10,800.00			10,800.00
411,943,255		462,302,225.17	2,654,275.28	(6,339,141.76)	458,617,358.69

Note:- 1. Negative figures are shown within brackets

Sgd. W.B. Herath
Senior Accountant TRI

Sgd. W. W. D. Modder
Director TRI

Sgd. S. D. I. E. Gunawardena
Chairman TRB

TRE RESEARCH BOARD
OPERATING ACCOUNT FOR THE PERIOD 1st JANUARY TO 31st DECEMBER, 2000

1999 Rs.						2000 Rs. Cts.
INCOME						
208,409,035	1	Cess	(Note 1)			168,992,013.33
13,649,730	2	Income from Estates and Other Commercial Activities				19,702,293.54
9,241,291	3	Interest on Investments				12,774,284.09
4,681,980	4	Miscellaneous				3,425,846.19
<u>235,982,036</u>		Total Income				<u>204,894,437.15</u>
EXPENDITURE						
<u>Total</u>			<u>Administration Finance and Common Service</u>	<u>Advisory, Extensions & Publicity</u>	<u>Research</u>	<u>Total</u>
44,838,624	01	Personnel Emoluments	18,982,383.25	10,940,018.03	24,451,522.99	54,373,924.27
4,880,197	02	Travelling	1,256,321.28	1,199,622.05	1,961,092.96	4,417,036.29
10,049,161	03	Supplies and Requisites	3,204,312.33	3,760,736.96	9,429,256.91	16,394,306.20
11,943,394	04	Repairs and Maintenance of Capital Assets	7,739,814.84	4,757,306.99	824,472.76	13,321,594.59
14,064,286	04	Depreciation of Fixed Assets	8,873,926.50	5,503,615.75	15,911,140.41	30,288,682.66
25,325,615	05	Transportation,Communication,Utility and Other Service	18,995,213.59	9,165,588.92	481,196.73	28,641,999.24
	06	Losses and Write Offs				0.00
1,720,638	07	Contributions,Grants and Subsidies	1,754,635.06	149,809.15	169,937.80	2,074,382.01
5,064,411	08	Pensions and Retirement Benefits	1,759,210.50	1,125,201.48	2,844,157.69	5,728,569.67
1,625,854	08	Gratuity Provision	1,552,792.50			1,552,792.50
805,838	10	Media,Advertising,Publicity and Gifts	192,020.28	224,448.07	16,861.70	433,330.05
5,371,328	11	Cultivation and Field Trials	0.00	4,532,584.91	1,184,564.53	5,717,149.44
5,809,867	12	Miscellaneous	2,657,584.99	56,403.50	2,799,554.86	5,513,543.35
<u>131,499,213</u>		Total Expenditure	<u>66,968,215.12</u>	<u>41,415,335.81</u>	<u>60,073,759.34</u>	<u>168,457,310.27</u>
<u>104,482,822</u>		Operating Surplus				<u>36,437,126.88</u>
(15,833,543)		Prior Year Adjustments				-
<u>88,649,280</u>		Excess of Income over Expenditure transferred to Tea Research Fund				<u>36,437,126.88</u>

Note: 1. Tea Cess reduced from 32% to 25% w.e.f. 01/01/2000. Tea Cess receivable - Rs.73,678,398.71

CASH FLOW STATEMENT 2000

The following statement shows the cash flow of the Board during the year under review and in the previous year.

Cash flows from Operating Activities	Year ended 31st December			
	Rs.	2000	Rs.	1999
Surplus/(Deficit) for the year excluding interest on investments		23,662,843		95,241,531
Adjustment for items not involving movement of cash:				
Depreciation	33,721,919		17,361,859	
Provision for Gratuity	1,608,169		16,078,840	
	<u>35,330,088</u>		<u>33,440,699</u>	
Less: Income from sale of fixed assets	(500,773)	<u>34,829,315</u>	<u>(1,343,486)</u>	<u>32,097,213</u>
		<u>58,492,158</u>		<u>127,338,744</u>
Less: Prior period items	-		(15,833,543)	
Adjustment for items not involving movement of cash:				
Depreciation	-	-	-	(15,833,543)
Operating surplus before changes in items of working capital		<u>58,492,158</u>		<u>111,505,201</u>
Changes in items of working capital				
Stocks - (Increase)/Decrease	175,989		314,201	
Debtors and other balances - (increase)/Decrease	(54,177,686)		13,117,499	
Deposits, Prepayments and purchase advances- (Increase)/Decrease	15,994,285		(41,819,576)	
Loans and advances to Staff & employees -(increase)/Decrease	(1,170,896)		(3,296,425)	
Excesses and shortages -(Increase)	6,522		(203)	
Creditors and provisions -(Decrease) Increase	<u>(21,247,681)</u>	<u>(60,419,467)</u>	<u>30,105,793</u>	<u>(1,578,711)</u>
		<u>(1,927,309)</u>		<u>109,926,490</u>

Less

Gratuity paid		-
Cash generated from operating activities	(1,927,309)	109,926,490

Cash Flows from Investing Activities

Interest on investments	11,998,065	8,273,419
Purchase of fixed assets	(84,435,971)	(51,002,219)
Proceeds from sale of fixed assets	500,841	1,343,991
(Increase)/Decrease in capital work-in-progress	3,570,906	(5,128,311)
Cash used in investing activities	(68,366,159)	(46,513,120)

Cash Flows from Financing Activities

Grants received from ARP	-	280,000
NARESHA	-	236,780
ACITR	-	2,248,441
ADB	8,561,261	-
UNDP	66,247	-
Cash generated from financing activities	8,627,508	2,765,221

Net Increase/(Decrease) in cash and cash equivalents	(61,665,960)	66,178,591
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Cash and cash equivalents at beginning of the year	141,360,740	75,182,149
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Cash and cash equivalents at end of the year (Note)	<u>79,694,780</u>	<u>141,360,740</u>
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Note:-Head Office

Short Term Investments - 7 Day Call Deposits	78,000,000	150,000,000
Bank of Ceylon Corporate Branch	(1,176,226)	(4,492,823)
Bank of Ceylon - Talawakelle	2,344,304	(7,456,121)
Bank of Ceylon - Talawakelle ADB	1,250	-
Bank of Ceylon - Deniyaya	6,412	6,412
Petty Cash Imprest	468,929	603,440
Stamp Imprest	9,245	17,709

St.Joachim Estate

Cash In Hand	18,256	17,606
Cash at Bank	979	2,641,054
Stamps	47	22

St.Coombs Estate

Cash In Hand	7,985	1,505
Cash at Bank	13,285	21,930
Stamps	314	6
	<u>79,694,780</u>	<u>141,360,740</u>

AGRONOMY DIVISION

Acting Head – A.Anandacoomaraswamy

Research activities

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

Project 9.1: Evaluate soil rehabilitation techniques

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

The objective of this study is to compare the effect of soil reconditioning before replanting at a very high altitude (>1800 mAMSL) where soil fertility is not limiting the establishment of tea. Five clones (PK2, TRI 2024, DT1, NAY3 and TRI 2025) are used in this study. This experiment has completed one cycle of five years and the average cycle yield is presented in Table 1.

TABLE 1 *Yield of tea (kg MT ha⁻¹)*

Treatments Clone	Yield		Mean
	Reconditioning	Direct Planting	
TRI 2025	1212	1022	1117
TRI 2024	1378	1181	1279
NAY3	1830	1745	1788
DT1	1773	1462	1567
PK 2	1937	1865	1901
Mean	1606	1455	
LSD (P=0.05) for Reconditioning	155.1		
LSD (P=0.05) for Clones	305.2		
SE for Reconditioning	91.9		
SE for Clone	56.1		
SE for Reconditioning x Clone	116.1		
CV (%)	9.0		

The experimental plots were pruned in December 1999 and brought into plucking in June 2000.

A.R.Amerasekera, U.P.Abeysekera

2. Thrust: 10- Development of an economically viable system to eliminate/ reduce the soil rehabilitation period prior to replanting in the mid-country

Project 10.1: Evaluate soil rehabilitation techniques

Effect of alternative methods of soil reconditioning compared with soil reconditioning by grass on the establishment and yield, TRI 3013, New Peacock Estate (1991)

The objective of this experiment is to test the available alternative 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 planting (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 yield for the second year of the first cycle (June 1999- May 2000) is presented in Table 2.

TABLE 2 *Yield of tea (kg MT ha⁻¹)*

Treatments	Yield
T1 – Tea planting in soil reconditioned with Mana	4792
T2 – Direct planting with compost (3kg per hole)	2028
T3 – Direct planting with Compost (1.5 kg at the bottom of the hole + T200 20g per hole)	2491
T4 – Direct planting with coir dust 1.5 kg at the bottom of the hole and compost 1.5 kg on the top	2789
T5 – Direct planting with coir dust (3 kg per hole and T200 –20g per hole)	2245
T6 – Direct planting with coir dust (3 kg per hole)	2279
T7 – Interplanting <i>Flemingia congesta</i> as a cover crop in the inter rows after planting tea	1975
T8 – Direct planting without any soil amendments + T200 20g per hole	1783
SE	389.4
LSD (P=0.05)	550.1
CV (%)	26.5

As seen in the previous year, the results indicated the importance of soil conditioning. None of the alternate methods to minimize the soil reconditioning period was seen to be effective. Since there was development of flowers in the non-reconditioned treatments, all the plots were pruned in November.

Project 10.2: Effect of alternative methods of soil reconditioning compared with traditional method of soil reconditioning by grass on the establishment and yield, TRI 2025, Ratwatte Estate, Ukuwela (2000)

The objective of this experiment is to investigate available alternative methods compared to traditional methods to reduce the soil reconditioning period. Compost with tricotama, refuse tea, coir dust with and without refuse tea were incorporated into the planting hole at the time of planting (August 2000). Further, mana, maize and 'turdhal' were used as other treatments of *in situ* soil reconditioning after planting tea. Other treatments were 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.

- Treatments: T1 - Control - Direct planting
 T2 - Rehabilitation with mana grass for two years
 T3 - Rehabilitation with mana grass for two years + cowpea
 T4 - Compost with Tricotama 3kg per hole
 T5 - Coir dust 2kg per hole
 T6 - Coir dust 4kg per hole
 T7 - Refuse tea 2kg per hole
 T8 - Refuse tea 4kg per hole
 T9 - Coir dust 2kg + Refuse tea 2kg per hole
 T10 - Mana grass *in situ* every row
 T11 - Maize *in situ* every row
 T12 - 'Turdhal' *in situ* every row

Design: RCBD

No. of Replicates: 3

Plot Size: 25 plants

The initial height of plants and the girth measurements are presented in Table 3.

TABLE 3 *Initial height and girth of plants*

Treatments	Mean Height (cm)	Mean Girth (cm)
T1 - Control (direct planting)	38.0	1.82
T2 - Rehabilitation with Mana for 2years	74.7	2.99
T3 - Rehabilitation with Mana for 2years + Cowpea	71.4	3.05
T4 - Compost + Tricotama 3 kg per hole	39.7	1.77
T5 - Coirdust 2 kg per hole	40.0	1.91
T6 - Coirdust 4 kg per hole	36.8	1.79

TABLE 3 *Contd.*

T7 - Refuse tea 2 kg per hole	48.3	2.13
T8 - Refuse tea 4 kg per hole	40.0	1.95
T9 - Coirdust 2 kg + Refuse tea 2 kg per hole	38.9	1.70
T10 - Mana in situ every row	37.9	1.90
T11 - Maize in situ every row	42.7	1.83
T12 - Turdhal in situ every row	42.1	1.87

This experiment is in progress.

P.B.Ekanayake, A.P.D.A.Jayasekara, A.Anandacoomarasamy

3. Thrust: 11- Development of an economically viable system to eliminate /reduce the soil rehabilitation period prior to replanting in the low-country

Project 11.1: Evaluate soil rehabilitation techniques

1. Balangoda Estate

This study was started in 1999. Planting of tea was done in September 1999. Treatments were as follows:

Planting after Rehabilitation

Direct planting (planting hole)

Planting with Compost (planting hole)

Planting with Compost (trenches)

Growth assessments (girth and height) were taken at every 4-month interval and soil sampling was done at 6-month interval for soil physical and chemical analysis.

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

2. St. Joachim Estate

This experiment was commenced in 2000. Treatments were as follows.

Planting after Rehabilitation

Direct planting

Interplanting tea with 'Turdhal'

Interplanting tea with Sweet Corn

Interplanting tea with Mana

3. Handford Estate, Deniyaya

The objective of this experiment is to investigate available alternative 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.

- Treatments:
- T1 - Control - Direct planting
 - T2 - Rehabilitation with mana grass for two years
 - T3 - Rehabilitation with mana grass for two years + Cowpea
 - T4 - Compost with Tricodama 3kg per hole
 - T5 - Coir dust 2kg per hole
 - T6 - Coir dust 4kg per hole
 - T7 - Refuse tea 2kg per hole
 - T8 - Refuse tea 4kg per hole
 - T9 - Coir dust 2kg + Refuse tea 2kg per hole
 - T10 - Mana grass *in situ* every row
 - T11 - Maize *in situ* everyrow
 - T12 - 'Turdhal' *in situ* every row

Soil sampling was done at the time of planting to test soil physical and chemical properties.

A.R.Amerasekara, U.P.Abeyssekara

Project 11.2: Minimum period required for soil rehabilitation

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. Soil sampling was done before planting of grasses for soil physical and chemical analysis.

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

4. Thrust A12. Development of intercropping systems (with pepper and coffee) for marginal tea lands in the mid-country smallholder sector

Effect of intercropping minor export crops in mid-country smallholder tea estate, Manikdewela (2000)

This trial was initiated to study the effect of minor crops on yield of young tea.

- Treatments:
1. Tea alone
 2. Tea x Pepper (Pepper spacing 4m x 4m)
 3. Tea x Coffee (Coffee spacing 4m x 4m)
 4. Tea x Pepper x Coffee (Intercrops planted alternately)

Design: Observation blocks.

This experiment is in progress.

P.B.Ekanayake, A.P.D.A.Jayasekara

5. Thrust A 13 Development of intercropping systems for marginal tea lands in the estate sector

13.1 Evaluating the most compatible crop combinations

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

This experiment is in progress.

P.B.Ekanayake, A.P.D.A.Jayasekara, C.B. Nugawela

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

Project 14.1. Evaluating the most compatible crop combinations

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 rehabilitated tea is in the first year after second pruning and unrehabilitated was pruned in June 2000. The yield is given Table 4.

TABLE 4 *Yield of tea under different spacing of rubber*

	<i>Green leaf Yield kg/bush/yr</i>
Rehabilitated tea	
Tea (monocropping)	1.550
Tea+Rubber (8'x27')	0.715
Tea+Rubber (8'x40')	0.747
LSD (P=0.05)	0.652
CV	37%

The yield of tea under rubber was significantly lower than that of monocropped tea. There was no significant difference between two different rubber spacing. The pruning weight of tea under rubber was also lower than that of monocropped tea. The yield of non-rehabilitated tea under rubber until pruning in June 2000 was also not affected by the two spacing of rubber. Recovery of these tea bushes after pruning was very poor and they recorded about 30% casualties after pruning.

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. Tea bushes were first pruned in July 1998. Plucking and assessments continued during the year 2000. There was no significant difference between tea yields. However, the yield of tea under rubber was marginally lower than that of monocropped tea *i.e.* 1.45 and 1.71 kg/bush/yr.

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

Harvesting of tea and rubber continued during the current year.

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

There are four plots in this observation. They are rubber (20' x 12'), 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.

Tea was pruned in June 2000. Yield of tea (fresh weight basis) for January-May 2000 was 0.879 kg/bush, 0.723 kg/bush and 1.005 kg/bush for monocropped tea, tea under rubber (40' x 8') and tea under rubber (60' x 8' x 8') respectively. Mean girth of rubber trees at chest height were 38.2, 49.0 and 49.9 cm for 40' x 8', 60' x 8' x 8' and 20' x 12' spacing.

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

5. Effect of intercropping tea and coconut on productivity and land utilization

Tea and coconut intercropping experiment - Citrus Estate, Poddala (2000)

This experiment was initiated in November in collaboration with the Coconut Research Institute of Sri Lanka.

- Treatments :
- T1 - Coconut alone at recommended spacing
 - T2 - Tea alone at recommended spacing (with rehabilitation)
 - T3 - Tea x Coconut at 12 ft x 30 ft without rehabilitation
 - T4 - Tea x Coconut at 12 ft x 30 ft with rehabilitation
 - T5 - Tea x Coconut at 12 ft x 40 ft without rehabilitation
 - T6 - Tea x Coconut at 12 ft x 40 ft with rehabilitation

Design: RCBD

No. of Replicates: 03

Plot marking was done in November. The trial is in progress.

P.B.Ekanayake, Jayantha Gunatilake, A.P.D.A.Jayasekara

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.

Evaluation of fertigation, 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 supplied by Messrs. Agriworld (Pvt.) Ltd., Colombo, and Natafim (Israel). The system covered about 0.4 ha. The experiment had to be unavoidably curtailed during the year.

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

Evaluation of fertigation, Somerset Estate, Nanu Oya

In this study, the four treatments of varying frequencies were tested in large blocks of land (1-2 ha). Fertilizer was given with the irrigation water at the rate of 180 kg N ha⁻¹ as urea for 300 days. The annual yield is presented in Table 5.

TABLE 5 *Yield of Tea*

	Yield (kg MT ha ⁻¹)
Fertigation daily (1 hr)	6058
Fertigation every two days (2hrs)	5195
Fertigation once in every three days (2hrs)	4294
Control (No fertigation)	2557

Organoleptic evaluation indicated that there was no difference between irrigated and control treatments.

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

Evaluation of fertigation, Dammara 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 October-December is presented in Table 6.

TABLE 6 *Yield of Tea*

	Yield (kg MT ha ⁻¹)
1 Fertigation daily (1.5hr)	787
2 Fertigation every two days (3hrs)	606
3 Fertigation once in every three days (3hrs)	958
4 Control (No fertigation)	526

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**
 20.3. Modifying harvesting intervals
 20.5. Modifying bush management

1. Hapugasthanna Estate (1992)

There was a continuous yield reduction with machines. Hence, new experiments were commenced in order to test machines with different fertilizer regimes and different styles of planting. Experimental plots were pruned and recovery assessments (shoot density, number of leaves/shoot, shoot height and tipping weight) were taken. Analysis of results showed that the recovery after pruning had not been affected significantly by different methods of harvesting. The experiment was terminated with the commencement of new trials.

M.A.Wijeratne, D.W.Vithana

2. Raigama Estate (2000)

A new trial was commenced at Raigama Estate to test Kawasaki NV 60H motorized machine supplied 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 at 14 and 21 day intervals.

Treatments:

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

Clones: TRI 2027 and H1/58

Replications: 4

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

3. Balangoda Estate (1998)

This experiment 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 2'x4' (100%), 2'x3'x5' (100%) 2'x2'x5' (114%) and 3'x1.5'x5' (133%) and the two clones are TRI 2026 and DG 39. Tea plants were brought into bearing in year 2000. Assessments were done on bush spread (ground cover) and weight of tipped shoots. Analysis of results showed that the % ground covered by tea was significantly low ($p < 0.01$) with the hedge rows planted at 3'x1.5'x5', that is, about 57% whereas that with other systems of planting was about 67-68%. Moreover, weight of tipped shoots of clone DG 39 was significantly lower than that of TRI 2026.

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

4. Noragalla Estate (2000)

Growth performance of tea plants will be recorded on large blocks (0.25 ha) of tea planted at different spacing as given below.

- Treatments (Spacing in ft)
- 1) 2x4 (single row-100%)
 - 2) 2x3x5 (double hedge rows-100%)
 - 3) 2x2x5 (double hedge rows-114%)
 - 4) 3x1.5x5 (double hedge rows-133%)

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

Project: 20.2: Evaluating harvesting devices

20.4 Modifying fertilizer application

1. Noragalla Estate (1998)

Experimental evidence has shown that mechanical harvesting using motorized machines reduces yield. Hence, an attempt was made to use growth regulators to induce shoot growth under mechanical harvesting. The growth regulator, Wokizim (Biozyme Crop) supplied by the Haychem Ltd., Colombo, was used at the rate of 200 ml/ha for two clones viz. TRI 2025 and TRI 2026. Spraying was done every month after harvesting the crop by machine at fortnight intervals. As there was no improvement in yield with the application of growth regulators after mechanical harvesting, the experiment was terminated.

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

2. 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

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

Replications: 4
Clone: TRI 2027

The machine will also be tested on large blocks of 3 other clones (TRI 3063, TRI 3047 and TRI 3041) with normal and high level of K.

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

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

Project 21.1: Evaluating and improving the efficiency of pruning devices

Pruning machines available in the market were modified to improve pruning efficiency. A Knapsack type brush cutter with a flexible shaft supplied by Messrs. P.P.Jinadasa Pvt. Ltd., was used for modifications. The original lever was shortened to 1.05 m for pruning of tea and a separate lever of 2.1 m was made for lopping of medium shade trees. Output of modified machine was 1600 tea bushes per day (6.5 working hours). When the machine was used for lopping *Gliricidia* trees, the output was 450 trees/day.

A new hand pruner has been designed and it is proposed to be tested with manual pruning.

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

Project: 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. Recovery after pruning is now being assessed.

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

Basic studies in pruning

1. Effect of different styles and times of pruning on productivity of tea bushes, TRI 2025 St. Coombs Estate (2000)

The objective of this experiment is to compare the different heights of pruning (45, 55 and 65 cm) on yield, active and *banji* shoot densities. The yield, active and dormant (*banji*) shoot densities are presented in Table 6

TABLE 6 *Yield of tea (kg MT ha⁻¹)*

<i>Height of Pruning</i>	<i>Yield</i>
45cm	2835
55cm	3069
65cm	2933
SE	53.7
LSD	156.7
CV (%)	6.6

The results suggests that pruning at 55cm gave the highest yield and at 45cm gave the lowest yield. There were no yield difference between 55cm and 65cm prune and 45cm and 65 cm prune.

Both active and dormant shoot density followed a similar pattern of yield. Further, light extinction coefficient was highest at 55cm pruning height. Maximum photosynthesis and light use efficiency was highest at 0-10 cm from the surface at all three pruning heights. The LAI and Canopy conductance are presented in Table 7.

TABLE 7 *LAI and Canopy Conductance*

<i>Pruning Height (cm)</i>	<i>LAI</i>	<i>Canopy conductance $\mu\text{ mol CO}_2\text{m}^{-2}\text{s}^{-1}$</i>
45	5.03	1.20
55	5.24	1.51
65	3.92	1.37

L.G.N. Dharmasiri, W.A.J.M.Costa, A.Anandacoomaraswamy
A.R.Amerasekera, P.Rathnatila, U.P.Absekara

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 into plucking (plucking-in and tipping to hard green wood) were tested. Harvesting continued and yield records were maintained during the year. Analysis of results showed that there was no significant difference in yield between treatments. However, the percentage of dormant shoots was comparatively high in the plots given a cut-across pruning.

M.A.Wijeratne, D.W.Vithana

3. Effect of different styles and times of pruning on productivity of tea bushes. Deniyaya Estate, Deniyaya

This is a collaborative study with the estate. Two styles of pruning viz. Lung pruning (22") and Cut-across (26") and 6 times of pruning viz. January, March, May, July, September and November are being tested on recovery and yield of tea. Yield record was maintained by the estate. Analysis of data for the first twelve months after pruning indicated that the yield of lung pruned bushes were about 10% more than that of plots given a cut-across. There were no difference in yield between the time of pruning probably due to favorable weather after pruning.

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

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

Project 22.4. Determining the time and method of pruning on shot-hole borer damage

1. Kiruwanaganga Estate, Deniyaya

This is a collaborative study with the Entomology Division. Three styles of prunings were rejuvenation pruning (10"), lung pruning (18") and cut-across (24"), and three times of prunings were January, April and October. The treatments were replicated 4 times. Shot-hole borer damage in relation to different times and methods of pruning was monitored by the Entomology Division. The experiment is in progress.

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

2. New Peacock Estate, Pussellawa

The 3rd year yield for the period from April 1999- March 2000 is presented in Table 8.

TABLE 8 *Yield of tea (kg MT ha⁻¹)*

Mean	Time of Prune			
	January	April	October	
Rejuvenation Prune (25 cm)	2223	2942	2751	2638
Normal Prune (45cm)	2855	2919	2856	2874
Cut-across Prune (60cm)	2801	3114	3006	2974
Mean	2624	2991	2871	
	Month	Height	Height xMonth	
SE	80.4	80.4	139.2	
LSD (P=0.05)	150.1	241.7	NS	
CV %	9.8			

A.P.D.A Jayasekara

3. Attampitiya Estate, Attampitiya- Field No 7

The yield for the period from May 1999- April 2000 is presented in Table 9.

TABLE 9 *Yield of tea (kg MT ha⁻¹)*

Mean	Time of Prune			
	January	April	October	
Rejuvenation Prune (25 cm)	2020	1983	2414	2139
Normal Prune (45cm)	2562	2430	2582	2525
Cut across Prune (60cm)	2661	2633	2510	2601
Mean	2414	2349	2502	
	Month	Height	Height xMonth	
SE	81.7	81.7	141.6	
LSD (P=0.05)	NS	238.7	NS	
CV %	11.7			

A.R.Amarasekera, U.P.Abeyssekara

11. Thrust A 24. Development of weed management strategies in tea

24.1 Screening of herbicides

24.1.1 : Screening of new herbicide - Amosuper (Glyphosate)

a) Testing of the correct dosage of the product for grasses and broad leaf weeds at St. Joachim Estate, Ratnapura

The visual injury is presented in Table 10.

TABLE 10 *Injury % (Visual) in weeds as affected by different dosages*

Dosage (%)	Injury (Visual) %						
	Axonopus grass			Broad leaf weeds			
	Weeks after application						
	1	2	10	1	2	4	10
0.1	02	03	25	-	-	-	-
0.2	13	15	33	30	60	75	70
0.3	41	28	77	40	80	90	80
0.4	55	45	90	50	80	95	90
0.5	67	63	96	75	90	99	90

Thus, the suitable range of herbicide dosage for the control of grasses and normal broad-leaf weeds is 0.3-0.5% herbicide solution. However, even 0.2% is adequate when the weed density is minor.

b) Control of problem weeds with Amosuper at Hantana Estate, Kandy

TABLE 11 *Killing rate of weeds as affected by 3 dosages of Amosuper & Roundup, one month after application [MAA]*

Product	Dosage	Killing rate	
		<i>Hedyotis auricularia</i>	<i>Commelina</i> spp.
Amosuper	0.3%	50% with 50% recovery	no kill
	0.5%	75% with 10% recovery	-
	0.7%	85% with 10% recovery	no kill
Roundup	0.3%	40% with 65% recovery	no kill
	0.5%	75% kill with 5% recovery	no kill
	0.7%	80% with 15% recovery	partial wilting
[0.3%=1.65 l ha ⁻¹		0.5%=2.75 l ha ⁻¹	0.7%=3.85 l ha ⁻¹]

TABLE 12 *Mean fresh weight (g/0.09 m²) of Getakola and other weeds, 1 MAA*

Product	Dosage	Getakola			
		Total	Above ground	Below ground	Other
Amosuper	0.3%	58±03	22.14	9.6	30±7
	0.5%	82±13	42.44	16.09	03±1
	0.7%	41±11	2.3	0.51	47±9
Roundup	0.3%	70±2	42.32	10.54	28
	0.5%	60±5			23±3
	0.7%	55±6	6.01	2.01	44±14
Control		63±7	19.37	2.01	44±14

It is apparent that a higher dosage of 0.7% or more is required to kill Getakola weed. For normal weeds, 0.5% of Amosuper is sufficient. Performances are more or less the same with both the glyphosate products.

c) Control of *Passali kodi* weed with Amosuper, Balangoda Estate

Rate	2.5 WAS	8 WAS
0.5%	Wilting	30% Wilting only and recovery of germination from bulbils
0.8%	Wilting and discolouration upper	50% Partial killing of tender weeds, tender shoots of mature weeds and recovery of germination from bulbils
1.0%	do	60% Killing of mature weeds and recovery of germination from bulbils

d) Control of *Caladium bicolor* weed with Amosuper

Visual observation 3 WAS

0.5%	Wilting, droopy leaves, discolouration (yellow/brown)
0.8%	Wilting and droopy leaves discolouration (Brown spots), recovery of germination from bulbils
1.0%	Brown spots and poor recovery from yams. No proper killing.

24.1.2: Weed control performances of glyphosate with incorporation of various adjuvants at TRI, Ratnapura

The following adjuvants were tested by incorporating into 0.2% glyphosate (Roundup, 36% a.i) in mid-July 2000:

T1	Glyphosate (0.2%)	+ (1.0%) Sandovit-N
T2	-do-	+ (0.5%) Urea
T3	-do-	+ (0.5%) Ammonium sulphate
T4	-do-	+ (0.01%) Latron [30 ml/225 l water]
T5	-do-	+ (0.2%) Teepol
T6	-do-	+ (0.3%) Kaolin [1.7 kg/550 l water]
T7	-do-	alone
T8	Control	

TABLE 13 Mean injury % on weeds (Visual) following herbicide application

	1 WAS		3 WAS	
	Broad leaf	Grasses	Broad leaf	Grasses
T1	35	62	32	85
T2	32	53	40	70
T3	65	73	47	89
T4	53	68	55	94
T5	45	70	45	83
T6	33	60	45	87
T7	35	62	33	80

A better performance was shown with Latron, Ammonium Sulphate, Kaolin and Sandovit-N, compared with Glyphosate alone. This is based on the injury rate in grasses observed 3 WAS. In respect of broad leaf weeds, a better performance was shown with all adjuvants except Sandovit-N. The best performance was shown by Latron. However, a similar trend was not seen in weed dry weight. Weed dry weight was reduced significantly ($p < 0.05$) only with Teepol compared to Urea. Therefore, this experiment is being repeated.

K.G.Prematilake, H.S.N. Peiris

A 24. 2 Management of Problem Weeds

2.1 Control of Getakola (*Hedyotis auricularia*): Weed control efficacy of Glyphosate incorporated with various adjuvants

0.3% or 0.7% Roundup (36% a.i, Glyphosate) were incorporated with different types of adjuvants and applied on field infested with Getakola in July 2000 at Hantana Estate, Kandy.

TABLE 14 Visual injury % and biomass yield of Getakola one MAA and recovery of growth 1.5 MAA

Treatments	Injury (Visual) %		Weed fresh weight (g /ft ²)		Recovery %	
	Glyphosate		Glyphosate		Glyphosate	
	0.3%	0.7%	0.3%	0.7%	0.3%	0.7%
1 Ammonium sulphate (0.5%)	86.6	96.0	6.83 d	6.88 d	8	2
2 Urea (0.5%)	67.3	91.7	24.17 cd	16.00 d	19	9
3 Latron (0.06%)	71.7	92.0	33.83 bcd	7.67 d	10	5
4 Sandovit-N (1%)	80.0	86.7	13.00 d	11.50 d	8	6
5 Kaolin (7g/l)	85.0	77.0	14.33 d	19.00 cd	8	8
6 Teepol (2 ml/l)	80.0	91.7	15.00 d	20.33 cd	16	3
7 No surfactant	50.0	70.0	32.17 bcd	25.50 cd	20	12
8 Control		35.0		84.17a		

Increased weed damage occurred with all surfactants. The highest injury % was recorded with Ammonium Sulphate (AS). Overall results indicated that AS had performed best. Improvement in weed control was also observed with Latron and Teepol.

TABLE 15 *Visual injury % and biomass yield of Getakola 2.5 MAA and recovery of growth 5 MAA*

Treatments	Injury (visual) %		Weed fresh weight (g /ft ²)		Recovery%	
	Glyphosate		Glyphosate		Glyphosate	
	0.3%	0.7 %	0.3%	0.7 %	0.3%	0.7 %
1 Ammonium sulphate (0.5%)	90	97	1.83 c	1.28 c	22	9
2 Urea (0.5%)	72	94	25.60 ab	8.02 bc	18	15
3 Latron (0.01%)	80	93	10.63 bc	2.37 c	5	4
4 Sandovit-N (1%)	88	100	2.90 bc	0.21 c	27	9
5 Kaolin (7g/l)	87	87	3.75 bc	5.62 bc	15	17
6 Teepol (2 ml/l)	79	100	6.20 bc	0.84 c	10	9
7 No adjuvant	62	80	18.60 b	13.3 bc	19	12
8 Control	7			36.1a		

Greater damage on weeds was also observed with Urea and Sandovit -N compared to the plots treated without any surfactant. Better performance in weed control was observed with AS, Latron, Sandovit -N and Teepol even 2.5 months after application. This experiment is being repeated.

K. G. Prematilake, A. Gamage

2.2 Control of Getakola (*Hedyotis auricularia*): Effect of various cultural measures on the control of Getakola at Mount Vernon Estate, Patana

2.3 Chemical control of *Caladium bicolor* weed

Treatments

T1	Round up	5.50 l/ha + Kaolin 3.4 kg/ha
T2	do	+ Kaolin 1.7 kg/ha
T3	do	2.75 l/ha + kaolin 3.4 kg/ha
T4	do	+ Kaolin 1.7 kg/ha
T5	Touch down	3.0 l/ha
T6	do	1.5 l/ha
T7	Wallop	3.0 l/ha
T8	Wallop	4.0 l/ha
T9	Spark	3.0 l/ha
T10	do	4.0 l/ha
T11	Weed Master	3.0 kg/ha
T12	Untreated control	

Treatments were first imposed in mid-October 1998 and the second and third spray in early May 1999 and November 1999 respectively. The weed number had been reduced before the imposition of treatments as affected by previous treatments.

TABLE 16 *Mean weed density and unit plant dry weight as affected by various herbicides*

Treatment	Weed Count				Weed dry weight (g/0.09 m ²)					
	No/m ²				Tuber		Stem		Total	
	1MAS	6MAS			6 MAS					
T1	14.5	bc	18.9	de	11.7	c	2.67	a	13.4	e
T2	14.4	bc	23.9	bcde	20.6	abc	5.21	a	24.9	bcde
T3	22.8	bc	36.5	abcd	18.7	abc	5.53	a	23.1	cde
T4	9.9	c	23.6	bcde	48.2	ab	5.84	a	53.3	abc
T5	17.4	bc	12.5	e	15.8	bc	4.67	a	19.6	cde
T6	21.9	bc	61.7	a	55.8	a	14.02	a	68.7	ab
T7	12.5	bc	38.9	abcd	33.7	abc	10.07	a	42.9	abcd
T8	40.4	ab	44.7	abc	28.6	abc	6.61	a	34.4	abcde
T9	11.4	bc	19.5	de	19.6	abc	6.65	a	25.5	bcde
T10	9.04	c	22.2	cde	14.4	c	3.57	a	17.1	de
T11	12.2	bc	51.29	ab	14.2	c	5.16	a	18.1	de
T12	69.7	a	69.18	a	36.6	abc	23.90	a	73.6	a

Weed number was significantly reduced ($p < 0.10$) in all treated plots except for Wallop (@ 4l/ha 1 MAS. With Wallop, weeds had a stunted growth. The tuber (below ground) and total plant dry weight were significantly reduced in plots treated with 1% Roundup + kaolin @ 3.4 kg/ha, Weedmaster @ 3 kg/ha, Spark @ 4l/ha and Touchdown @ 3l/ha compared to that of control. Furthermore, the total plant dry weight was reduced also in treatments such as Spark @ 3l/ha and 0.5% Roundup.

K. G. Prematilake, A. Gamage

Project D/AGRY - Divisional Activities

1. Effect 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)
- 2) Application of Dolomite (1.5 t/ha)

Treatments were repeated in 4 plots. The first application of dolomite and refuse tea after pruning was done in October 1998. Due to the decline in soil pH with the decomposition of refuse tea, application of refuse tea was repeated 9 months after the first application.

Monthly assessments were done on pH, soil organic carbon content and soil and leaf K content. The yield is presented in Table 17.

TABLE 17 *Yield of tea in relation to dolomite and refuse tea application*

	<i>Made tea yield (kg/ha)</i>	
	<i>(1st 6 months: after 2nd appl.)</i>	<i>(2nd 6 month: after 2nd appl.)</i>
Dolomite	1960	2247
Refuse tea	2678	2697
LSD (p=0.05)	342	184
CV	8.5%	4.3%

Monthly yield data showed that the application of refuse tea significantly increased the yield of tea but lasted about 10 months. However, the effect of refuse tea application on tea yield disappeared about 10 months after the refuse tea application. The soil pH, organic carbon content and soil K content are given in Table 18.

TABLE 18 *pH, organic carbon and soil K in relation to dolomite and refuse tea application*

	<i>Months after 2nd application</i>			
	6	9	12	15
pH				
Dolomite	5.0	4.6	4.7	4.6
Refuse tea	5.1	4.7	4.6	4.6
	NS	NS	NS	NS
Organic carbon				
Dolomite	1.37	1.25	1.28	1.28
Refuse tea	2.49	1.93	1.90	1.75
LSD (p=0.05)	0.20	0.14	0.12	0.21
CV%	6.8	5.5	4.7	8.6
Soil K				
Dolomite	157	153	155	155
Refuse tea	234	210	186	171
LSD (p=0.05)	22	41	20	NS
CV%	7.3	14	7.1	-

Changes of soil pH were similar in both treatments i.e. application of dolomite and refuse tea. However, the level of soil organic carbon and soil K of tea plots applied with refuse tea was higher than that treated with dolomite. The influence of refuse tea on soil K and organic carbon reduced with time.

2. Effect of spraying growth regulators on yield of tea - St. Joachim Estate, Ratnapura

Two growth regulators were tested against recommended Zn spraying in mature tea (Field No. 6: TRI 2026). Treatments were as follows:

Main plot Treatments

- 1) Bounty 100 ml/ha/application
- 2) Bounty 200 ml/ha/application
- 3) Wokozim 200 ml/ha/application
- 4) Wokozim 400 ml/ha/application
- 5) Zn sulphate 2.75 kg/ha/application

Sub-plot treatments

- 1) Manual harvesting
- 2) Shear harvesting

There were 3 replicates and treatments were arranged in a split-plot design. Spraying of chemicals was done 4 times in March, May, August and October. As the application of growth regulators had no effect on the yield, the experiment was terminated.

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

3. Study on plucking-in *vis-a-vis* Tipping - St. Joachim Estate

An observation was made after the pruning of tea plots used for assessing seasonal variation of root starch reserves at St. Joachim Estate. The clone was S 106. Plucking-in and tipping were introduced to 8 plots of tea (4 plots/treatment) and yield records are given in Table 19.

TABLE 19 *Tea Yield*

	Made tea yield kg/ha		
	July-January	February-July	August-December
Plucking-in	891	2181	1935
Tipping	841	2976	2790
LSD (p=0.05)	41	488	596
CV %	2.1	8.4	11.2

Results show that although plucking-in gave a higher yield than tipping during the first 6 months, the subsequent position was that the latter tipping treatment out-yielded the plucking-in treatment. Overall, annual yield (first year) showed that there was a yield increase of about 24% after tipping when compared with plucking-in. The significant increase in yield with tipping was still seen after about 1 1/2 years of the imposition of these treatments.

M.A.Wijeratne, P.Premathunga

4. Effect of resting and hard plucking on root starch reserves of tea

An study was carried out at St.Joachim Estate with the following treatments and 4 replication.

Pruning (control)

Pruning after 2 months of Black plucking

Pruning after 2 months of resting

Starch reserves at pruning after imposition of above treatments were 4.9%, 8.0% and 12.3% respectively. Starch reserves before imposition of treatments was 6.3%. The results indicate that resting before pruning and removal of all growing shoots and buds (leaving only maintenance foliage) appear to increase the starch level in roots. This could be due to the diversion of more assimilates down to roots with the absence of growing buds and arimbus (sink) (at latter stages of resting and through out black plucking) on the plucking table. However, this needs further investigation.

M.A.Wijeratne, P.Premathunga

5. To evaluate the effect of Dadap shade on yield of tea – Field No 7, Stonycliff Estate, Kotagala (1995)

The objective of this study is to compare the performance of tea with and without Dadaps (*Erithrina Lithosperma*). The spacing of dadaps is 6m x 6m. The first year yield from June 1999 to May 2000 is presented in Table 20.

TABLE 20 Yield of tea (kg MT ha⁻¹)

Treatments	Yield
Without Dadaps	3982
With Dadaps	3312
SE	80.5
LSD (P=0.05)	292.1
CV	5.4

During the current year, yield under dadap was less compared to tea without dadap, mainly due to the blister blight attack.

A.R.Amerasekera, U.P.Abeysekara

6. Evaluation of *Grevillea robusta* provenances

The objective of this study is to evaluate the performance of 30 provenances of *Grevillea robusta* at different elevations. These provenances were planted in nine estates. The growth assessments are in progress.

A.Anandacoomaraswamy, K.G.Prematilaka, K.D.Dahanayake, S.Jayasinghe
A.R.Amerasekera, A.P.D.A.Jayasekara U.P.Abeysekara, P.Rathinatilaka

7. Effect of recycling the prunings on the yield and soil fertility, St. Coombs Estate (1991)

The objective of this study is to compare the effect of recycling prunings in the tea field. Prunings were recycled by burying in trenches of 15 - 20cm depth in between the tea rows and retained on the surface in between the rows. In addition, two levels of fertilizers 360 and 180 kg N ha⁻¹ year⁻¹ (normal and half the doses) were tested. This experiment was in the fifth year of the current cycle. The yield from September 1998 to August 2000 and first and second cycle average yield are presented in Table 21.

TABLE 21 *Yield of tea (kg MT ha⁻¹)*

<i>Treatments</i>	5 th year	First Cycle	Second Cycle
Control (with normal fertilizer)	4255	3817	4461
Burying prunings + normal fertilizer	4978	4061	4747
Burying prunings + half of normal fertilizer	4370	3394	4203
Burying prunings only	3160	2902	3547
Burying brush wood + normal fertilizer	3888	3631	3916
Burying brushwood + half of normal fertilizer	3828	3191	3703
Retention of prunings + normal fertilizer	4090	3706	4368
SE	327.2	145.3	180.5
LSD (P=0.05)	972.2	431.7	536.3
CV	16.0	8.2	8.7

8. Effect of mulching materials and pH amendments on soil properties in young and mature tea at high elevation, Field No 10 and Field No 3, St. Coombs Estate

An investigation was undertaken to determine the effect of commonly available mulching materials and soil pH amendments on the soil biological, chemical and physical properties of soil under young and mature tea after pruning. The mulching materials used were refuse tea (25 tons ha⁻¹), dadap (35 tons ha⁻¹ of fresh materials) and mana (35 tons ha⁻¹ of fresh materials). The mulching materials used have different polyphenol content. The C/N ratio are Mana- 27, refuse tea -11 and Dadap -11. The soil pH amendments tested were dolomite (1000kg.ha⁻¹) and minplus-crushed basaltic rock (1000kg ha⁻¹). Soil microbial biomass carbon, soil organic carbon, pH, total nitrogen, sulphuric acid extractable P, exchangeable K, bulk density and saturated hydraulic conductivity. Dadap had the lowest half life of 6-8 weeks and mana had the highest half life of 14-16 weeks.

Measurements taken after 3 months of treatment application had indicated that young tea, organic carbon and microbial biomass carbon of soil (0-15cm) were improved by mulching materials in young tea. Refuse tea was superior to mana and dadap in improving the soil organic carbon and soil microbial biomass. Soil pH and exchangeable potassium was highest with refuse tea. Dadap gave highest available P. Dadap had the lowest bulk density and highest saturated hydraulic conductivity. There was a slight increase in soil pH under refuse tea. A similar pattern was seen in the mature tea.

M.S.D.L.Silva, Umaah Kailayanathan, Sujeeva Kanagalingam

9. Satellite derived Leaf Area Index (LAI) for estimating tea yield, Westhall Estate, Kataboola

IRS-1C satellite image acquired on 12th February 2000 and LANDSAT-TM satellite image acquired on March 1995 were used for this study. LAI is one of the main key factors in crop growth models that may be derived from optical remote sensing data. The LAI during plucking stage is an important state variable in tea yield modeling. Therefore, the relationship between tea LAI and Normalized Difference Vegetation Index (NDVI) was investigated. A model with a logarithmic function was developed to find the relationship between NDVI and measured LAI.

Satellite derived LAI values and existing spatial, meteorological and agronomic variables were used for tea yield model development. A model developed using weights of the considered variables was selected as the best model for estimating tea yield.

These findings were based on the thesis submitted for partial fulfillment of Master of Science (Remote Sensing and GIS) obtained from the Asian Institute of Technology, Bangkok, Thailand.

R.M.S.S. Rajapakse

10. Effect of organic matter content on nitrogen requirement of tea plants - Brunswick Estate, 1998

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

The yield for the 12-month period from December 1999 to November 2000 is given in the Table 22.

TABLE 22 *Effect of different rates of Vermi compost and N on yield of tea*

Treatment	Yield (Made Tea kg/ha)
T1 300g of Vermi Compost + 150Kg N/ha/year	5703
T2 300g of Vermi Compost + 300Kg N/ha/year	5594
T3 300g of Vermi Compost + 450Kg N/ha/year	5653
T4 600g of Vermi Compost + 150Kg N/ha/year	5646
T5 600g of Vermi Compost + 300Kg N/ha/year	5763
T6 600g of Vermi Compost + 450Kg N/ha/year	5877
T7 150Kg N/ha/year	5667
T8 300Kg N/ha/year	5695
T9 450Kg N/ha/year	5703

There was no significant difference in yield between any of the treatments.
The experiment is in progress.

P.B.Ekanayake, S.N.Wijesekara, A.P.D.A.Jayasekara,
Superintendent, Brunswick Estate

11. Arboretum and Herbarium

Maintenance of arboretum continued. Herbarium was dislocated due to the construction of new building complex.

C.Gunasekara

Publications

1. Wijeratne, M.A., and Bandara, N.P.S.N. (2000). Drip irrigation in tea. *TRI Update*, Vol., 5, No.1, June 2000
2. Wijeratne, M.A., Vithana, D.W. and Perera, K.T.C. (2000). Mechanization of field practices in tea lands for higher labour productivity. I. Mechanical harvesting, *J.NAT.INST.PLANT.MGMT.*, Vol. 16: No.1, 8-16
3. Wijeratne, M.A., Vithana, D.W. and Perera, K.T.C. (2000). Mechanization of field practices in tea lands for higher labour productivity. II. Mechanical pruning and lopping, *J.NAT.INST.PLANT.MGMT.*, Vol. 16: No.1, 17-24
4. Amarathunga, S.L.D.A., Wijeratne, M.A. and Jayaratne, K.P.S.C. (2000) The study on variation of the productivity of tea lands in the different agro-ecological regions in Sri Lanka. *SLAAS Proceedings*, 56th Annual Sessions, November 27- December 1, 2000, Colombo, 49.1
5. Prematilake, K.G. (2000). "SALT- A sustainable agricultural Technology that benefit the Tea cultivation" A Sinhala news paper article, *DINAMINA*, 15th June

6. Rajapakse, R.M.S.S, Tripathi, N.K. and Honda, K. (2000), "Modelling tea (*Camellia sinensis* (L) O. kuntze) yield using satellite derived LAI, landuse and meteorological data", Proceedings of 21st Asian conference on Remote sensing, Vol. 1, page 1-6
7. Rajapakse, R.M.S.S, (2000), "Estimating tea yield using Remote Sensing", Proceedings of the 3rd Advanced Technologies Symposium, School of Advanced Technologies, AIT, Bangkok, Thailand

Presentations/Conferences/Workshops

Dr. K. G. Prematilake presented a paper at the 56th annual session of the SLAAS held at the Faculty of Science, Univ. of Peradeniya.

Prematilake, K.G., A.Gamage & HSN Pieris (2000). Weed controlling efficacy of glyphosate herbicides with "Controlled Droplet Applicator (CDA) sprayer. SLAAS. Proc. of the 56th annual session, part 1- Abstract, 27 Nov.-01 Dec. 2000, Colombo, Sri Lanka.

R.M.S.S. Rajapakse presented a paper on "Estimating tea yield using Remote Sensing" in 3rd Advanced Technologies symposium at Asian Institute of Technology, Bangkok, Thailand on 1st December 2000.

R.M.S.S. Rajapakse attended the 21st Asian Conference on Remote Sensing held at Taipei, Taiwan during 4th December to 8th December 26, 2000. At this conference she presented a paper on "Modelling tea (*Camellia sinensis* (L) O. kuntze) yield using satellite derived LAI, landuse and meteorological data".

General

1. Dr.M.A.Wijeratne was awarded a Gold medal for the invention of the TRI shear at International Exhibition of Inventions held in Geneva in April.
2. Dr.M.A.Wijeratne won the Presidential Award (Sri Lanka) -1998 organized by the Sri Lanka Inventor's Commission in August 2000 for the invention of the TRI shear
3. Dr. M.A.Wijeratne was elected Rapportuer for SLAAS section B (Agriculture and Forestry).
4. Dr.M.A.Wijeratne conducted lectures and practical classes for NIPM trainees. He also addressed Superintendents, Assistant Superintendents, Field officers and Smallholders on Plucking, Pruning and Soil Management of tea at 14 forums, including three E&E Forums and two RSC seminars organized by the TRI and TSHDA.

5. Dr.M.A.Wijeratne conducted 17 field demonstrations on mechanical harvesting (especially on the TRI shear) and mechanical pruning for executives and field staff of plantations and smallholders.
6. Dr M.A.Wijeratne continued as a Visiting Lecturer at the Faculty of Agriculture, University of Ruhuna.
7. MSc Research Project of Mr.M.K.S.L.D.Amarathunga and Undergraduate Research Project of Ms. A.C.P.Ananda Kumra (University of Ruhuna) were supervised by Dr.M.A.Wijeratne
8. Four NAB trainees completed their training on Tea Agronomy.
9. Dr.M.A.Wijeratne assisted the Advisory Division and the Open University as a resource person for producing the video film on shear plucking.
10. Dr.M.A.Wijeratne participated in the "Lakhanda" Radio programme organized by the TRI and Haychem Ltd.
11. Dr. M.A.Wjeratne designed and built a prototype a new hand pruner for improving productivity of workers.
12. Ms.R.S.S.Rajapakse was awarded MSc by the Asian Institute of Technology (Thailand) for the thesis on 'A model for estimating tea yield, by combining remote sensing and GIS: A case study of a tea plantation in Sri Lanka'
13. Dr. K. G. Prematilake conducted lectures for Estate Monitoring Officers of the Plantation Companies on weed management in tea plantations.
14. Dr. K.G. Prematilake addressed the bought leaf suppliers of Bogawantalawa Plantation Ltd. on Pruning of Tea.
15. Dr. K.G. Prematilake and Mr. P.B. Ekanayake jointly wrote a "Precautionary note" on Glyphosate use in tea plantations. This has since been issued as a TRI Guideline.
16. Dr. K. G. Prematilake and Mr. P.B. Ekanayake jointly presented a paper on "Use of glyphosate based herbicides for weed control in Tea plantation" for the Managers of Watawala Plantation Ltd. at Dickoya, Hatton.
17. Dr. K. G. Prematilake continued to address the students of the NIPM and Eastern University on weed management in tea plantations.
18. Dr. K. G. Prematilake conducted lectures on safe and effective use of herbicides and spray machines in the workshop on Operational Management Development for Asst. Superintendents of Kahawatte Plantation Ltd. at Rilhena Estate, Pelmadulle, organized by NIPM.

19. Dr. K. G. Prematilake participated in "Lakhanda" Radio on "Weed management in tea plantations" under a commercial programme sponsored by Heychem Com. Ltd.
20. Dr. K. G. Prematilake continued to be involved with the collaborative research project on the control of Passali kodi weed, with the University of Peradeniya.
21. Dr. K. G. Prematilake completed the screening of two glyphosate products called "Blaster" and "Weedmaster" and proposed to ACSC for TRI recommendation. TRI has recommended these products, an analysis of the residuals in made tea.
22. Dr. K. G. Prematilake participated in the workshop for the formations of an action group on the control of Parthinium weed, organized by the Dept. of Agriculture at PGRC, Gannoruwa, Peradeniya.
23. Dr. K. G. Prematilake participated in the conference on Parthinium weed problem organized by the Dept. of Agriculture at PGRC, Gannoruwa, Peradeniya.
24. Dr. K. G. Prematikale participated in the National Workshop on Weed Management Strategies organized by the CARP at the PGRC, Gannoruwa, Peradeniya.
25. Dr. K. G. Prematilake also served as a referee for the Scientific papers submitted to the SLAAS and NSF.

BIOCHEMISTRY DIVISION

Acting Head – I.S.B.Abeysinghe

1. Project – B17 - Development of Chemical/Biochemical methods in the control of shot-hole borer (*Xyleborus fornicatus*) in the tea plant

Shot-hole borer is a major insect pest of tea whose infestation is a serious problem found in 30% of the 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 biology and life cycle of shot-hole borer have been well documented (Dantanarayana, 1970). Conventional methods of SHB control involve the use of synthetic pesticides. The slow degradation of these pesticides leads to the accumulation of toxic residues, while the development of resistance to pesticides by pests has made pest control a much more formidable task. The search for effective and environmentally acceptable alternative methods of control for these pests has, therefore, taken on a new urgency.

Some tea clones have been found to be more susceptible to attack than others. It had been suggested that the susceptibility to shot-hole borer is related to the saponin content of tea stems, the saponin complexing with a-spinasterol in the stem, making it unavailable as an ecdysone precursor to the beetle (Wickramasinghe et.al.1976). In order to check this hypothesis, shot-hole borer was allowed to complete its life cycle on a diet medium, which did not contain the sterol sources, yeast extract and tea bark extract. The beetle was able to complete four life cycles without showing any adverse effects, thus indicating that the beetle did not require sterols from the medium to complete its life cycle. The hypothesis that saponins were responsible for the resistance of tea clones by making steroids unavailable to the insect was, therefore, shown to be invalid.

This project will attempt to understand the mechanism of the action of caffeine, preformed and post-infectious changes of polyphenols in the resistance of tea clones to attack by shot-hole borer and thereby to develop a strategy for the control of the pest.

The chemical analysis to establish the catechin profiles of SHB susceptible and resistant clones belonging to TRI 2000, 3000 and 4000 series was carried out and the data were presented in the 1999 annual report. These data were statistically analysed and it was found that SHB susceptible clones contain significantly higher amounts of catechin, epicatechin, epigallocatechin, epigallocatechin gallate and epicatechin gallate in bark and stem sections of both infested and healthy samples except for the epicatechin levels in the stem sections where the highest levels were found in resistant clones.

Upon infestation epicatechin content in the stem portion of the resistant clones, epicatechin gallate in the bark portion of the resistant clone were decreased by two fold.

Studies were carried out to ascertain the effect of bark and stem extracts of both resistant and susceptible clones on the growth of ambrosia fungus. In addition to the effect of catechin and epicatechin on the growth of ambrosia was studied.

The search for a SHB attractant or repellent volatile compounds was continued during 2000 with special emphasis being given to the changes of linalool and its oxides in the plant upon infestation. Earlier, an increase in the levels of linalool oxides upon SHB infestation was observed in clones TRI 2025 and 2023.

This study was extended to the bio tea project where the use of three different compost treatments (compost, neem oil cake and tea waste) were tested against conventional fertiliser treatments. The clone used in this study was DT1. Healthy and infested stem samples of the above treatments were subjected for Gas Chromatographic analysis of volatile chemical compounds. Results confirmed our earlier observation that upon SHB infestation, the levels of linalool oxides increased significantly.

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*

The fungus *Exobasidium vexans* Masee causes blister blight leaf disease of tea and is spread by wind borne spores. It is by far the most serious disease of tea and is now endemic in all tea growing areas of Asia. It affects young succulent leaves and stems and causes considerable yield losses. This disease is of major economic importance as its control costs the country several millions of rupees per annum.

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 the fungus developing resistance to the disease. The presence of pesticide residues in made tea in the global context is a matter of serious concern. This has become a prime issue as many tea buying countries now implement stringent quality control measures to assess the tea that they are procuring. Therefore, the development of biochemical

control methods based on natural resistance mechanisms has become indispensable for the survival of the tea industry.

The main objectives of this project is to find out the chemistry and biochemistry of disease resistant mechanisms in relation to blister blight leaf disease of tea and 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 was mainly focussed on the establishment of catechins profiles of tea clones which are susceptible or resistant to blister blight leaf disease. Catechins play a major role in disease resistance mechanism in other plants and therefore understanding the chemical differences in susceptible and resistance tea clones should throw some light on the resistance mechanism in the tea plant.

Twenty seven tea clones were selected on the basis of their resistance/susceptibility to blister blight leaf disease. A method for the extraction and HPLC analysis of tea catechins was optimised. Catechin profiles of tea clones were established using HPLC acquired under this project in October 2000.

Five major catechins, namely catechin, epicatechin, epigallocatechin, epigallocatechin gallate and epicatechin gallate were identified as the major catechins present in young tea leaves of these clones. In addition, the levels of caffeine in these clones were established. This was repeated four times during the wet season and statistical analysis was carried out using the SAS package.

The levels of catechins in resistant clones were compared with susceptible clones (Table (1)). It was found that epicatechin levels in the resistant clones were significantly higher (22ppm) than the susceptible clones (11ppm). This is an interesting observation since epicatechin levels may determine the disease resistance through its effect on lipoxygenase and in turn accumulation of the antifungal compounds in the tea plant. Enzyme assay methods for lipoxygenase and penylalanine ammonialyase in tea were optimised and these methods will be used to determine the enzyme activity in susceptible and resistant clones.

The levels of epigallocatechin gallate in susceptible clones (136ppm) were significantly higher than the resistant clones (97ppm).

TABLE 1 *Catechin profiles and caffeine content of blister blight resistant and susceptible clones*

Catechins (mg/g) and Caffeine(mg/g) content in tea clones on dry weight basis

CLONE	R/S	C	EGC	EC	EGCG	ECG	CAFFEINE
DT1	R	7.68	52.79	20.15	98.05	46.66	38.3
TRI777	R	5.74	38.21	26.64	107.15	59.17	41.62
TRI2043	R	9.29	22.83	21.17	68.87	41.94	35.39
N2	R	5.63	59.29	19.08	113.82	34.56	39.12
TRI4067	R	3.1	74.88	20.98	81.27	22.85	31.38
TRI4052	R	5.6	46.39	21.37	93.65	29.15	41.5
TRINAY3	R	3.53	55.79	25.23	130.13	42.57	33.42
TRI3073	R	3.27	33.47	24.63	90.14	39.05	35.43
TRI2025	S	5.76	28.99	8.16	142.72	36.3	38.53
TRI2024	S	8.72	41.28	13.4	141.73	55.15	39.81
TRI2023	S	9.83	45.14	11.45	152.77	37.37	42.8
TRI62/5	S	4.51	43.53	13.3	132.06	35.78	36.28
TRI3015	S	6.71	44.39	13.92	133.68	42.67	38.37
TRI3014	S	7.92	38.52	9.23	138.8	29.59	35.47
TRI62/1	S	6.88	30.23	12.43	113.95	42.37	38.33
LSD(P=0.05)0		78	5.63	1.74	11.03	4.84	4.16

C:(+)-Catechin

EC:(-)-Epicatechin

EGC:(-)-Epigallocatehin

ECG:(-)-Epicatechin
gallate

EGCG:(-)-Epigallocatechin
gallate

R: Resistant to blister bligh

S: Susceptible to blister blight

P A N Punyasiri, A Balasooriya (Pathology Division),
S Kumar (University of Peradeniya), I S B Abeysinghe

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

The development of DNA markers will be useful to assess the level of genetic variation within the germplasm. The main objective of this project is to determine the genetic identity of the existing tea clones, to detect genetic diversity between tea clones and to set priorities for future breeding programmes.

This CARP-funded project was initiated in January 1999. The details are listed in the annual reports of 1998 and 1999.

In order to select primers giving polymorphism, polymerase chain reaction (PCR) was carried out on three clones 2043, 2023 and 2026 with 100 primers. Out of the 100 primers, 20 primers showing polymorphisms were selected to carry out PCR on 40 selected clones. So far, PCR has been carried out with 18 primers on 40 clones and a dendrogramme has been constructed to detect genetic relatedness of clones. In order to confirm the dendrogramme, PCR will be carried out with

the balance primers. Restriction digestion on tea DNA has been initiated in order to construct a genomic library.

A C Liyanage, K M Mevan, E Karunanayake (University of Colombo), J M D T Everard (Coconut Research Institute), M T K Amarakoon (Division of Plant Breeding, T R I)

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

- (a) 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.

Quality ratings of 21 tea clones belonging to TRI 3000 and 4000 series were established in 1999. As a continuation of this exercise, 21 more clones belonging to 3000 and 4000 series were evaluated for their quality potential and data analysis is in progress. In addition, 36 selections from the phase two stage of the breeding programme being analysed for their quality potential.

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

Chemical characterisation of TRI clones belonging to high, moderate and poor quality was carried out to generate detail information on chemical composition and also to establish a relationship between quality and the composition. Twelve clones were selected and flush samples were analysed for caffeine, gallic acid, total flavanol content, individual catechins, total polyphenol content, polyphenol oxidase activity, sugar content, moisture content, amino acid content and chlorophyll content.

These samples were manufactured using the miniature manufacturing facility at the Technology Division and made tea samples were analysed for quality parameters. Analysis of the results are in progress.

J. Jayasundara, M.L.D.P.Gunatilake, D.Kumarasinghe, U.R.N Udagama, D.M.U.S. Senarath Bandara, P.B.Chandradasa, I. S.B.Abeysinghe

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

This project was initiated in 1998. Its objective is to develop a method to improve the keeping qualities of tea. Preliminary investigations have shown that when

fermented dhoor is exposed to microwave energy, PPO gets inactivated. (results presented in Annual Report 1998). Further trials on microwave drying conducted at factory level at Great Western estate showed that the microwave dried tea is less superior 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 Annual Report 1999)

A similar trial with some modifications on the time of exposure to microwave energy was conducted at Watagoda Factory where low-country manufacture is being carried out. Fermented dhoor was dried parallelly in the microwave oven as well as in the FBD. The fired teas were compared for the moisture content, TF/TR, flavour profile and taste. The trials were repeated three times and the average of the above parameters was recorded and compared.

50g each of fermented dhoor was initially exposed to 80% power level for 6.5 mins. and a combination of power levels *ie* at 40% for 3mins. and 80% for 3.5 mins. The results for TF, TR and moisture content are given in Table 2.

TABLE 2 *Comparison of TF, TR and moisture content of microwave dried teas as against conventionally dried teas for low-country manufacture*

Treatment	%TF	%TR	%moisture
F1 80% (6.5min)	0.85	3.84	3.1
F1 40% (3min) + 80% (3.5min)	0.84	3.65	4.1
BT	1.03	4.11	3.1
F1 – normal fermentation			
BT – conventionally dried tea			
TF – Theaflavins; TR – Thearubigins			

On comparing the results, it was observed that % TF is lower than that of conventionally dried teas. The moisture content of the conventionally dried tea was comparable to that of microwave dried teas at 80% power level. The moisture content of teas dried using a combination of power levels (40% 3mins + 80% 3.5mins) was higher than tea dried at 80% power level and the conventionally dried tea.

On tasting the liquors, it was felt that the teas dried using the microwave oven were thinner than those dried in the conventional drier. This was evident from the results of analysis of TF and TR. The infusions of microwave dried teas were duller than those of conventionally dried teas. The appearance with reference to blackness of tea for all three samples was similar owing to the high drier temperatures used in low-country manufacture to achieve blacker dhoors.

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

less superior to that of conventionally dried teas in both instances.

Further trials were conducted on two-stage drying where microwave drying is 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 Factory. The dried dhools were subjected to microbiological analysis in addition to TF, TR, moisture content and flavour.

The results of the above trials will be reported in the Annual Report of 2001.

A C Liyanage, D M U S Bandara, L Jayasinge (Technology Division),
M T Ziyad 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 Candidiasis (oral thrush). Therefore, a project was initiated in collaboration with Faculty of Dental Science, University of Peradeniya, to find 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 crude catechin fraction. The study will be continued to find the clinical significance of tea consumption on the growth of *Candida* species in the oral cavity.

(b) Antioxidant activity of different polyphenolic fractions of Sri Lankan black tea

Black tea contains both unoxidised (catechin) and oxidised (theaflavin and thearubigin) polyphenols. Although antioxidant activity of black tea extracts has been established, relative antioxidant activity in these polyphenolic fractions are not known. Hence, their relative contribution to total antioxidant activity of the brew is also not known. Therefore, a study was initiated to measure the antioxidant activity of catechins, theaflavins, water soluble thearubigin fraction and ethyl acetate soluble thearubigin fraction. Measurement of antioxidant activity by Total Radical Trapping Antioxidant Parameter (TRAP) assay indicated that catechins and theaflavins had higher activity, which were comparable, while thearubigin fractions had lower activity. Ethyl acetate soluble thearubigin fraction had slightly higher activity than the water soluble thearubigin fraction. Analysis of further samples using TRAP assay and Total Antioxidant Status (TAS) assay will be carried out to corroborate these findings.

(c) 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 of polyphenols, 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. Therefore, a study was initiated 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.

Analysis of total polyphenols (TP), theaflavin (TF), thearubigin (TR) and TR to TF ratio indicate that there were no significant differences in these parameters in teas produced in different regions. Total colour (TC) of the brew was higher for low-country teas than for up-country, Uva and mid-country teas. Up-country and Uva teas had brighter liquors than mid-country and low-country teas. Aluminium (Al) content of teas did not vary with the region while Uva teas had higher manganese (Mn) content than in teas produced in other regions. TRAP assay had shown that the total antioxidant activity of teas produced in different regions did not vary significantly, Thereby indicating that all types of Sri Lankan teas have similar health-giving properties. Further samples will be analysed using TAS assay to confirm these findings.

U.R.N.Udagama, M.R.D.M. Senanayake (University of Peradeniya),
G.J. Panagoda (University of Peradeniya), A.M.T.Amarakoon

7. Project – B-22 – Establishment 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 8 estates in the Uva region during the season and subjected to gas chromatographic analysis for volatile chemical compounds. This study will continue during the year 2001 for Dimbulla and Uva seasons.

D. Kumarasinghe, J Jayasundara, I S B Abeysinghe

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

The colour of the tea brew is mainly due to the oxidised phenolic pigments formed during fermentation stage of the tea manufacture. These pigments belong to two major groups of chemical compounds, namely, theaflavins and thearubigins. Theaflavins are bright orange 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 Bogu Valley and Maskeliya Valley regions show an extra redness in their liquors, which cannot be totally accounted for 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 Bogu Valley 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 forms 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 included in the analysis. This project is in progress.

M.L.D.P.Gunatilake, I.S.B.Abeysinghe

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 residue remaining in the edible crop has led to national authorities particular 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 crop by the year 2000. Tea is also included in this programme. There is thus a growing demand from the buyers that pesticide levels of exported tea be contained at acceptable levels.

In the 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 establish with the help of SAREC.

Since the availability of robust and reliable multi residue methods for tea is of prime importance, development and evaluation of multi residue methods has been carried out since the outset of this project.

Eight organochlorine pesticides (HCH-gamma, heptachlor, aldrin, endosulfan-alpha, endosulfan-beta, dieldrin, endrin, DDT-p,p.) were selected and two methods based on gel permeation chromatography and solid phase extraction compared. Biobeads SX-3 was used as the solid support for GPC and commercially available pre packed cartridges (ENV+ and OASIS) were used for SPE. Recovery studies were carried out using SE-54 column coupled to electron capture detector of a Gas Chromatograph. The mean values of % recovery and the CVs are given in Table 3.

TABLE 3 % Mean Recovery levels and CV in the parenthesis

Pesticide	GPC	ENV+	OASIS
HCH-gamma	73(17.6)	20(21.8)	36(21.4)
Heptachlor	71(5.2)	92(5.99)	94(8.7)
Aldrin	73(9.0)	80(8.2)	87(11.2)
Endosulfan-a	67(6.8)	103(6.1)	115(9.3)
Dieldrin	70(6.5)	92(5.2)	102(6.7)
Endrin	70(6.6)	98(9.56)	109(9.7)
Endosulfan-β	71(5.7)	64(24.1)	85(13.8)
DDT-p,p	66(2.9)	173(11.6)	172(11.4)

Spike levels(mg/kg) -

GPC- DDT-p,p: 0.67 all other pesticides 0.16 and SPE- DDT-p,p: 0.27 and all other pesticides 0.1

Methods based on GPC gave acceptable recovery levels for most of the organochlorines under study. When compared with other food matrices, tea possesses a very complex matrice and it is therefore necessary to find an effective clean up method. GPC could be one of such method suitable for tea.

Thin layer chromatography techniques based on Hill reaction and on the inhibition of acetylcholine esterase by organophosphorous (OP) pesticides were evaluated for the detection of herbicides and organophosphorous pesticides in tea.

P.A.N.Punyasiri, J.Jayasundara, I.S.B.Abeysinghe

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

PAHs can be formed during combustion in the manufacture of tea and 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 about 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.

Extraction methods and chromatographic procedures for the PAH analysis of tea were initiated and smokey and non-smokey tea samples were analysed as a preliminary study. A proper monitoring study is underway to establish the levels of PAHs (if any) in Sri Lankan teas.

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

M.L.D.P.Gunatilake, M.N.Dharmasena (Undergraduate Trainee,
University of Colombo), I.S.B.Abeysinghe

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

(i) 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 to determine whether the level of sodium benzoate could be reduced or totally replaced by sterilising the product.

This trial is a repetition of that undertaken in 1999 with a few modifications. Samples of tea concentrate using 4 levels of sodium benzoate; 2g/l, 1.75g/l, 1.5g/l, 1g/l, 0g/l and one without sodium benzoate and sterilised were prepared in triplicate. Microbiological analysis and tasting of the samples are to be carried out monthly.

Initial microbiological analysis of the samples indicate that the sterilised samples were free of contaminants, while samples having 1.5g/l – 0 level sodium benzoate were contaminated. Further microbial analysis will be carried.

(ii) Trials to produce the tea concentrate in the form of a powder

Trials are in progress to produce the tea concentrate in the form of a cold water soluble powder. Possibilities of flavouring the product are also being investigated.

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

12. A 30.2 – (a) Incorporation of tea to dairy products

Trials on the incorporation of tea to yoghurt were carried out with the following objectives: use of tea as a natural colouring agent, use tea as a natural flavour, to make use of antioxidant property of tea to increase the shelf life of yoghurt, to enhance therapeutic property of yoghurt and to increase the consumption of tea.

Black tea extract was incorporated into milk at 4 levels 1g/l, 2g/l, 3g/l and 4g/l and yoghurt was prepared according to a standard procedure to meet the SLS standards. The samples were evaluated for appearance, colour, texture, flavour and general acceptability by 35 panelists using a 9 point hedonic scale method. The results were analysed statistically using the software package minitab and are given in Table 4.

TABLE 4 *Sums of ranks given by the panelists*

Treatment	Sums of ranks					
	Appearance	Colour	Spoonability	Texture	Flavour	General Acceptability
1g/l	102.0	102.0	103.0	97.0	97.5	106.5
2g/l	112.0	110.5	96.5	105.5	108.5	106.0
3g/l	62.0	67.0	77.0	72.5	79.5	70.0
4g/l	74.0	70.5	73.5	75.5	64.5	67.5

Results showed that samples prepared with 2gs of black tea were the best as far as appearance colour, texture and flavour are concerned. However these samples were rated second when the spoonability and general acceptability was concerned. Therefore, it is possible to incorporate 1-2 g of tea in the production of yoghurt while maintaining the desired organoleptic properties.

G.A.A.R.Perera, S.Silva (University of Peradeniya), 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 tea 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 teas as the starting material for tea wine/sherry. In addition, blends of up-country and low-country teas were tested for the same. 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. 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. This product 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, I.S.B.Abeysinghe

General

Ms. D.M.U.S. Senarath Bandara resigned from the services of the Institute w.e.f.31st October.

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. Henrik Kylin, a collaborator from the Swedish University for Agricultural Sciences, visited TRI from 31 July to 4 August.

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. S. Silva, Faculty of Agriculture, University of Peradeniya, on Incorporation of Tea to Dairy Products
6. Dr. Henrik Kylin, Swedish University for Agricultural Sciences, Sweden

Students

Ms C. Adikaram and Ms. M.N.Dharmasena, Undergraduate trainees from the Department of Molecular Biology and Biochemistry, University of Colombo were engaged in projects titled "Factors affecting blackness of low country tea" and "Polycyclic aromatic hydrocarbons in tea" respectively.

Journal Articles

1. Mewan, K.M., Liyanage, A.C., Everard, J.M.T.D., Gunasekera, M.T.K. and Karunanayake, E.H. (2000) - Random amplified polymorphic DNA (RAPD) markers reveal genetic relatedness of tea (*Camellia sinensis* L.) clones in Sri Lanka, Proceedings of 56th Annual Sessions, SLAAS
2. Balendran, S., Abeysinghe I.S.B. and Mahendran, T. (2000) Effect of pruning cycle on the quality of made tea in Dimbulla region of Sri Lanka, Proceedings of 56th Annual sessions, SLAAS
3. Udagama, U.R.N., Senanayake, M.R.D.M., Panagoda, G.J., Amarakoon, A.M.T. (2000), Tea drinking and oral health: Effect of black tea on oral *candida albicans* isolates. TRI UPDATE, 5(1), 3
4. Punyasiri, P.A.N. and Jayasundara, J. (2000) environmental implications of pesticide use and their residues in tea. TRI Update, 5(1), 4
5. Punyasiri, P.A.N., Jayasundara, J. and Abeysinghe, I.S.B.(2000), Role of polyphenols in the tea plant. TRI Update, 5(2), 1

Conference papers and workshop proceedings

1. Udagama, U.R.N., Senanayake, M.R.D.M., Panagoda, G.J., Amarakoon, A.M.T. (2000), Tea drinking and oral health: Effect of black tea on oral *candida albicans* isolates. Proceedings of Annual Research Sessions, Faculty of Dental Science, University of Peradeniya.

Donors

1. 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

Dr. I.S.B.Abeysinghe addressed the plantation management executives of the Kelani Valley Plantation on the use of glyphosate in tea on 31 May 2000 at a workshop conducted at Darrawela Club.

Dr A C Liyanage attended a business meeting on “Hazard Analysis and Critical Control Points (HACCP) system certification, organised by Sri Lanka Standards Institution (SLSI) at Trans Asia Hotel, Colombo on 11th July 2000.

Dr. I.S.B.Abeysinghe made a presentation on “Pesticide Residues in made tea” at the general meetings of Nuwara Eliya District Planters’ Association on 2 August and Badulla District Planters’ Association on 17 August

Dr A C Liyanage participated in the course “New Technologies for Agricultural Research; Managing Biotechnology in a Time of Transition” organised by International Service for National Agricultural Research (ISNAR) from 30th October – 10th November 2000, in Kuala Lumpur, Malaysia.

Dr. I S B Abeysinghe attended a national seminar on “Intellectual Property rights (IPR) and commercialization of research” organised by National Science Foundation and the Post Graduate Institute of Science at BMICH, Colombo, on 24 November 2000.

ENTOMOLOGY DIVISION

Entomologist and Acting Head - Sushila I. Vitarana

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 TRI 4042, TRI 4046, TRI 4052, TRI 4053, TRI 4047, TRI 2024, TRI 2025, TRI 2043, DT 95, K 145, NIL 53 were planted on 4th September for test tanks and are being maintained. The first assessment is scheduled for January 2001. The experiment is in progress.

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

N 383 -Effect of different isolates of *Pratylenchus loosi* on symptomology and partitioning of assimilates of tea

Table 1 presents the symptomological differences caused by 4 Sri Lankan *P. loosi* isolates and the variations in dry matter partitioning in nematode infested tea. Further experimentation with pure laboratory cultures of different *P. loosi* isolates is planned.

TABLE 1 *Symptomological differences and dry matter partitioning of tea caused by four Sri Lankan P. loosi isolates*

Measurement	<i>Pratylenchus loosi</i> isolate								LSD
	St. Coombs		Delmar		Hantane		Passara		
	C	N	C	N	C	N	C	N	
<i>Flowers</i>									
Number	19.3	1.6	6.7	25.5	11.5	10.5	7.5	44.3	NS
Fresh weight (g)	2.87	0.09	0.76	2.51	1.28	1.23	0.84	7.31	NS
Dry weight (g)	0.60	0.09	0.20	0.75	0.32	0.31	0.26	0.87	NS
<i>Leaves</i>									
Number	66.2	53	100.5	83.7	43.2	69.2	142.8	147.0	46.3
Fresh weight (g)	26.0	6.8	37.5	33.5	35.1	28.5	54.1	78.0	23.9
Dry weight (g)	10.0	3.6	15.2	12.9	8.6	11.1	19.9	30.5	8.7
<i>Stem</i>									
Fresh weight (g)	47.4	29.0	64.5	68.4	52.4	66.9	88.5	136.2	32.6
Dry weight (g)	19.4	12.1	26.7	27.0	21.6	28.6	33.7	54.9	11.7
<i>Roots</i>									
Fresh weight (g)	58.4	26.6	82.6	65.7	43.0	41.3	102.2	137.9	41.1
Dry weight (g)	16.1	8.4	21.1	14.8	11.5	14.7	24.6	31.5	8.9
Total root length(cm)	6932	1207	13469	12250	4150	4126	14728	15970	6880

C-Untreated control N- Treated with Phenamiphos (Nemacur) at 7g/plant

Keerthi Mohotti

Total polyphenol contents in tea roots infested with 4 Sri Lankan *P. loosi* isolates and treated with nematicides are presented in Table 2.

TABLE 2 *Total polyphenol contents in tea roots infested with four Sri Lankan P.loosi isolates*

	<i>Pratylenchus loosi</i> isolate								LSD
	S. Coombs		Delmar		Hantane		Passara		
	C	N	C	N	C	N	C	N	
Total polyphenol content (mg)/g Root	14.5	21.3	16.1	13.4	12.3	16.9	19.1	27.5	NS

C-Untreated, control N-Treated with Phenamiphos (Nemacur) at 7g/plant

Keerthi Mohotti, M. P. T. Premaratne (University student), I.S.B. Abeyesinghe

Root population structure of *P. loosi* isolates on different tea soils

Population structure in tea roots infested with 4 Sri Lankan *P. loosi* isolates showed highly significant results. The results are presented in Table 3.

TABLE 3 *Population structure of root nematodes exposed to our Sri Lankan P. loosi isolates for 12 months*

Mean number of <i>P. loosi</i> (n+1)/g Root	<i>Pratylenchus loosi</i> isolate								LSD
	S. Coombs		Delmar		Hantane		Passara		
	C	N	C	N	C	N	C	N	
Male	91	6	124	131	91	49	261	204	101
Female	98	1	128	124	81	38	186	179	64
Larvae	376	19	486	539	279	163	819	571	329
Total	563	24	736	793	449	248	1264	953	476

C-Untreated control N- Treated with Phenamiphos (Nemacur) at 7g/plant

Keerthi Mohotti, N. Navaratne

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(1): 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 root and soil and the growth of tea plants - TRI Mid-country Station, Hantana (2000)

Cuttings of the following clones were put out in August in fumigated beds of the Central Nursery at the station for rooting:

TRI 3055, TRI 3017, TRI 3013, TRI 3020, TRI 3025, TRI 3014, TRI 3069, TRI 3015, TRI 3019, TRI 4046, TRI 4042, TRI 4015, TRI 4043, TRI 4053, TRI 4006, TRI 4014 and TRI 4052

Testing tanks in the divisional experimental area were prepared by inoculating the soil with laboratory cultures of *R. similis*, and thereafter planting Anthurium to build up the population in tank soil. Plants from the following clones were of comparable growth and transferred to the infested soil in the testing tanks on 7th December:

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

The other clones from the rooting bed were used for N 1B2.

S.I. Vitarana, H.M.U.B. Herath, G.P. Udamulla, B. Sureshkumar

N 1 B(2): 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 root and soil and growth of tea plants - Hantane Estate, Hantane (2000)

Three nematode testing tanks (100cm deep) were built at the estate nursery in August. They were filled with nematode infested soil brought from Westhall Estate, Kataboola. The soil in the tanks was allowed to settle over a period of three weeks. Four month old plants of the following clones grown in fumigated beds at the TRI station were transferred into the tanks on 6th December: TRI 3055, 4046, 3017, 4042, 3014, 4015, 3020, 3025 and 4043 with TRI 2025 and DN as the standards. The experiment is in progress.

S.I. Vitarana, H.M.U.B. Herath, G.P. Udamulla, B. Sureshkumar

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

The following damage rates were introduced for screening lines for shot-hole borer resistance using laboratory bio-assays as against the field assessments (assessments based on mean number of galleries per 30 cm long branch):

Laboratory bio-assay

0 – 3.0 resistant
 3.1 – 6.0 moderate
 6.1 – 9.0 susceptible

Field assessment

0 – 2.0 - resistant
 2.1 – 4.0 - moderate
 4.1 – 6.0 - susceptible
 6.1 – 8 - very susceptible

A 3.2 Screening lines for resistance to shot-hole borer

Screening of new clonal lines (selections for up-country) against shot-hole borer resistance

a. Phase II Trial VP 80 of Plant Breeding Division (VP 37/UC/2) St. Coombs Estate, Field No. 12

Bio-assay studies were carried out on 34 lines selected for their resistance against shot-hole borer damage. Character rating of the selections based on the mean of galleries is given in Table 4.

TABLE 4 *Characterization of selection lines in relating to S.H.B infestation (Mean of six replicates of two sets of samples)*

Index	Mean No. Galleries	Selection line					
Resistant	0 - 3.0	21	55	208	216		
Moderate	3.1 – 6.0	20	30	40	43	50	99
		190	215	230	498	557	582
Susceptible	>6.1	15	22	24	35	39	49
		53	88	89	101	110	189
		193	210	213	225	272	497

b. Laboratory bio-assay of clones recommended for the up-country: St. Coombs Estate, Lamiliere Division

The following clones meant for up-country planting were tested for their resistance to shot-hole borer damage in bio-assays. Damage rates are given in Table 5.

TABLE 5 *Bio-assay of clones for SHB resistance*

<i>Clone</i>	<i>No. of galleries per 30 cm of branch</i>	<i>Susceptibility status</i>
4053	0	
3052	1	
4067	1	
4006	2	
3048	2	
3072	2	Resistant
3073	2	
3013	3	
3046	3	
3047	3	
3049	3	
3069	3	
4079	3	
3014	4	
4052	4	
4063	4	Moderately susceptible
3020	5	
4078	6	
4071	7	Highly susceptible

L.D. Amarasinghe, A. Abeysekara, M. Jayatilake
P. Dharmalatha, J.D. Kottawarachchi (Plant Breeding)

LE-83: Balangoda Estate, L.P.G. Division, Block 61 (1999)

The original 100 mother bushes in the field and the progeny of 34 of the best bushes planted in November 1999 in randomized complete block design with two replicates on LPG division are being maintained. One growth assessment was carried out. The observations are given in Table 6.

TABLE 6 *Performance of the progeny of the selections at LE 83 site
(non parametric)*

<i>Label of the selection</i>	<i>Growth</i>	<i>Average of % survival</i>
MT 101	Fair	85.00
102	Poor	54.00
104	Fair	80.00
105	Fair	87.50
114	Fair	80.00
165	Fair	75.00
158	Fair	75.00
138	Fair	75.00
122	Fair	100

TABLE 6 *Contd.*

<i>Label of the selection</i>	<i>Growth</i>	<i>Average of % survival</i>
131	Fair	90.00
116	Fair	70.00
141	Poor	30.00
133	Poor	75.00
153	Fair	80.00
150	Poor	70.00
166	Poor	45.00
119	Fair	95.00
108	Fair	92.50
106	Poor	42.50
170	Fair	75.00
168	Poor	70.00
126	Poor	60.00
127	Fair	95.00
142	Poor	75.00
121	Fair	85.00
128	Fair	80.00
117	Fair	90.00
143	Poor	60.00
162	Fair	85.00
163	Poor	70.00
171	Fair	77.50
157	Fair	100
156	Fair	80.00
TRI 2025 (standard)	Poor	57.50

The experiment is in progress.

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

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

A 4.2 Screening of clonal lines for resistance to Low-Country Live Wood Termites

LE-50: Hapugastenna Estate, Lower Amunutenna Division

The progeny of the best 11 selections (out of a total of 152) from Field No. 7 of Hadaraganga Division) and one Pettigala Estate selection were being screened for resistance to LCLWT: Selection No. H 101, H 108, H 426, H 427, H 122, H 125, H 402, H 211, PET 1A2, H 134, H 27 and H 424. No assessments were scheduled for 2000. The plots are being maintained.

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

LE-78: Hapugastenna Estate, Hadaraganga Division

Screening of 37 clonal lines selected from Field No.4 of Hadaraganga Division is in progress. Experimental blocks are being maintained.

Survival of bushes after the dry period and their general performance was assessed and the observations are given in the Table 7.

TABLE 7 *Performance of the clonal selections*

Clone	% Survivals (Rep. Avg.)	Growth
HG 17	100	Good
HG 1	95.00	Good
HG 2	96.67	Good
HG 3	96.67	Good
HG 6	97.50	Good
HG 4	96.67	Fair
HG 8	98.33	Fair
HG 10	97.50	Fair
HG 11	100	Good
HG 13	100	Fair
HG 24	100	Fair
HG 15	100	Fair
HG 14	95.00	Fair
HG 9	96.67	Fair
HG 7	95.00	Good
HG 5	96.67	Good
HG 20	80.00	Fair
HG 21	87.50	Fair
HG 23	95.00	Good
HG 28	95.00	Good
HG 37	100	Fair
HG 48	95.00	Good
HG 12	100	Fair
HG 16	95.00	Fair
HG 49	97.50	Good
HG 42	100	Good
HG 43	75.00	Poor
HG 44	55.00	Poor
HG 35	95.00	Fair
HG 33	100	Fair
HG 32	90.00	Fair
HG 30	90.00	Fair
HG 19	85.00	Good
HG 27	90.00	Fair
HG 45	100	Fair
HG 47	100	Fair
HG 50	100	Fair

LE-81: Hapugastenna Estate, Upper Wewelketiya Division

Screening of 4000 series clones for resistance to LCLWT is in progress. The survival of bushes after the drought and the general performance of the bushes were assessed. The observations are given in Table 8.

TABLE 8 *General performance of the clones*

Clone	Replicate average of the % survival of bushes	Growth
TRI 20	84	Fair
4036	68	Fair
4004	58	Poor
4089	44	Poor
4003	76	Poor
4019	50	Poor
4046	52	Poor
4088	42	Fair
4053	50	Poor
4052	50	Poor
4020	80	Fair
4015	52	Poor
4024	54	Poor

The clones TRI 4036 and 4020 were found to be the most outstanding. 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 (July 1996 planted)

The clones available at Aigburth and Madampe Estates were assessed in January at the time of the first proper prune. Growth of the bushes in some clones was very variable from bush to bush within the same clone. Therefore, only five of the clones of which the bushes exhibited uniform growth were considered for the assessment. The results have been summarized in Table 9.

TABLE 9 Assessment of TRI 4000 series clones (January 2000)

Clone	Avg. of Callus	Canker	Termites	Incidence of S.H.B. %	No. of cuts/bush	Girth (cm)
TRI 4006	0	0	0	90	7.9	2.276
TRI 4047	0	0.1	0	100	6.9	1.691
TRI 4053	0	0	0	100	8.8	2.455
TRI 4049	0	0	0	90	9.1	1.786
TRI 4048	0	0	0	80	10.4	2.799

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

A 12.5 - Screening of the different economic crops which have a potential for intercropping with tea or for rehabilitation purposes at high and mid elevations for their susceptibility to the nematode pests of tea

N 384 - Studies on nematicidal action of planting *Arachis pintoii* in tea soils

An observation trial was set out in the cement-lined tanks at TRI, Hantane. Three tanks each containing two sections were filled with *P. loosi*, *R. similis* infested tea soils and *Meloidogyne* spp. infested vegetable soils respectively. Tea (TRI 2024 and TRI 2925) and tomato (variety K 146) plants were planted in the different tanks in order to multiply nematode populations in the respective tanks. *A. pintoii* were planted in one section and the balance was left as the control.

Periodic assessments on population dynamics of nematodes, nematicidal constituents and C:N ratio in soil will be monitored. The experiment is in progress.

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

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 in mature and immature tea

E-275: Use of insecticides for controlling shot-hole borer in immature tea in mid-country wet zone: New Peacock Estate, NP Division, Field No. 6 (1996) RCBD 8T X4 Replicates

Treatments

T1	Admire (Nitroguanadine 200SL)	@ 500 ml/ha
T2	Admire	@ 750 ml/ha
T3	Ekalux 20EC	@ 1000 ml/ha
T4	Ekalux 20EC	@ 2000 ml/ha
T5	Laybacid	@ 3500 ml/ha
T6	Chlorpyrifos 20EC	@ 1500 ml/ha
T7	Chlorpyrifos 20EC	@ 2500 ml/ha
T8	Untreated control	nil

Two blocks of eight plots each were planted, one in 1994 and the other in 1995. Treatments were applied in January 1997. Post-treatment assessments were based on branch breakage on 40 plants per plot. Mean branch breakage of each treatment is given in Figures 2a and 2b.

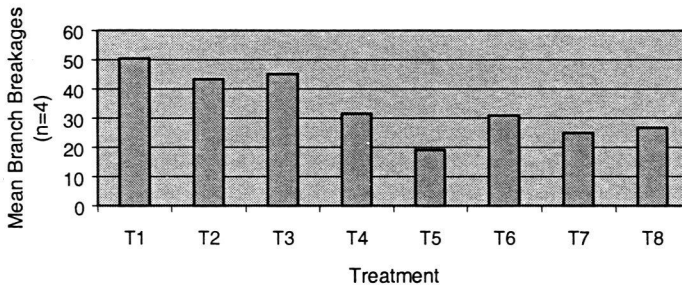


Figure 2a Block planted in 1995 (about 20- month old plants sprayed)

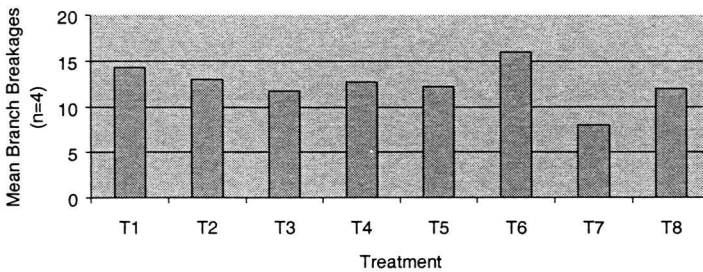


Figure 2b Block planted in 1994 (about 30- month old plants sprayed)

It was noted that Chlorpyrifos 20 EC @ 2500 ml/ha (T7) had significantly reduced the damage to immature tea. The study was discontinued as the recommendation of chlopyrifos on tea is not advisable for reasons of residues in made tea.

E-295: Use of pyrethroid insecticides for controlling shot-hole borer in mature tea in up-country: Hapugastenna Estate, Theberton Division, Field No.1 (1998), Maskeliya

The following treatments were being compared with fenthion ("Laybacid") @ 4500 ml/ha in un-replicated block design in large blocks, to ascertain the efficacy of pyrethroids:

- "Baythroid" (cyfluthrin) 500 ml/ha
- "Decis" (deltamethrin) 500 ml/ha
- "Karate" (cyhalothrine) 500 ml /ha

Treatments were applied in January 1999. The first post-treatment assessment was carried out at one year from treatment in January. A total of 20 branches (30 cm long) from each block were assessed. Population and gallery counts are given in Table 10.

TABLE 10 *Assessment of borer infestation at one year from treatment (Galleries and population in 20 branches)*

Treatment	Clone	Total galleries	Total brood
Baythroid @ 500 ml/ha	DN	10	2
Baythroid @ 500 ml/ha	DT1	5	8
Baythroid @ 500 ml/ha	TRI 2025	8	25
Karate @ 500 ml/ha	TRI 2025	4	6
Decis @ 500 ml/ha	DT1	1	0
Decis @ 250 ml/ha	DT1	11	9
Laybacid @ 4500ml/ha	TRI 2025	6	8
Untreated Control	TRI 2025	8	7

Results indicated that it is only Decis @ 500 ml/ha that could lower the infestation in comparison with the untreated control. The same treatments were subsequently tested in a properly designed experiment (E296).

E-296: Use of pyrethroid insecticides for controlling shot-hole borer in mature tea in Uva: Attampittia Estate, Second Div. Field No.14 (1998)

The treatments included the following:

T1	Admire	@ 750 ml/ha
T2	Baythroid	@ 500 ml/ha
T3	Decis	@ 500 ml/ha
T4	Ambush	@ 500 ml/ha
T5	Karate	@ 500 ml/ha
T6	Karate	@ 250 ml/ha
T7	Laybacid	@ 4500ml/ha
T8	Untreated control	nil

A second spraying was carried out in May 2000 at 17 months after prune, because the population build up was not noticeable during the period from May 1999 to April 2000. The population build up is given in Graph 3 in which the build up of the population per 10 branches was plotted against the time period for five months from the second spray (Figure 3). Treatment differences were not significant.

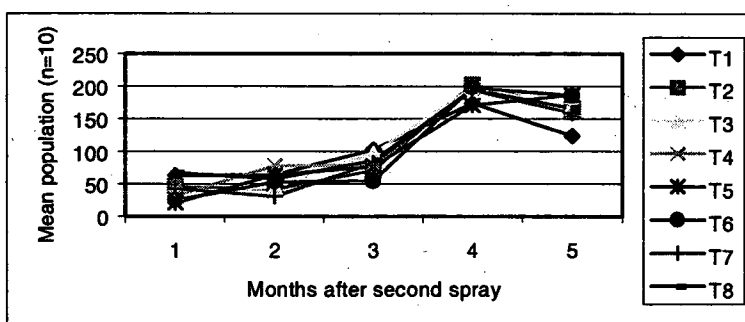


Figure 3 Infestation build up (Mean live stages per 30 cm. stem)

This experiment was terminated.

E-297: Use of Pyrethroid insecticides for controlling SHB in mature tea in the mid-country wet zone: New Peacock Estate, NP Division, Field No.6 T7

Treatments were identical to those of E 296.

Treatments were applied in February 1999, a period of four months after prune and the post treatment assessments commenced in March 1999. Spraying was repeated nine months after the first and the gallery counts and the population build-up per 30 cm branch had been recorded. The build up of the population (per 10 branches) was plotted against the time period for five months from the second spray (Figure 4). Treatment differences were not significant.

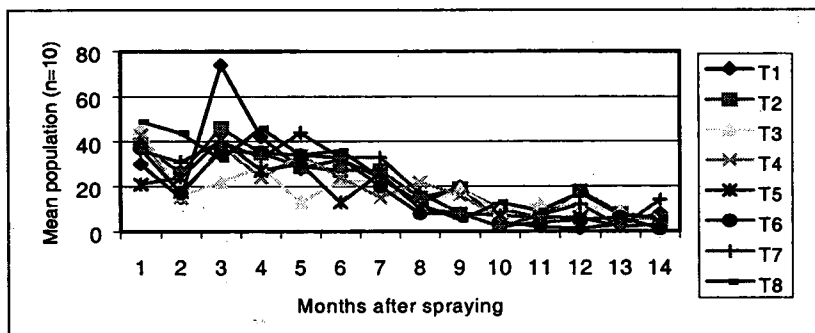


Figure 4 Mean population build up after spraying / insecticides

This experiment was terminated.

E-300: Use of insecticides for controlling shot-hole borer in mature tea in the mid-country wet zone: Nayapane Estate, Lower Div., Field No.1 (November 1999) RCBD Design of 8 treatments into 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	nil

Pre-treatment assessment on the build up of shot-hole borer population was carried out in December. Assessment data indicated that spraying should be carried out in early January 2001 to prevent the infestation in new shoots.

L.D. Amarasinghe, S. Walgama, A. Abeyssekara,
P. Dharmalatha, M. Jayatilake

E-303: Use of insecticides for controlling shot-hole borer in immature tea in mid-country wet zone: Rangala Estate, Field No.1 (2000)

Plots were laid out in RCBD design of 5 treatments x 3 replicates with 50 plants per plot The experiment is in progress.

L.D. Amarasinghe, S. Abeysinghe, B. Sureshkumar,
Padmini Darmalatha, A. Abeyssekara

A 22.2 Screening of biological control agents for reducing shot-hole borer damage in immature and mature tea

E-294: Effect of *Beauveria bassiana* on shot hole borer (1996)

This experiment was unsuccessful due to the drastic drop of sporulation of the different strains of the test fungus after sub-culturing it several times in the laboratory. The experiment had to be suspended at the end of 2000.

L.D. Amarasinghe, A. Abeyssekara, P. Dharmalatha

A 22.3 Identifying shade species as diversionary hosts for reducing shot hole borer damage

The experiments E 286, E 287 and E 288 were continued as observation trials at three locations representing the different climatic regions.

E-286: Attampitiya Estate, Second Division, Field No.14, Ettampitiya (1996)

The following three experiments were in progress:

E 286 – Attampettiya Estate, Second Division, Field No.14

E 287 – Kiruwanaganga Estate, Sirimedura Division, Field No.1

E 288 – New Peacock Estate, NP Division, Field No.6

These were terminated for reasons of inconclusive results. This project will however continue to test other plant species available in tea lands using bio-assay techniques.

L.D. Amarasinghe, S. Walgama, Peter de Silva, A. Abeysekara,
P. Dharmalatha, M. Jayatilake, S. Abeysinghe, B. Sureshkumar

A 22.4 Determining the time and style of pruning for reducing shot hole borer damage

The following three experiments E 283, E 284 and E 285 were in progress:

E 283-Uva; Attampitiya 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 Div., Field No.6, Pussellawa (1996)

Assessments on the occurrence of galleries continued on a bi-monthly basis.

Mean number of healed galleries encountered at the end of the first pruning cycle is given in Table 11.

TABLE 11 *Occurrence of healed galleries at the end of the cycle*

Month of Prune	Style of prune	Mean No.healed galleries / branch x 10 (n=10)		
		Uva	Mid (wet)	Low- country
October	Rejuvenation	35.3	16.8	14.5
	Lung prune	43.3	17.3	10.8
	Cut-across	35.8	17.8	11.8
January	Rejuvenation	32.3	09.0	19.5
	Lung prune	37.8	19.8	14.0
	Cut-across	39.8	18.0	16.3
April	Rejuvenation	36.8	17.0	09.8
	Lung prune	35.5	18.5	13.5
	Cut-across	32.3	17.3	11.3

A 22.5 Modifying potassium fertilization with a view to reducing shot-hole borer damage

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

Application of high potash fertilizer in the form of Muriate of Potash was continued @ 1.5 g, 3.0g and 4.5 g MOP. Five more assessments on borer damage were completed. The branch breakage at the end of three years was assessed on 45 plants per treatment, and the results are given in Table 12.

TABLE 12 *Branch breakage at the end of 3 years (total of 24 plants)*

Treatment	DN	TRI 407	TRI 2025
0 g MOP (90 kg /ha/yr)	11	06	14
1.5 g MOP (135 kg/ha/yr)	16	04	19
3 g MOP (180 kg/ha/yr)	06	05	22
4.5 g MOP (225 kg/ha/yr)	08	08	23

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

High potash fertilizer application on three clones (DN, TRI 2023 and TRI 2025) was continued. Six more assessments on borer damage were carried out. Branch breakage on 24 plants was carried out at the end of three years. The average data is given in Table 13.

TABLE 13 *Branch breakage (Avg. of 24 bushes)*

Treatment	DN	TRI 2023	TRI 2025
0 g MOP (90 kg /ha/yr)	15	15	76
1.5 g MOP (135 kg/ha/yr)	13	16	42
3 g MOP (180 kg/ha/yr)	18	15	48
4.5 g MOP (225 kg/ha/yr)	20	24	39

It was premature to derive any conclusions. Experiments E 289 and 290 are in progress.

L.D. Amarasinghe, S. Abeysinghe, B. Sureshkumar,
Padmini Darmalatha, A. Abeysekara

A22.6 Identifying semio-chemicals found in the tea plant and testing their feasibility at reducing shot-hole borer infestation

E-293: St. Coombs Estate

Chemicals that were found to be attractive to SHB were applied on trapping devices and the insects caught in the traps were sorted out. The average of other insects attracted to each volatile compound in the field is given in Table 14. (n=10)

TABLE 14 *Trap catches of insects other than shot-hole borer*

Compound	Beetles	Diptera	Hymenoptera	Coleoptera
Linalool	1.1	1.6	11.0	0.4
Methyl salicylate	1.3	1.8	6.8	1.8
Phenyl acetaldehyde	2.3	1.2	8.7	0.7
Geraniol	0.3	0.3	5.8	0.8
t-2 hexanal	0.3	0.4	6.8	1.2

The above data indicated that hymenopterans which include most of the beneficial insects were attracted to the volatiles applied in the field. Hence, a specific attractant that would preferentially attract shot-hole borer beetle has to be found. Improvements in this direction have been planned.

L.D. Amarasinghe, Padmini Darmalatha

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

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

MN-2: Screening of *Sesbania sesban* for its susceptibility to the burrowing nematode *Radopholus similis* in mid country-TRI Mid Country Station, Hantana

An experiment established in the nursery to study the susceptibility of *S. sesban* to *R. similis* in a pot trial did not yield positive results in 1999. The plants were allowed to grow further and one assessment was carried out in July, six months after the second inoculation. Observations are given in Table 15.

TABLE 15 *Nematode Assessment at 6 months after inoculation (Average of 6 replicates)*

Plant species	Nematode count per 1.0 g root	Nematode count per 100g soil
Tea (TRI2025)	8.00	5.60
Sesbania sesban	3.33	1.67
Veteveria zizanooides	0.00	1.17

It was shown that *Sesbania sesban* does not support *R. similis* infestation the way the susceptible tea clone does, even though it is not as good a nematicidal plant as *V. zizanooides*.

S.I. Vitarana, D. Pallemulla, B. Sureshkumar

N-369: Large scale propagation and use of nematode bio control agents. Pot cultures of local isolates of the bacterium, *Pastueria penetrans* and laboratory cultures of nematode trapping fungi, *Arthrobotrys musiformis*, *A. oligospora*, *A. spp.*, *Dactylella spp.* and *Monacrosporium spp.* are being maintained. These are to be used for further experimentation by utilizing indigenous biological materials for agricultural purpose and field dissemination on an experimental basis.

A set of laboratory cultures initiated from soils in the Southern area was established in August 2000. Purification and identification of various organisms in these cultures are in progress.

Keerthi Mohotti

N-371: Monitoring naturally occurring nematode antagonists of tea nematodes
Monitoring naturally occurring nematode antagonists of tea nematodes

Densities of nematode bio control agents and population dynamics of (a) *P. loosi* in Needwood Estate and (b) *Radopholus similis* in Kottawa TRI station were monitored periodically. The experiment is in progress.

Keerthi Mohotti

N-370: Management of tea nematodes under bio-tea conditions - Organic Tea Project.

St. Coombs Estate, Field No. 13

Experimental plots established at Field No. 13 of St. Coombs Estate in 1996 were continued to be maintained under IFOAM guidelines. In addition to

monitoring plant parasitic nematode populations and densities of nematode bio control agents in organic and conventional soils, studies were extended to elucidate the following aspects in collaboration with the relevant research Divisions.

- Status of soil microbiology as an indication of biodiversity of soil
- Incidence of pest, weed and disease problems
- Physiological processes
- Manufacture and quality aspects
- Plant nutrition and soil properties

The experimental plots were pruned in November 2000. The prunings were machine chipped and incorporated to soil *in situ*. The results of pre-prune (at first prune) assessments are presented in Tables 16, 17, 21 and 22 and also under the reports of the Biochemistry, Plant Physiology and Technology Divisions. Periodic monitoring of yield and other post-prune assessments are in progress. Yield of organic and conventional tea monitored to date is presented in Table 16.

TABLE 16 *Mean yield of young tea grown under organic and conventional methods*

Yield	Tea Waste	Neem Oil Cake	Compost	Inorganic (Conventional)
Kg Dry weight / ha / year	1183±6	971±28	1229±7	1157±7

i. Role of organic farming on nematode incidence in tea

Greater efficacy of natural nematode management was evident in many organic tea soils i.e. Needwood Estate, Haldumulla. The bio control efficacy and the role of organic amendments under field conditions on suppressiveness of *P. loosi* populations are to be ascertained. Therefore, studies on population dynamics of *P. loosi* in organic and conventional tea soils are under way at experimental plots in Field No. 13, St. Coombs Estate.

Table 17 presents the results of assessments on *P. loosi* populations and total polyphenol contents in tea roots. Although root polyphenol contents and nematode populations showed a very weak correlation ($R^2 = 0.06$), it was evident that the organic matter addition has induced root tolerance to *P. loosi*.

TABLE 17 *Suppression of Pratylenchus loosi populations by organic and conventional treatments*

Treatment	Tea Waste	Neem Oil Cake	Compost	Inorganic (Conventional)	LSD
<i>P. loosi</i> /g root	28.16	21.15	48.56	91.83	NS
Total polyphenol content root (mg/g root)	15.74	16.12	17.80	14.17	NS
Root-knot nematode rating	4.25	3.50	5.75	8.00	2.15
Micorrhizal spore counts/100g soil	210.5	375.5	192.5	275.5	NS
C:N ratio	18.9	9.7	13.2	15.6	NS
Soil microbial activity(mg CO ₂ /day)	321.75	231.28	213.68	186.45	NS

Bio control efficacy of treated soils assessed through root-knot nematode rating showed significant results. Ample C:N ratios for optimal establishment of densities of nematode bio control agents were found in all plots except in neem oil cake treated plots. Results of micorrhizal (VAM) spore counts and the microbial activity was measured as CO₂ evolution rates in soil.

Keerthi Mohotti, M. P. T. Premaratne (University Student),
A. Balasuriya, R. M. A. Ratnayake, N. Navaratne

ii. Incidence of weeds in organic tea fields

In order to evaluate the weed incidence in organic and conventional soils, weed growth was monitored periodically and the results are given in Table 18.

TABLE 18 *Weed biomass in organic and conventional tea soils in Field No. 13, St. Coombs Estate*

	Tea Waste	Neem oil cake	Compost	Conventional
Jul-99	1.77±0.41	2.76±0.53	2.51±0.52	2.33±0.61
Aug-99	1.71±0.26	2.88±0.41	2.40±0.34	2.24±0.47
Oct-99	3.43±0.75	2.62±1.24	3.71±0.76	4.69±0.26
Nov-99	1.89±0.36	2.12±0.69	1.77±0.59	1.84±0.46
Feb-00	2.27±0.63	2.76±0.73	2.47±0.45	2.29±0.74
May-00	1.87±1.14	2.07±0.83	1.96±0.27	1.92±0.85
Sep-00	1.66±0.71	2.95±0.40	1.78±0.72	1.74±0.79
Nov-00	2.74±0.54	2.14±0.63	2.41±0.48	2.55±0.82

Keerthi Mohotti

iii. Incidence of shot-hole borer damage in organic tea fields

Assessments were made to evaluate the damage caused by shot-hole borer in tea bushes exposed to organic and conventional treatments prior to pruning. The results are given in Table 19. Results of volatile chemicals extracted from shot hole borer infested and healthy branches of organic and conventional tea are given in the report of the Biochemistry Division.

TABLE 19 *Incidence of shot-hole borer damage in 4 year old tea exposed to organic and conventional treatments, Field No. 13, St. Coombs Estate*

Treatment	Tea Waste	Neem Oil Cake	Compost	Inorganic (Conventional)	LSD
Mean number of Open galleries	3.000	3.075	3.775	3.475	2.288

L. D. Amarasinghe, P. Dharmalatha, Keerthi Mohotti

iv. Effect of incorporation of prune chips into tea soils on population dynamics of *Pratylenchus loosi*

Two experiments were established to study the role of incorporating prune chips into mature tea fields infested with the root lesion nematode, *Pratylenchus loosi*, as a 'post-prune nematicidal treatment'. The nutrient composition of different prune chips is being analyzed. The biological, chemical and physical changes in soils incorporated with prune chips will also be monitored.

A) Field experiment: at organic tea trial plots at St. Coombs

Population dynamics of *P. loosi* in the different plots incorporated with prune chips are being monitored periodically.

B) Pot experiment: in the glass house at Nematology Experimental Area

The following treatments were given.

- T1 1:1 (vol./vol.) Prune chips (from Tea waste treated plots)
- T2 1:1 (vol./vol.) Prune chips (from Neem Oil Cake treated plots)
- T3 1:1 (vol./vol.) Prune chips (from Compost treated plots)
- T4 1:1 (vol./vol.) Prune chips (from Conventional plots)
- T5 Phenamiphos (Nemacur) 10g per plant basis
- T6 Untreated
- T7 Control (uninfested soil)

Approximately one year old tea plants of TRI 2024 were planted in 4 l plastic pots filled with soil subjected to different treatments. Treatments T1-T6 each received *P. loosi* (isolate: Talawakelle) 1000±25. All treatments were arranged in a completely randomized design with 4 replicates.

Keerthi Mohotti

N-373: Dual purpose compost mixture

Bioassays were carried out to determine the efficacy of 'dual purpose compost materials' on nutrient supply as well as on pest control in tea. Positive results were evident on the management of nematodes and weeds in organic tea trial plots at St. Coombs Estate and the growth of tea in the affected (sick) soils of Deniyaya region. Further work is in progress.

Keerthi Mohotti

N-377: Role of mechanization on nematode management in tea - Mechanical Uprooting of old tea fields- Great Western Estate, Talawakelle

i. Mechanical uprooting in old tea fields

As a demonstration trial, periodic assessments were made in tea soils planted with Mana following uprooting old tea mechanically and manually at Talawakelle Estate. Nematode population dynamics, biological, chemical and physical properties of soil and economic analyses on field practices are being monitored since 1999.

Results of biomass of Mana in different fields evaluated periodically are given in Table 20. Greater proportion of organic matter addition in mechanically uprooted old tea fields will help induce nematode bio control efficacy by enhanced densities of nematode antagonists. It is planned to conduct a statistically designed experiment in order to ascertain more information on the role of mechanization as a novel IPM approach in nematode management in tea.

TABLE 20 *Results of periodic assessments of biomass of Mana in mechanically and manually uprooted old tea fields at Great Western Estate*

Treatment	Biomass of Mana (kg dry matter / ha)		
	June 2000	August 2000	September 2000
Mechanical	5783±990	2296±488	1686±474
Manual	5176±1183	2085±378	1199±183

An experiment was conducted at the glass house of Nematology Experimental Area, TRI, for six months. Tea plants (TRI 2024) were grown in pots filled with mechanically and manually uprooted field soils in order to trap the residual soil populations of nematodes as well as to study the growth performance of tea. The results of final assessments are presented in Table 21.

It was evident that mechanically uprooted old tea soils possessed low residual population of *P. loosi* as compared to manually uprooted soils. Plant growth on mechanically uprooted old tea soils was not significantly affected probably due to the short time period of this study. However, significantly greater root biomass in mechanically uprooted old tea soils will help to manage the damage caused by *P. loosi* in tea.

TABLE 21 *Results of entrapped populations of Pratylenchus loosi in tea roots and growth of tea on mechanically and manually uprooted tea soils*

	Mecha- nical	Mecha-nical + Nematicur	Manual	Manual + Nematicur	Sterilized soils (Control)	LSD
<i>P. loosi</i> /g root	173.21	105.76	286.15	86.32	0	NS
<i>P. loosi</i> /100g soil	2.33	0	4.67	1.33	0	NS
Shoot fresh weight (g)	1.67	1.80	1.77	2.03	2.73	NS
Shoot dry weight (g)	0.68	0.84	0.79	1.03	1.45	NS
Root fresh weight (g)	3.83	3.62	1.67	2.09	5.69	2.05
Root dry weight (g)	0.59	0.47	0.48	0.54	0.68	NS

Keerthi Mohotti, Maithri Liyanage (Manager, Great Western Estate), N. Navaratne

ii. Fertigation in tea nurseries

In order to ascertain the impact of restricted handling of planting materials and reduced nursery period, two model nurseries were set up at the Nematology experimental area at TRI and Great Western Estate, Talawakelle, as 'Protected tea nursery'. It is aimed at setting up an automated watering and manuring system in tea nurseries. The work is in progress.

Keerthi Mohotti, Maithri Liyanage (Manager, Great Western Estate)

N-375: Soil-less medium for tea propagation as an alternative to chemical treatment in tea nurseries - TRI, Talawakelle, and Great Western Estate, Talawakelle

Results revealed that dry Oasis was superior to wet Oasis and showed potentials of a soil-less medium for tea propagation.

Investigations are in progress to make substitutes for Oasis using locally available natural rubber latex and organic materials at Rubber Research Institute laboratories, Ratmalana, and Proflora workshop at Wennappuwa. The products are to be evaluated for characteristics of propagating media.

Keerthi Mohotti, Karnika De Silva (Rubber Research Institute),
Meril Fernando (Proflora Co. Ltd., Marawila), Maithri Liyanage
(Manager, Great Western Estate)

Status of microbial biomass and biological activity of Southern tea soils

Soil biomass plays a major role in productivity of soil which, in turn, affects agricultural performance. Adequate biological studies have not been carried out in the Southern tea soils and hence a study was initiated to explore the status of microbial biomass and biological activity of tea soils. In general, microbial activity of Southern tea soils was comparatively low. Beneficial organisms such as free-living nematodes and earthworms showed low population densities. Low organic matter contents and heavy usage of soil pesticides especially herbicides could have brought down the levels of microbial communities of soils in the area. In addition, socio-economic factors, mainly labour shortage seemed to limit poor crop and soil management practices recommended by the TRI.

Biological studies in soil were closely monitored *in situ* at Handford Estate, Deniyaya. Herbicides dramatically reduced CO₂ evaluation rates in soils, which was similar to Formalin application. In contrast, incorporation of organic matter (compost and tea waste) significantly enhanced biological activity in tea soils. This was also correlated to crop growth as observed by bioassays with tea and tomato.

The results emphasized the importance of rehabilitation of old tea lands, incorporation organic soil amendments, soil cultivation through forking, improved crop management practices and reduced usage of soil pesticides. These will help enable to ascertain greater microbial activities, monitor incidence of soil borne pathogens including nematodes and thereby enhance crop productivity in southern tea soils.

A.R. Prathapasinghe, N.G.N. Rasangi
(University of Ruhuna), Keerthi Mohotti, P. K. Jayawickrema,
K. L. Wasantha Kumara (University of Ruhuna)

Problems affecting tea in Deniyaya region

In the recent past, the high yielding estate sector holdings in Deniyaya region experienced debilitation of tea, which eventually lead to the death of the bushes. Loss of vegetative buds, emergence of fruits and flowers and damage to root

biomass are common symptoms. A significant declining trend in tea yields in the area is also evident, the reasons for which have yet to be investigated.

The probable causal factors and localities were analyzed by studying abiotic and biotic factors and common observations. The data revealed a significant change of rainfall pattern, increase in rainfall, reduced sunshine and temperature in the region. Excess precipitation along with poor shade management has created ill-drained stress conditions to the crop on clayey soils found in the region. This was confirmed by diminished symptoms of damage and growth enhancement of tea plants in micro-plots established in affected tea fields at Handford Estate, Deniyaya. Hence the importance of improving drainage facilities in Deniyaya tea soils.

The growth of estate and TRI clones was superior on sterilized soils than on sick (affected) soils. Soil borne organisms are attributed to cause problems in these soils but these could not be confirmed as a primary or secondary pathogen. Bacterial infection in affected tea has been ruled out. The commonly grown tea clones viz. TRI 2025 and TRI 2026 were mostly affected. Among the tea cultivars tested in this study, estate clones performed well under sick soils as compared to TRI clones. Plant growth of annuals (tomato, common weed species, rehabilitation grasses) was not affected significantly.

Low nutrient compositions in sick soils as compared to healthy soils were noted. Moreover, healthy soils processed greater CO₂ evaluation rates. Reduced soil biomass could have created poor soil productivity which affected crop growth as experienced in Deniyaya area.

It was also evident that as a consequence of the unusual weather, poor crop and shade management practices, unthrifty and 'Up-country' climatic conditions have emerged in this area. Frequent prevalence of the root-lesion nematode, *Pratylenchus loosi*, in tea soils in this area was evident. Therefore, further attention is warranted to ascertain the management of this nematode.

Moreover, this particular problem unknown to tea did not have similarities to other three problems that already exist viz. High Forest and Dimbula problems in Sri Lanka and TV2 problem in India. This was partly confirmed by the sections of root and stems studied.

N. G. N. Rasangi, A. R. Prathapasinghe (University of Ruhuna),
Keerthi Mohotti, P. K. Jayawickrema, A. J. Mohotti,
K. L. Wasantha Kumara (University of Ruhuna), Shantha Jayasinghe

2. Basic Research

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

B 29.1: Refining of short-cut methods for clonal screening in the laboratory / SHB

Bio-assay of clones for their resistance to borer damage has been carried out in order to perfect the techniques and screening new clones. Undergraduate trainees (one for every six months) have been employed at this work. The most recently concluded work led to the following results:

- a. Technique testing- The following bio-assay arenas have been tested using 20 cm length of pencil thick wood of different clones:
 - i. Stems kept in both ends closed perforated **Polythene Cylinders**:
30cm stems were mounted on perforated circular regifoam discs before being placed inside the cylinder (the method selected as the best from 1999 study)
 - ii. Stems inside **Insect Cage** (glass fronted and wire-meshed on the sides), stems were mounted on perforated circular regifoam discs before being placed inside the cage
 - iii. Stems placed vertically inside **Glass Bottle** mouth of which was covered with netting (stems were not mounted on regiform disc.)
 - iv. Stems placed horizontally inside rectangular **Plastic Box**

The Insect Cage was found to be the best, having the highest gallery making, highest occupied galleries, longest gallery chambers and largest broods (differences statistically significantly different from each other at 5% level). Comparison between bio-assay chambers is given in Table 22.

TABLE 22 *Borer infestation in cut stems in the different bio-assay arenas (at one month from initiation of the experiment)*

Arena Type	Mean No. Bore-Holes	Mean Gallery Length (cm)	Mean Brood Size (Total no. of individuals)
Insect Cage	3.600 a	6.167 a	21 F + 4 P + 36 L + 11 E
Polythene Cylinder	1.767 b	3.000 b	13 F + 5 P + 31 L + 9 E
Plastic Box	1.756 b	2.667 b	9 F + 0 P + 0 L + 0 E
Glass Bottle	1.744 b	2.156 b	No brood at all
LSD at 5%	1.47	2.973	

Key: F- Females; P- Pupae; L- Larvae; E- Eggs

- b. **Clonal screening:** The Insect Cage was employed to screen TRI 4000 clones with TRI 2023 and TRI 2025 as the standards. The observations are given in Table 23.

TABLE 23 *Borer infestation in cut stems of different clones (at one month from initiation of the experiment)*

Clone	Mean No. Bore-Holes	Mean No Galleries	Mean Gallery Length (cm)	Mean Brood Size
TRI 4024	1.000 b	0.667 d	0.400 d	1 F
TRI 4054	2.000 b	1.333 cd	2.733 cd	2 F
TRI 4034	2.167 ab	2.000 bcd	1.700 cd	1 F
TRI 2023	2.500 ab	2.000 bcd	2.433 cd	2 F + 5 E
TRI 4014	3.167 ab	2.667 bcd	5.267 cd	2 F + 1 L
KEN 16/3	4.333 ab	4.667 abc	5.900 bcd	3 F + 5 L + 4 E
TRI 2025	5.500 ab	5.333 ab	7.233 bc	4 F + 9 L
TRI 4049	5.833 ab	7.667 a	17.367 a	3 F + 4 P + 22 L + 1 E
TRI 4052	7.500 a	8.000 a	12.200 ab	3 F + 4 L + 4 E

F- Females; P- Pupae; L- Larvae; E- Eggs

Thus, the clones could be arranged according to their degree of resistance as follows:

Highly Resistant	:	TRI 4024, 4054, 4034
Moderately Susceptible	:	TRI 2023, 4014
Susceptible	:	KEN 16/3, TRI 2025
Highly Susceptible	:	TRI 4052, 4049

This was proven to be a reliable fast method of screening clones against shot-hole borer.

S.I.Vitarana, B. Jayawardena (University of Ruhuna)

B 29.2 Bio-Assay Work

Time saving techniques for fast screening of clones / LCLWT

a. Olfactometry

Olfactometers made of Perspex were used in screening experiments to determine attractant and repellent properties of plant extracts (Patterson *et al.*, 1991). This Olfactometer has 4 arms and a center hole through which air is drawn by a slow suction pump. The end of each arm has an inlet with which an odour stimulants can be applied. The arena is divided into 5 zones, 4 arm zones and 1 indifferent zone in the central part of the arena. Air is sucked through the hole of the 4 arms of the olfactometer while odour stimulus are applied to the 4 arms. (TRI 2023 as a Standard and 3 other test clones). A termite (alate) was introduced into the central part of the arena and the tube from the suction pump was connected.

A positive behaviour of 1 was recorded when the insect is in the arm zone and negative behaviour of 0 recorded when it is in the middle arena. Observations were made at intervals of 5 minutes continuously for 1 hour, after an initial settling period of 10 minutes. (18 reps in 3 arrangements).

b. Petri-dish Couplet Assay

Petri-dish couplets were used as test chambers. A filter paper was kept in each petri dish and divided into 4 by drawing 2 cross lines. Four circles were drawn inside each section and an extract was kept inside one circle and other 3 circles were used as controls. Four termites of worker caste were used in each treatment and the experiment was replicated 6-12 times. Termites were allowed to move freely inside the petri-dish and the behaviour was recorded at 15 minute intervals for 3 hours. Behaviour was recorded as 1 when a termite was in a particular section. (Palatability of wood material can be observed)

c. Glass Plate Method

Glass plate was divided into two sections. One section was filled with the wood-rotted material Agar, and the other section with filter paper to which termites were introduced and covered with a Glass Plate. A little water was introduced to the filter paper and 2 alates/ reproductives and 4 workers introduced. Their activity, gallery making, feeding, no. alive were recorded. If they are not feeding the wood material, they can be feed filter paper with only cellulose. Observations were recorded.

The above 3 methods are deployed to identify their use for screening termite susceptible/resistance/tolerant clones. Field performance of these clones are also being considered at the same time.

a. Field Observations of Clones Studies – St. Joachim Estate

Clone	Amount of Wood Rot	Termite Attack
2023	+++	+++
3063	+++	+++
3014	+++ (drought)	-
4049	+ (hardy)	-
4048	+ (hardy)	-
62/1	+ (hardy)	-
3055 (Talangaha)	+	++
4052	+	-
DG 39	+ (hardy)	-
3047 (Up country)	+++	++
PW 39	+	-
4053	++	-

b. Observations of the Olfactometer study (Bio assay)

Clone	Olfactometer Study	
	Significant Level	Attractive
2023	P<0.001	Attractive
3063	P<0.001	Attractive
3014	P<0.001	Attractive
4049	P<0.005	Repelling
4048	P<0.001	Repelling
62/1	P<0.005	Repelling
3055	P<0.001	Repelling
4052	P<0.001	Attractive
DG 39	P<0.001	Attractive
3047	P<0.001	Attractive
PW 39	P<0.005	Repelling
4053	P<0.001	Attractive

c. Petridish Couplet Study

Clone	Petridish Couplet Study	
	Significant Level	Attractiveness
2023	P<0.001	Attractive
3063	P<0.001	Attractive
3014	NS	Not Attractive
4049	NS	Not Attractive
4048	P<0.005	Repelling
62/1	NS	Not Attractive
3055	P<0.000	Repelling
4052	P<0.001	Attractive
DG 39	P<0.001	Attractive
3047	P<0.001	Attractive
PW 39	NS	Not Attractive
4053	P<0.001	Attractive
Control	NS	Not Attractive

d. Glass Plate Method

Clone	Activity	Gallery Making	Survival	Cellulose Eating	Mean Gallery Length
2023	73.33%	43.70%	59.62%	38.51%	1.2 cm
3063	65.92%	71.85%	68.88%	33.33%	2.4 cm
3014	74.96%	34.07%	66.66%	59.25%	1.0 cm
4049	60.00%	00.00%	50.74%	68.14%	-

This experiment is in progress.

S.I. Vitarana, S.M. Samarasinghe, K.L.K. Dharmadasa (University of Ruhuna)

Supporting Research

3. Miscellaneous Divisional Projects (D)

3.1. Applied Research Projects

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

3.1.1. Use of Methyl Bromide substitutes in the eradication of nematodes at management of nematode pests in tea nurseries and tea fields

a. Soil Solarization as a means of soil sterilization:

Five experiments were carried out in 1999/2000 at the following sites:

- i. Rangala Estate, Rangala (Dec./99)
- ii. MeBr 34 - Kellebokka Estate, Madulkelle, (Sep./99)
- iii. Handford Estate, Deniyaya (Dec./99)
- iv. Murray Estate, Maskeliya (Sep./99)
- v. Nayabedda Estate, Bandarawela (May/00)

MeBr-34: Studies on Soil Solarization
Expt. MeBr 34 – Kellebokka Estate, Madulkelle

Experiment Design: RCBD

Final assessment at 7 months was carried out in August 2000. Results are given in Table 24.

TABLE 24 *Assessment at 7 months from planting cuttings (average of 30 plants (1/10 of total) per treatment per replicate)*

Serial No.	Treatment	Treatment Averages			
		Plant Height (cm)	Plant Girth (mm)	Side Branches	No. of Leaves per plant
1	Dazomate	22.72 d	4.05 c	0.90 b	9.42 d
2	Control	27.40 c	4.39 c	0.65 b	9.37 d
3	Soil Solarization	28.73 c	4.57 bc	1.27 b	13.02 c
4	Urea + Soil Solarization	40.49 a	5.13 a	2.32 a	19.53 a
5	Methyl Bromide	31.53 b	5.00 ab	1.20 b	13.87 bc
6	S.A. + Soil Solarization	34.47 b	5.07 ab	1.70 ab	16.44 ab
	LSD _{5%}	4.12	0.661	0.99	3.28
	LSD _{1%}	6.46			

b. Nematicidal treatments useful for Direct planting of nematode infested lands

Two experiments are being carried out at:

(i) Murray Estate, Maskeliya (April/2000)

Treatments:

- T1 Metham Sodium (@500 l / ha by injection into holes made around the plant
- T2 Cadusaphos (“Rugby” @7g/plant) into the planting hole
- T3 Vettiver – planting in the inter-row and continuous thatching
- 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 1 liter water; repeated at 2 month intervals for one year

Basal application: tea waste applied to a height of 15 cm at the bottom of the planting hole, to each treatment

(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 60 cm interval, for one year
- Basal application: 1kg tea waste + 20g T200 applied to a height of 15 cm at the bottom of the planting hole, to each treatment

c. Chemical Nematicides for nursery stage

(Sites: Hauteville Estate, Agrapatana, St. James Estate, Bandarawela and Moray Estate, Maskeliya)

The following treatments have been used in the on-going trials:

1. Metam Sodium fumigation
2. Neem formulation (“Neemazal 1%TS”) – dilution @ 3ml concentrate / 1 water
3. Dazomet fumigation (standard)
4. MeBr fumigation (Standard)
5. Untreated Control

Assessments of a, b and c have been scheduled for 2001.

New experimentation has been planned to combine chemical nematicidal treatment with soil solarization and soil substitutes (tea waste) in order to cut down on the dose of nematicide. Nematicides would be used at half dosage. The experiments will be replicated in Uva, Matale District and Deniyaya.

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

N-330 (MeBr 8): To study alternatives to rehabilitation for eradication of nematodes in the field in Uva - Queenstown Estate, Hali Ela (Split plot design) (1997)

Treatments were applied at the time of planting and are being tested on two clones.

Clones- C1= DN
C2= TRI 2027

Nematicidal Treatments:

T1 Rugby (cadusafos) 7 g /plant
*T2 Neemazal 30 ml of dilution/plant
T3 Fenamifos ('Nemacur') @7g/plant
T4 Control
(* "Neemazal 1% TS" was diluted @ 3 ml per litre of water)

Results of assessments in relation to plant survival and tipping weights at the time of bringing into bearing are shown in Table 25.

TABLE 25 *Survival of plants after application of nematicidal treatments and the tipping weights compared*

Treatments	Average % Live Plants		Treatment Average (%)	Average Tipping Wt.(g)		Treatment Average
	C1	C2		C1	C2	
T ₁ = Rugby @ 7g / hole	46.37	17.72	32.04 b	0.4	0.5	0.45
T ₂ = Neemazal 30ml / plant	92.89	69.40	81.14a	0.6	0.5	0.55
T ₃ = Nemacur @ 7g / hole	64.75	60.77	62.76a	0.4	0.4	0.4
T ₄ = Control	82.66	69.41	76.03a	0.6	0.6	0.6
Clone % Average	71.67	54.32	LSD5%=30.08	0.5	0.5	(NS)

Cadusaphos exhibited phytotoxicity and caused heavy casualties. This was in contrast to the observations made at Courtlodge Estate (N-325 (MeBr 3)) with the same chemical. Although Neemazal treatment gave the best survival of plants, the results were not statistically significantly different from the untreated control

or nemacur treatment. It was concluded that cadusphos may have shown different behaviour at the two places on account of the difference in the ambient temperatures. The trial was terminated.

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

N-318 (MeBr 9): Development of Steam Chamber for sterilization of infested soil for use in tea nurseries – Diyagama East Estate Workshop (1999)

Construction of the Steam Chamber at the factory workshop of Diyagama East Estate was completed in October.

S.I. Vitarana, D.D. Liyanage, A. Madawala, W. Wijesinghe, S. Sarath

N-335 (MeBr 18): Soil solarization as a means of eradicating nematodes in soil used for tea nursery, TRI Station, Deniyaya

Solarization under clear ploythene by itself, and in combination with nitrogen fertilizers to impart synergistic effect, was being tested in replicate trial, using 150 plant area per plot.

- T1 Soil Solarization (SS) six weeks
- T2 SS for 8 weeks
- T3 Methyl bromide fumigation
- T4 SS for 6 weeks of soil treated with Urea @ 2g/bag
- T5 SS for 8 weeks of soil treated with Urea @ 2g/bag
- T6 SS for 6 weeks of soil treated with $(\text{NH}_4)_2\text{SO}_4$ @ 2g/bag
- T7 SS for 8 weeks of soil treated with $(\text{NH}_4)_2\text{SO}_4$ @ 2g/bag
- T8 SS for 6 weeks of soil treated with Dazomet 98% @ 0.27g/bag
- T9 SS for 8 weeks of soil treated with Dazomet 98% @ 0.27 g/bag
- T10 Untreated control

The experiment is in progress.

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

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

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

1. Observations carried out – roots and soil sampling
2. 1st centering / 2nd centering did this year

Taken soils and root samples for nematode observations

Roots and shoot weights and nematode analysis were carried out.

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

N-342 (MeBr 24): To study the alternatives to rehabilitation for eradication of nematodes in the field in up-country – St. Coombs Estate

This experiment is in progress.

N-376 (MeBr 32): Soil solarization as a substitute to MeBr to eradicate nematodes in tea nurseries in mid-country –Rangala Estate, Rangala

Treatments:

- T1 soil mix with Urea 2g/plant + 6weeks solarization
- T2 soil mix with Urea 2g/plant + 8weeks solarization
- T3 08Weeks soil solarization
- T4 Dazamet (Basamid) normal fumigation
- T5 Fumigation with MeBr
- T6 Untreated control

No. of replicates – 03

No. of plants per replicates – 300

Clones- C1 = TRI3018
C2 = TRI2025

Design – Split plot (6N x 2 Clones x 3 Rep)

Date commenced – March 2000

This experiment has been started and the 1st assessment done 6 months after the cuttings were put out. The assessments include growth measurement and nematode assessments. Results have been sent for analysis.

TABLE 26 Comparison of clones at 6 months (Average of 30 plants)

Treatment	No. of branches per plant	No. of leaves per plant	plant Height (mm)	plant Girth (mm)	Banji %	Shoot Weight (g)	Root Weight	Nematode /100g Soil (n+1)	Nematode /05g Root (n+1)
T ₁ - Mix with Urea 2g bag + 6 weeks SS	1.38	6.80	184.20	9.97	62.13	6.04	4.01	0.00	0.00
T ₂ - Mix with Urea 2g bag + 8 weeks SS	1.77	8.23	178.88	10.48	61.09	5.91	3.95	0.00	0.00
T ₃ - 8 weeks Soil Solarization	1.10	6.45	187.30	10.37	73.75	6.66	4.08	0.00	0.00
T ₄ - Basamid normal Fumigation method	1.29	7.14	192.62	14.55	63.32	6.16	4.00	1.00	0.00
T ₅ - Fumigation with MeBr	1.46	7.30	186.90	10.17	67.09	6.31	3.97	0.00	0.00
T ₆ - Untreated Control	1.24	7.09	174.78	10.47	64.96	4.93	3.45	1.50	2.33
LSD _{5%} =	NS	2.81	NS	NS	NS	NS	NS	NS	2.21

Rangala Estate – Rangala

Treatment	No. of branches per plant	No. of leaves per plant	plant Height (mm)	plant Girth (mm)	Banji %	Shoot Weight (g)	Root Weight	Nematode /100g Soil (n+1)	Nematode /05g Root (n+1)
C ₁ =TRI 3018	1.44	5.21	174.87	9.63	68.24	5.70	3.63	0.33	0.39
C ₂ =TRI 2025	1.30	9.13	193.35	12.38	62.54	6.31	4.19	0.50	0.39
LSD _{5%} =	NS	3.47	NS	NS	NS	NS	NS	NS	NS

S.I. Vitarana, H.M.U.B. Herath, G.P. Udamulla

N-351 (MeBr 33): Roasting of soil to eradicate nematodes in soil meant for nursery use Pitaratmalie Estate, Haputale (1999)

- T1 Methyl Bromide
- T2 Soil roasting (estate practice)
- T3 Basamid
- T4 Soil roasting – Indian method
- T5 Roasting of soil mixed with paddy husk
- T6 Untreated control

Tea cuttings were planted in December 1999 but the experiment had to be abandoned for lack of co-operation from field staff.

S.I. Vitarana, D.D. Liyanage

N-352 (MeBr 34): Soil solarization as a substitute to MeBr to eradicate Nematodes in tea nurseries in mid-country - Kellabokka Estate System 1A Site 3

- T1 2 g Urea/bag + SS (8 weeks)
 T2 2 g Sulphate of Ammonia/Bag + Ss (8 weeks)
 T3 Ss (8 weeks)
 T4 Basamid
 T5 MeBr
 T6 Control

Experiment was established in October.

Final assessment was carried out in the year 2000.

The observations are given in Table 27.

TABLE 27 Assessment at 9 months from planting cuttings

No.	Treatments	Avg. Plant at the planting Time in field	Avg. Stem girth at planting time in the field	Avg. lateral branching at the planting time of no thumb nailing	Avg. of total No. leaves per plant at the time of planting	Nem count /g root
1	Dazomat (standard)	22.72 d	4.05 c	0.90 b	9.42 d	0
2	Control (Untreated)	27.40 c	4.39 c	0.65 b	9.37 d	5
3	Soil Solarization	28.73 c	4.57 bc	1.27 b	13.02 c	0
4	Urea + SS	40.49a	5.13a	2.32a	19.53a	0
5	MeBr	31.13 b	5.00ab	1.20 b	13.87 bc	0
6	SA + SS	34.47 b	5.07ab	1.70ab	16.44ab	0
		LSD _{5%} = 4.12	LSD _{5%} = 0.66	LSD _{5%} = 0.66	LSD _{5%} = 3.28	
		LSD _{5%} = 6.46				

At the time of transferring the nursery plants to the field, only the untreated control still harboured any nematode infestation. All substitutes tested were proven on par with MeBr, in terms of nematicidal activity. Dazomet failed to show any improvement over the untreated control in terms of growth parameters. In addition to eradicating nematodes, soil solarization by itself showed only marginal improvement in growth over the control and dazomet treatment. Nitrogen supplemented SS and MeBr showed statistically significantly better growth of plants than SS by itself. Urea supplemented SS was proven as the best treatment in terms of growth boosting effect as well as nematicidal effect.

N-358 (MeBr 35): To find suitable cost effective nursery soil substitutes for use in nematode active areas in mid-country - Kellebokke Estate, Kellebokke (1999)

The experiment commenced in September 1999 with the following treatments in randomized complete block design with three replicates:

- T1 Soil + Paddy husk (PH) mixed at 1:1
- T2 ½ Soil + ½ Paddy husk in layers with Paddy husk at bottom
- T3 Soil + Tea waste (TW) mixed 1:1
- T4 ½ Soil + ½ Tea waste in 2 layers with tea waste at the bottom
- T5 Fumigation with methyl bromide (MeBr)
- T6 Untreated control

Plants were maintained without being subjected to any bringing into bearing operations in the nursery. Final assessments were carried out in September. The results are shown in Table 28.

TABLE 28 *Assessment of plant growth and nematodes at Kellabokka Estate*

No.	Treatment	Average plant height at the time of field planting (cm)	Average number of lateral branches per plant at the time of field planting	Average of total number of leave per plant at the time of field planting	Avg. Stem girth of the treatment	Nem count/g root
1	MeBr fumigation	34.80 bc	1.87 cd	13.93 bc	5.24ab	0
2	TW 1/1 layer	58.00a	4.74a	26.935a	6.17ab	0
3	TW 1:1 Mixture	40.43 b	2.42 b	16.965 b	6.45a	0
4	PH 1/1 layer	25.93 c	1.00 d	10.4 c	4.22 b	0
5	PH 1:1 Mixture	34.47 bc	2.19 bc	13.93 bc	5.32ab	0
6	Control	30.95 bc	1.39 cd	12.75 bc	4.52 b	7
		LSD5%=10.96	LSD5%=1.05	LSD5%=5.43	LSD5%=1.72	

Nematodes survived in the nursery bags only in the case of untreated control. Thus, all the test materials were seen to have the same nematicidal effect as MeBr.

Tea waste in 1/1 layer arrangement exhibited the highest growth boosting effect in terms of plant height, total number of leaves and unaided lateral branching. Tea waste in 1:1 mixture came next in relation to growth boosting effect, though not statistically significantly different from the untreated control. Paddy husk in 1/1 layer arrangement retarded the growth though not statistically significantly different from the untreated control. Paddy husk in 1:1 mixture imparted better growth though not statistically significantly different from the untreated control.

TABLE 29 Assessment of shrinkage of the medium at 7 months

No.	Treatment	Avg. column height of nursery medium (cm) (Original column height = 20 cm)	% sinking of the medium
1	MeBr	19.37a	3.15%
2	TW1/1 layer	17.615c	11.93%
3	TW1:1Mixture	19.22ab	3.90%
4	PH1/1 Layer	18.72abc	6.40%
5	PH 1:1Mixture	18.095b	9.53%
6	Control	19.785a	1.08%

LSD5% = 1.124

There was no statistically significant difference in shrinkage between the untreated control and MeBr treated. Tea waste in 1/1 layer treatment exhibited the highest amount of shrinkage of the nursery bag medium (11.93%) though not statistically significantly different from tea waste in mixture, paddy husk in layer arrangement and paddy husk in mixture.

Thus, it can be inferred that tea waste in 1/1 layer arrangement is the best treatment, provided that sinking after planting can be eliminated. Follow up studies in the form of experiment No. MeBr 35a (reported below) will yield conclusive observations in due course.

S.I. Vitarana, H.M.U.B. Herath, P. Udumulla, B. Sureshkumar

N-359 (MeBr 36): To study the alternatives to rehabilitation for eradication of nematodes in mature clonal tea fields in mid-country estates 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 Nematicur @ 3g/bush – repeated in 6 month intervals for 3 times
- T4 Neemazal 1%TS @ 1 lt. of 1% Neemazal in 600lt/ ha.

No. of replicates – 02

No. of plants per replicate – Approximately 650

Design – RCBD

Clone – TRI 2025

Initial soil sampling was carried out. The results are given in Table 30.

TABLE 30 *Nematode analysis of soil*

Plot No:	Treatment	Nem Count <i>P. loosi</i> /100g Soil	Nem Count <i>R similis</i> /100g Soil	Nem Count <i>R. reniformis</i> /100g Soil
1	T3	0	0	7
2	T1	0	0	23
3	T2	2	0	08
4	T2	0	0	08
5	T3	0	0	0
6	T4	0	2	0
7	T4	0	2	0
8	T1	0	0	02

The experiment is in progress.

S.I. Vitarana, H.M.U.B. Herath, G.P. Udumulla

N-360 (MeBr 37): Diyagama East Estate, Diyagama

TABLE 31 *Comparison of treatments at 8 ½ months (average of 45 plants)*

Treatment	Plant Height (mm)	Plant Girth (mm)	No. of Leaves Per Plant	No. of Lateral Branches	Occurrence of Banji %
T ₁ - Coir Dust	214.00	3.47	10.08	2.51a	42.22
T ₂ - Coir dust: Soil (1:1)	228.33	3.93	9.26	1.89 b	53.33
T ₃ - Soil / Coir dust in Layers	201.00	3.60	9.70	2.23ab	42.22
T ₄ - Paddy Husk: Soil (1:1)	255.67	4.00	10.38	2.24ab	26.66
T ₅ - Untreated Control	189.00	3.53	8.07	1.96ab	35.55
T ₆ - Basamid	169.00	3.50	7.04	1.73 b	40.00
LSD _{5%} =	NS	NS	NS	0.60	NS

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

N-363 (MeBr 40): Handford Estate, Deniyaya (System 1A)

Soil solarization as a substitute for MeBr to eradicate nematodes in tea nurseries

Assessments carried out:

1. Vacancies counted – after 10 weeks from planting
2. Fully open leaf count – after 12 weeks from planting
3. Growth assessment from 3 months Plant height / stem girth; Total No. of leaves / No. of side branches, Active/ Bangi plucking points (sample size – 15 plants)

4. Growth assessment on 14/11/2000 from 6 months planting

TABLE 32 *Comparison of treatments at 3 months with reference to growth parameters (mean of 180 plants)*

Treatment	Plant height (mm)	Plant girth (mm)	No. of leaves per plant	Occurrence of banji (%)
T ₁ - Urea + 6 weeks S.S.	172.40ab	2.65	3.67ab	58.93
T ₂ - Urea + 8 weeks S.S.	149.12ab	2.70	3.17ab	61.10
T ₃ - 8 weeks S.S. only	160.37ab	2.58	3.67ab	67.77
T ₄ - Basamid	139.85 b	2.67	3.00 b	70.00
T ₅ - MeBr	179.90a	2.80	4.00a	74.43
T ₆ - Control	154.00ab	2.67	3.33ab	70.00
LSD _{5%} =	37.39	NS	0.86	NS

TABLE 33 *Comparison of clones at 3 months (mean of 540 plants)*

Treatment	Plant height (mm)	Plant girth (mm)	No. of leaves per plant	Occurrence of banji (%)
C ₁ =TRI 2026	225.64a	2.98	4.33a	63.71
C ₂ =TRI 2025	092.90 b	2.38	2.61 b	70.37
LSD _{5%} =	19.01	NS	2.37	NS

TABLE 34 *Comparison of treatments at 6 months with reference to growth parameters (mean of 180 plants)*

Treatment	Plant height (mm)	Plant girth (mm)	Total No. of leaves per plant	No. of lateral branches	No. of leaves on lateral branches	Occurrence of banji (%)
T ₁ - Urea + 6 weeks S.S.	397.67 b	3.85 ab	13.38 ab	1.18 ab	3.17 ab	57.78
T ₂ - Urea + 8 weeks S.S.	335.83 c	3.47 bc	11.37 bc	0.90 b	2.23 b	67.78
T ₃ - 8 weeks S.S. only	324.33 c	2.98 c	11.77 abc	1.00 b	2.63 b	58.89
T ₄ - Basamid	407.83 a	3.63 b	12.07 abc	1.30 ab	3.20 ab	64.44
T ₅ - MeBr	458.17 a	4.45 a	14.32 a	1.52 a	4.43 a	54.44
T ₆ - Control	269.67 c	2.93 c	10.22 c	0.77 b	1.75 b	66.67
LSD _{5%}	58.18	0.66	2.8	0.36	1.68	NS

The studies show that the nematicidal effect of treatments can be seen in 6 months.

TABLE 35 *Nematode analysis at 6 months (mean of 180 plants)*

Treatment	Mean shoot weight (g)	Mean root weight (g)	Nematode count in root	Nematode count in soil
T ₁ - Urea + 6 weeks S.S.	12.50 b	3.83	0	0
T ₂ - Urea + 8 weeks S.S.	11.98 c	3.25	0	0
T ₃ - 8 weeks S.S. only	09.78 d	2.68	0	1.17
T ₄ - Basamid	12.80 b	2.88	0	0
T ₅ - MeBr	14.12 a	3.40	0	0
T ₆ - Control	08.25 e	2.03	1.17	4.33
LSD _{5%} =	0.63	NS	NS	NS

TABLE 36 *Comparison of clones at 6 months (mean of 540 plants)*

Clone	Plant height (m m)	Plant girth (m m)	No. of leaves per plant	No. of lateral branches	No. of leaves on lateral	Occurrence of banji (%)
C ₁ =TRI 2026	408.28	3.80	13.22	1.27	3.47	49.63
C ₂ =TRI 2025	322.89	3.31	11.15	0.95	2.33	73.70
LSD _{5%} =	85.44	0.16	NS	NS	NS	NS

TABLE 37 *Nematode analysis at 6 months (mean of 540 plants)*

Clone	Mean shoot weight (g)	Mean root weight (g)	Netmatode count per 1 g root (n+1)	Netmatode count per 5g soil (n+1)
C ₁ =TRI 2026	13.18	3.69	0.00	0.67
C ₂ =TRI 2025	09.96	2.34	0.39	1.17
LSD _{5%} =	0.97	NS	NS	NS

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

N-378 (MeBr 47): To study the alternatives to rehabilitation for eradication of nematodes in the nurseries in mid-country estates, Westhall Estate, Kataboola (2000)

One experiment to test the efficacy of neem formulation to eradicate nematodes in infested nurseries was initiated in December at Westhall Estate.

Treatments:

- T1 Neemazal 1%TS - 3ml/Lt dilution - 30ml/Plant
 T2 Multineem - 3ml/Lt dilution - 30ml/Plant
 T3 Multineem - 6ml/Lt dilution - 30ml/Plant
 T4 Neemazal 1%TS - 6ml/Lt dilution - 30ml/Plant
 T5 Nematicur - 2g/Plant
 T6 Untreated control

All treatments were scheduled to be repeated at 6 week intervals for 3 applications.

No. of replicates - 03

No. of plants/ Replicate - 200

Design - RCBD

S.I. Vitarana, H.M.U.B. Herath, G.P. Udamulla

N-382 (MeBr 51): Testing of the nematicidal effect of soil solarization when used in combination with soil substitute and chemical nematicides.

Handford Estate, Deniyaya (2000)

One experiment was established in December to test the efficacy of combinations of soil substitutes and soil solarization on nematodes.

Treatments:

- T1 TW + SS₁ + M
 T2 TW + SS₁ + D
 T3 TW + SS₁ + Nz
 T4 TW + SS₂ + M
 T5 TW + SS₂ + D
 T6 TW + SS₂ + Nz
 T7 PH + SS₁ + M
 T8 PH + SS₁ + D
 T9 PH + SS₁ + Nz
 T10 PH + SS₂ + M
 T11 PH + SS₂ + D
 T12 PH + SS₂ + Nz

TW = Bed having Tea Waste (1:1)

PH = Bed having Paddy Husk (1:1)

SS₁ = Prior to mixing – solarization ½ load soil only, thereafter mix with substitute material and bag the mixture

SS₂ = Mix the soil and the substitute material, bag the mixture and thereafter solarization

M = ½ doze Metam
D = ½ doze Dazomet
Nz = Neemazal (Normal doze)

No. of Plots - 36
No. of plants per plot - 250
Total No. of plants – 9000
Design – Split Plot Design

This experiment is in progress.

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

MeBr 35a & 34a: Follow up study of MeBr 34 and 35
Kellabokke Estate, 2000 New Clearing Block, Madulkelle,
(July 2000)

Nursery plants of the experiments MeBr 34 and 35 were transferred in October to field plots in a paired plot design with following as the basal treatments:

BT1 – Planting hole filled with 01kg of tea waste + 10g Nema-cur

BT2 – Planting holes receive only 10g of Nema-cur (the standard treatment).

This experiment is in progress. The first nematode assessment is scheduled for March 2001.

S.I. Vitarana, H.M.U.B. Herath

D 18- Management of the up-country live wood termite

E-298: Use of termiticides in controlling the up-country live wood termite, *Postelectrotermes Militarisis*: Moray Estate, Valladollid Division, Field No. 2B & Geddes Division, Field No.2A.

Treatments:

T1	Admire	@ 6.25 l/ha
T2	Mosphilan	@ 750 g/ha
T3	Admire	@ 3.1 l/ha
T4	Mosphilan	@ 375 g/ha
T5	Untreated control	nil

After completion of 6 post-treatment assessments over a period of 9 months, the experiment was terminated. The first 3 assessments were done at monthly intervals while the remaining was done at bi-monthly intervals. The treatment effect on the termite population is plotted, as the number of live termites in Figure 5 below.

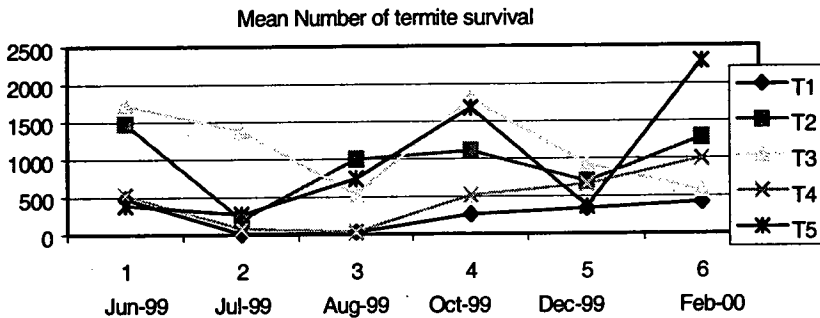


Figure 5

The above graph shows that the T1, Admire at higher dosage has always given a considerable control of the population compared to the other treatments. However, the treatment effects are not significantly different from each other.

L.D. Amarasinghe, S. Walgama, A. Abeyssekara, P. Darmalatha, M. Jayatilake

D 19 Pest ecology and management with special reference to live-wood termites in the low-country

D 19.1 Clonal Resistance as a component of IPM

LE-80(a):

Bio-assay of test clones with TRI 2023 as the standard and using dry powder of stem material was carried out adopting the '4-channel perspex olfactometer' and testing 4 clones at a time. Six replicates were run simultaneously. The following clones are being tested: 4036, 4049, 4046, 4070, 4042.

The study is in progress.

S.I. Vitarana, S. Samarasinghe, B.S.N. Vithana

D 19.2 Field assay of TRI 4000 series in relation to infestation by SHB (Sites: Deniyaya, Hapugastenna and Watapotha)

Field infestation levels and the degree of damage (in terms of gallery length & length of the wood rot in association with the gallery) were assessed. In summary, the clones could be rated as given below:

Clone	Galleries per cm x 100
TRI 2023	0.78
TRI 4059	4.36
TRI 4002	6.22

Clone	Galleries per cm x 100
TRI 4070	7.46
TRI 4052	7.52
TRI 4049	8.37
TRI 3025 (std.)	9.75
TRI 4071	14.71
TRI 3041	14.95

The findings of this study corroborated the results of the bio-assays of B29.2 by showing that TRI 4052 and 4049 are highly susceptible. They are as highly susceptible as the TRI 3025 (of known susceptibility). TRI 4071 and 3041 are even more susceptible. (Clone 3041 has shown this degree of susceptibility after several cycles of growth in the field in the low-country).

S.I. Vitarana, K.M.A. Malkanthi (University of Ruhuna), S.M. Samarasinghe

D 19.3 Study of the influence of Host Plant Volatiles on the Colonization of Tea by LCLWT (Work based on a study leading to M.Phil on LCLWT)

LE-80: Identification of biologically active compounds which act as attractants and repellents of termite susceptible, resistant tolerant clones

Preliminary studies revealed that tea volatiles methyl salicylate, E-2 hexenal, geranial, linalool and phenyl acetaldehyde showed positive attractancy to the LCLWT.

Diet studies showed that wood rotted stems of susceptible clones were more palatable to termites than from immune clones and their feeding activity was increased when fed on wood-rotted material from susceptible clones.

Tea plants already damaged by LCLWT (infested wood) wood rotted stems and dead wood of susceptible tea clones were shown to be the main source of volatiles that attract termite *G. dilatatus*. In addition, non-volatile compounds of susceptible clones were shown to be attractive to termites.

Termite behaviour also showed significant negative curvilinearity with dichloromethane extract of rotted wood as against the immune clone TRI 2016 and the methanol and hexane extracts of TRI 3041 clonal rotted wood. Hexane and methanol extracts of rotted wood of moderately susceptible clone TRI 3014 did not show significant curvilinearity, but the dichloromethane extract showed negative curvilinearity. Therefore, it could be concluded that termite repellants are present in the dichloromethane extract of TRI 2016 and TRI 3014 and the methanol and hexane extract of TRI 3041.

Bio-assays of extracts of rotted wood and infested wood of TRI 2023 and rotted wood of TRI 3063 revealed that termite behaviour is highly correlated with the concentration of hexane and dichloromethane extracts of rotted wood of TRI 2023 and dichloromethane and methanol extracts of rotted wood of TRI 3063.

Of the 13 VLC fractions of tea clones TRI 2023 and TRI 3063, 3rd, 5th, 8th, 9th, 10th, 12th and 13th showed significant attractant to termites.

The attractancy of the 1st, 13th, 14th and 15th MPLC fractions of the combined 8th, 9th and 10th VLC fractions of tea clone TRI 2023 was significant compared with control. Olfactometric analysis of MPLC fractions of the 5th VLC fractions of tea clone TRI 2023 showed the presence of both attractants and repellants in the 5th VLC fraction. The identification of the biologically active compounds present in these extracts will be important.

S.M. Samarasinghe

Bio-Assay Work

List of Clones (final list) of Plant Breeding Division which was given as 'US' (under study) were observed for termite attractiveness.

Clone No.	Estates / Significant Level (P=0.001 – High attractive, P=0.001 resist, high resist at 1% level)
DG 39	Kottawa / P<0.001; Watapotha / P<0.001; Diyadawa / P<0.001
KEN 16/3	Hapugastenne / P<0.001; Kottawa / P<0.001; Talangaha P<0.005 Noragalla / P<0.001; Watapotha / P<0.001
TRI 4059	Hapugastenne / P<0.001; Watapotha / P<0.001; Diyadawa / P<0.001
TRI 4085	Kottawa / Not Significant (NS)
TRI 4071	Kottawa / P<0.001; Diyadawa / Resistant at 5% level
S 106	Kottawa / P<0.005; Noragalla / Resistant at 5%, St. Joachim / P<0.001
TRI 4053	Kottawa / Not Significant
TRI 4006	Kottawa / P<0.001; Diyadawa / P<0.001
TRI 3015	Talangaha / P<0.001; St. Joachim / P<0.001
CY 9	Talangaha / P<0.001; St. Joachim / P<0.001
DG 7	Noragolla / P<0.001
TRI 3051	Watapotha / P<0.001; St. Joachim / P<0.001
TRI 3020	Watapotha / P<0.001
TRI 4079	Diyadawa / P<0.001
TRI 4034	Diyadawa / P<0.001
TRI 4078	Diyadawa / P<0.001 High Resistant
TRI 3073	St. Joachim / P<0.001
TRI 3072	St. Joachim / P<0.001

S.M. Samarasinghe

Management Soil Dwelling Ants - Deniyaya Ant, *Acropyga acutiventris*

D 20 Identification of safe insecticides, acaricides and designing of IPM methods for control of seasonal pests of tea

E-301: Screening of safe insecticides to control tea tortrix in the up-country area –Waltrim Estate, Lindula, Maria Division, Field No.2

A randomized block trial has been started in order to identify promising chemicals for control of tea tortrix. Pre-treatment samples were taken and the following treatments have been allocated:

1. Cascade 200 ml/ha
2. Rimon 500 ml/ha
3. Mimic 750 ml/ha
4. Aum Neem
5. Runner (RH 2485) 520 ml/ha
6. Neemazal 1000 ml/ha
7. Untreated control

Four post-treatment samples were taken at weekly intervals. The results were inconclusive. Heavy rains interrupted the dry weather after the treatments and a crash down of population was evident. Treatment effect therefore could not be evaluated.

A study was also carried out to determine the efficacy of parasitism of tea tortrix by *Macrocentrus homonae*. The hyperparasitism was found to be 33% and an unsuccessful emergence due to diseases was 17%. Thus, hyperparasitism (33%) and other causes (17%) contributed to 50% of the unsuccessful emergence of *Macrocentrus*. This clearly indicated that the efficacy of the exotic parasite had come down on account of hyperparasitism.

This finding was published in the Proceedings of the Twentieth Annual Session of the Institute of Biology, Sri Lanka.

S.I. Vitarana, S. Walgama, A. Abeysekara, M. Jayatilake, P. Dharmalatha

E-302a: Screening of safe insecticides to control tea tortrix in up-county area St.Coombs Estate, Field No.5

1. Cascade 200 ml/ha
2. Rimon 500 ml/ha
3. Runner (RH 2485) 520 ml/ha
4. Safer 135 ml/ha
5. Neemazal 1000 ml/ha
6. Untreated control

An up-replicated block trial has been initiated in order to compare the efficacy of new chemicals for tea tortrix control.

One pre-treatment assessment and four post-treatment assessments were carried out and results will be analysed. The promising chemicals will be subjected to a properly designed experiment.

S.I. Vitarana, L.D. Amarasinghe, S. Walgama, A. Abeysekara,
P. Dharmalatha, M. Jayatilake

E-302b: Eildon Hall Estate, Lindula, Field No. 11 and 13

A randomized complete block trial has been initiated to screen new chemicals for their efficacy in controlling tea tortrix. Following treatments have been allocated.

1. Cascade 200 ml/ha
2. Rimon 500 ml/ha
3. Mimic 750 ml/ha
4. Multineem 5000 ml/ha
5. Runner (RH 2485) 520 ml/ha
6. Neemazal 1000 ml/ha
7. Safer 135 ml/ha
8. Untreated control

Four post-treatment assessments were carried out at weekly intervals. The results are due for analysis.

S.I. Vitarana, R.S. Walgama, A. Abeysekara, P. Dharmalatha, M. Jayatilake

In addition, two types of tea tortrix pheromone formulations supplied by the Tri Folio-M GmbH have also been tested for their efficacy in trapping tortrix moths. These are given below:

Homona coffearia – 5 mg

Homona magnanima – 1 mg

These two types in rubber dispensers have been compared with the old tortrix pheromone in hollow fiber formulation for their efficacy in trapping moths.

This trial also used to compare the efficacy of a new moth trap supplied by the same company in trapping moths, which has been made out of plastic. Comparison will be done in relation to delta type aluminium trap (TRI traps). These trials are in progress.

S.I. Vitarana, A. Abeysekara, P. Dharmalatha, M. Jayatilake, S. Walgama

Non-availability of 'Birds tangle foot' adhesive for usage in the traps prompted to test various other compounds that are cheaply available locally. The following compounds/mixtures have been tested for their persistence in the field:

1. Grease
2. Starplex 2 (Premium automotive wheel bearing and chassis grease)
3. Starplex 2 + Castor oil (10:1 and 20:1 ratios in w/w/basis)
4. Starplex 2 + Binder gum (3:1, 5:1 ratios in w/w/basis)
5. Beehoney + Bee was + Grease

Results indicated that Starplex 2 in isolation and Starplex with binder gum in both ratios have shown a good persistence in the field for a little over one month. The rainy weather did have an effect. The mixture has to be replaced in 3 weeks if rain interferes. Starplex with Castor oil did not give satisfactory results in terms of its persistence in the field. Bee wax got hardened and its adhesive qualities were lost immediately.

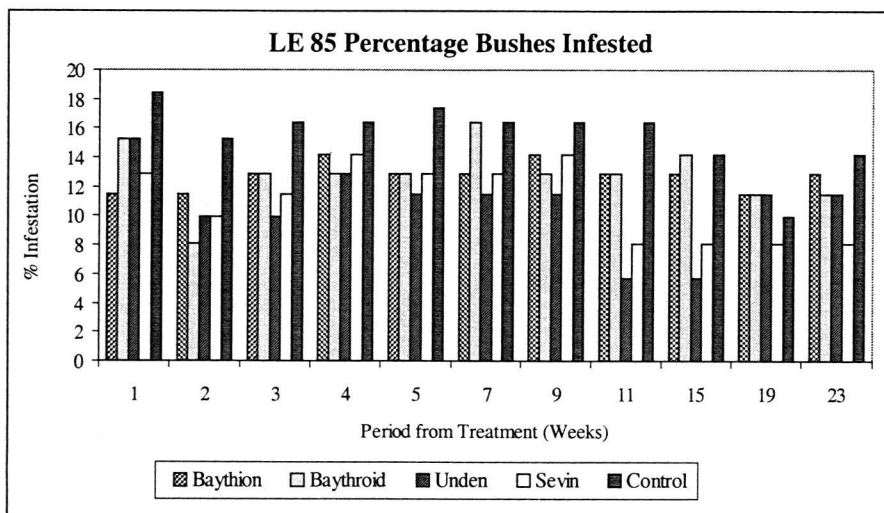
S.I.Vitarana, P. Dharmalatha, A. Abeysekara

LE-85: Insecticidal trial on Deniyaya Ant
Tea smallholding, Pasgoda, Deniyaya

Location – Pothuhalgoda Estate, Age of the plants – 8 years, Experiment – Design RCBD, No. of Replicates – 3

- T₁- Baythion 3% @ 1.8 kg/ha
T₂- Baythroid 20% @ 500ml/ha
T₃- Uden 1% @ 2.0kg/ha
T₄- Sevin 85% @ 1.2l/ha
T₅- Untreated Control – Plain water

Uden and Sevin treated plots had the lowest numbers of infested bushes as time passed. The experiment is in progress.



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

Management of Scavenging Termites on tea lands - Screening of chemical termiticides to manage Scavenging Termites

ME-5: Screening of safe insecticides to manage scavenging termites in the mid-country-Hagalle Estate, Field No 5C & 12, Madulkelle (January in 1997)

A new termiticide, fiprinol ('Regent 50SC') was compared @ 3.5 liter per ha, with chlorpyrifos ('Dursban 40 EC' @ 2 l/ha) and imidachloprid ('Admire SL 200') @ 2 l/ha in randomized complete block design.

The experiment is in progress.

S.I.Vitarana, S.Abeysinghe, B. Sureshkumar, H.M.U.B. Herath, T. Yatawatte

ME-6: Screening of insecticides to manage scavenging termites in the mid-country area – Duckwari Estate, Loolgama Division, Field No. 10 (2000).

Experimental Design: RCBD

No. of replicates: 3

Treatments:

- T1 Prince GR (Granular Formation of Fipronil) @ 30kg/ha
- T2 Regent SC (liquid 50g/L suspension concentration) @ 23.5L/ha
- T3 Regent SC (liquid 50g/L suspension concentration) @ 2.01/ha
- T4 Untreated Control

Monthly assessments are in progress.

S.I. Vitarana, S. Abeysinghe, B. Sureshkumar, H.M.U.B. Herath

ME-7: Screening of new acaricidal formulations on mites. Hantane Estate Field No. 5A/B

Experimental Design: RCBD

No. of replicates: 3

Treatments:

T1 Sunspray oil (Superior petroleum oil 98.6%) 2000ml/ ha

T2 Neemazal 1% 1000 ml/ ha

T3 Sulpher 8g/l

T4 Water 1000l/ ha.

Four weekly assessments were completed and counting of mites is in progress.

S.I. Vitarana, S. Abeysinghe, B. Sureshkumar,
A. Abeysikara, Padmini Dharmalatha

Survey on the occurrence of Pink Mite in mid-country tea estates

Following estates were checked for the presence of pink mite:

1. Rothschild Estate **
2. Mooloys Estate **
3. Kellabokke Estate
4. Rangala Estate
5. Duckwari Estate
6. Goomara Estate
7. Hagalla Estate
8. Hantane Estate

** Estates in which infestations of pink mite were encountered.

S.I. Vitarana, S. Abeysinghe, B. Sureshkumar, D. Pallemulla, H.M.U.B. Herath

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. The predatory mite, *Amblycius cucumeris*, could be recovered from the blocks. No outbreak of red spider mite was encountered. Early signs of outbreak were seen twice during the course of the year, but the mites disappeared as soon as they appeared. Red Spider counts are very low, indicating that the predatory mites are active in the field. In these blocks, *Amblycius cucumeris* was encountered in the samples in February.

E-273: Deverenside Estate, Rakwana (1997)

To study the effect of biological control of *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 outbreak after the 1995 introduction of the predators.

S.I. Vitarana, E.R. Perera, A.K. Prematunge, S.B. Vithana

Miscellaneous Studies**Identification of Insect Contaminants of Made Tea**

Samples of made tea exported to New Zealand and detected as having contaminants were referred to the TRI for identification.

Company	Identification
1. Dilmah– Ceylon Tea Services Ltd. (Storage pest)	A storage pest was identified as a Pscopteran of family – Liposelidae
2. Stassen Exports Ltd. (Storage pest)	A larval stage was identified as a Lepidoptera of family – Pyralidae

S.I. Vitarana, B.S.N. Vithana, S. Walgama, P. Dharmalatha

4.1 Staff Position

- Mrs. S.I. Vitarana continued to serve in the dual capacity of Head of the Entomology Division and the Officer-in-Charge of the TRI Low-country Station, Ratnapura.
- 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 involved in drawing up the Regulations for Plant Quarantine
 - Steering Committee of the ADB Tea Development Project
 - Chairperson of the Publication and Presentations Panel of the TRI

- Convenor/Secretary of the Consultative Committee on Estates and Advisory & Extension Services of the Tea Research Board.
- Mrs. S.I. Vitarana and Dr. (Mrs.) L.D.Amarasinghe supervised two research projects each. Dr.Keerthi Mohotti supervised final year research projects of M/s. A.R.Prathapasinghe, N.G.N.Rasangi (University of Ruhuna) and M.P.T.Premaratne (University of Peradeniya) and the industrial training of Mr.T.M.P. Madulakkana of Aquanas Agriculture College, Colombo.
- Dr. Keerthi Mohotti and Mrs. S.I. Vitarana served as members of the multi-disciplinary team nominated by the Director, TRI, to investigate into the problem of death of bushes in the Deniyaya area.
- Mr. M.M. Jayatilake started a one-year (part time) training on “Certificate Course in Laboratory Technology” at the Open University of Sri Lanka with effect from 7th December 2000.
- Ms. S.M. Samarasinghe was awarded M.Phil. Degree by the University of Peradeniya in August 2000.

4.2. Seminars, Conferences, Meetings, Workshops and Field Days

- Dr. Keerthi Mohotti attended the Sixth Annual Forestry and Environment Symposium 2000 on ‘Developments in Environmental and Forest Sciences in Sri Lanka 2000’ organized by Sri Jayawardenapura University and the Ministry of Forestry and Environment held in Kandy on 29-30 December 2000.
- Dr. Keerthi Mohotti attended the Seminar and Workshop on ‘The role of earth worms in organic agriculture and the preparation of vermicompost and vermiwash’ conducted by Dr. Sultan Ahamed Ismail in Kandy on 21, December 2000.
- Dr. Keerthi Mohotti attended the International meeting on ‘Microbiology of Composting and other biodegradation processes’ held in Innsbruck, Austria, on 18-20 October 2000. He made an oral presentation on ‘Development of nematode antagonistic potential in organic matter amended tea soils’ at the session on ‘Plant diseases and suppressiveness’.

Dr. Mohotti presented posters at the same meeting on:

- a) ‘Histopathology of tea roots infested with *Pratylenchus loosi* due to organic matter treatments’ at the session on ‘Plant diseases and suppressiveness’

- b) 'A way to solve a problem associated with organic tea soils in Sri Lanka' at the session on 'Special aspects on waste bio-treatment in developing countries and new market niches for composts'. During the visit, he also, visited small and large scale compost plants and waste dump and sewage-sludge composting plant for land filling in Austria.
- Mr.R.S. Walgama conducted a lecture and practical session on "Insect Pests & Mites of Tea" for Aquinas College Students at TRI, Talawakelle, on 14th & 15th March 2000
 - Mrs.S.I. Vitarana and Mr. R.S. Walgama conducted a communication session on "Hyperparasitism of Tea tortrix" at the 20th Annual Sessions of Institute of Biology at SLAAS, Colombo on 22nd September 2000.
 - Mr.R.S. Walgama conducted a lecture on "Insect Pests & Mites of Tea" for Undergraduates of Wayamba University at Talawakelle on 8th December 2000.
 - Mrs. S.I. Vitarana, Mr.R.S. Walgama, Dr. K.M. Mohotti attended the Regional Scientific Committee (RSC – I) [Nuwara Eliya] held at Talawakelle on 29th February 2000.
 - Mr. R.S. Walgama and Miss. R.D.P. Dharmalatha attended the workshop on "Insect Toxicology" at Horticultural Research & Development Institute (HORDI), Gannoruwa, conducted jointly by Post Graduate Institute of Science (PGIS), on 25th-27th April 2000.
 - Mr. R.S. Walgama attended the workshop on "Sampling Techniques, Survey Design & Analysis" held at PGIA, Peradeniya, conducted by PGIA, from 22nd to 26th May 2000.
 - Ms. S.M. Samarasinghe and Mr. R.S. Walgama attended the workshop on "Research Methods (Pure & Applied)" at the National Library Documentation Center, Colombo, organized by the NLDC, Colombo on 20th-21st July 2000.
 - Mr. R.S. Walgama attended the National workshop on "Scientific Writing" conducted jointly by the National Science Foundation (NSF) & Post Graduate Institute of Science (PGIS) at PGIS, Peradeniya, from 14th to 17th September 2000.
 - Mr. R.S. Walgama attended the workshop on "Physics & Mathematics for National Development" conducted by National Science Foundation (NSF) and PGIS at NSF Auditorium, Colombo, on 29th September 2000.

4.3. Publications

- Hunt, D.J. & Mohotti, K.M. (2000). *Hekarella talawakelae* gen. and sp. nov., a curious new genus and species of monogrant Carnoyidae (Nematoda: Rhigonematidae) from Sri Lanka. *Annales Zoologici* (Warszawa), 50(2): 239-246.
- Mohotti J., and Mohotti K. M. (2000). Growth and photosynthesis of field grown tea (*Camellia sinensis*) plants as affected by incorporation of organic soil amendments. Abstracts of papers presented at International meeting on Microbiology of Composting and other biodegradation processes, Innsbruck, Austria, 18-20 October, 2000, 16.
- Mohotti K.M., Bridge J., and Gowen S. R. (2000). Development of nematode Antagonistic potential in organic matter amended tea soils. Abstracts of papers presented at International meeting on Microbiology of Composting and other biodegradation processes, Innsbruck, Austria, 18-20 October, 2000, 16.
- Mohotti K. M. (2000). A way to solve a problem associated with organic tea soils in Sri Lanka. Abstracts of papers presented at International meeting on Microbiology of Composting and other biodegradation processes (poster), Innsbruck, Austria, 18-20 October, 2000, 39-40.
- Mohotti K. M., Gowen, S.R., and Bridge, J (2000). Histopathology of tea roots infested with *Pratylenchus loosi* due to organic matter treatments. Abstracts of papers presented at International meeting on Microbiology of Composting and other biodegradation processes (poster), Innsbruck, Austria, 18-20 October, 2000, 40.
- Samarasinghe, S.M. (2000). Influence of Host plant volatiles on the colonization of tea by the low-country live wood termite *Glyptotermes dilatatus* (Bugnion and Popoff). M.Phil Research Seminar presented at University of Peradeniya.
- Vitarana, S.I. (2000). Prospects of using Neem Products and Pheromones as Pest Control Tools and the Target Organisms in tea in Sri Lanka. Proceedings of the 9th Workshop on Practice Oriented Results on the Use and Production of Neem Ingredients and Pheromones. March 13-15, 2000.
- Vitarana, S.I. (2000). Bad News. Pink Mite in Sri Lanka. TRI Update Vol.5, No. 1, June 2000.

- Vitarana, S.I., Walgama, R.S., Abeysekera, A.R., Dharmalatha, R.D.P. and Jayathilake, M.M. (2000). Hyper-parasitism of Tea tortrix (*Homona coffearia* Nietner) Proceedings of the twentieth Annual Sessions of the Institute of Biology, held in Colombo, Sri Lanka, September 2000, 34.

4.4 Meetings of Internal and External Committees (those in which Divisional Staff participated)

- Pesticides Technical and Advisory Committee – 6 meetings
- Specialist Committee on Plant Protection appointed by CARP – 6 meetings
- Steering Committee on National Plant Quarantine to prepare Regulations for Plant Quarantine – 4 meetings
- Steering Committee of the ADB Tea Development Project – 7 meetings
- Publications and Presentations Panel – 19 Meetings
- TRB Consultative Committee on Estates and Advisory & Extension Services - 4 meetings

PLANT PATHOLOGY DIVISION

Acting Head - A Balasuriya

1. Applied Projects

PROJECT A-1.2 - Screening for resistance, Up-country

PP/POR1/98 - Screening of new clones for the resistance/susceptibility of 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 two and a half years' exposure of the five clones tested, TRI 2025, 4052 and 3072, in that order, are showing a high level of tolerance. The clone TRI 3057 was found most susceptible and TRI 2025 the least to poria root disease.

PP/BB3/99 - Selection of OST bushes for the resistance of 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 recommend to the Plant Breeding Division for inclusion in its breeding programme.

Frequent visits were made to this field during the year. A second round of selections was completed. The field was pruned by the estate in July and the labeling of about 75 bushes was completed.

A Balasuriya, N H L Pradeepa, J W K K Jayasundara, R M A Ratnayake

PP/POR1/00 - Screening of new clones for the resistance/susceptibility of 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 resistance/susceptibility to poria root disease (serialised activity)

This is the second of the series. The pit was ready with poria inoculum for the testing. A set of five (second since) clones obtained from the Plant Breeding Division, namely, TRI 2025, 3014, 4006, 4042 and 4046 (15 plants each, in three replicates) was planted.

A Balasuriya, R M A Ratnayake

PROJECT A-4.2 - Selection for resistance, Low-country**PP/MC1/00 - Selection of OST bushes for the resistance of 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.

The first round of selections was completed. About 110 bushes were earmarked from an area of about 6 ha. A repeat selection had to be effected as some of the stakes could not be traced due to termite attack. Presently, about 60 selected bushes require further observations.

A Balasuriya, N H L Pradeepa, J W K K Jayasundara, R M A Ratnayake

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

Three saprophytic organisms (fungi), *Trichoderma* sp., *Penicillium* sp. and *Aspergillus* sp., were collected for testing against *Poria hypolateritia*.

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.

Attempts were made to collect VAM in association with different clones maintained by the Loolecondera Estate in a clonal multiplication block. The 12 samples collected did not yield the expected results. All of them recorded very low spore and infection counts, probably due to recurrent damage by wild animals (pigs).

The Organic Tea experiment (Nematology) in Field No. 3 of St. Coombs Estate was also sampled for VAM (spore counts and root infections). Only the 'Neem oil cake' and 'tea waste' amended soils recorded reasonable counts of spores (>400/100g of soil).

A Balasuriya, R M A Ratnayake

PROJECT A-23.3 - VAM as a nutrient improviser and an IPM tool

Objective: To confirm the preliminary findings in which mycorrhizal treatments improved P utilization efficiency and to test the degree of tolerance VAM could impart to the young tea root systems against early-field-establishment problems.

Forty cement pots have been kept in readiness for the pot experiment.

2. Supportive Projects

PROJECT D-21 (D/LEAFDC) – Control of Leaf Diseases

The Scanning Electron Micrographs of blister blight infections were studied, with the help of the Botany Department, Faculty of Science, University of Colombo. It was evident from these photographs that the blister spore producing basidia liberally emerge from the stomatal openings (underside). This finding is contrary to the earlier belief that they mainly penetrate the lower epidermis of the tea leaf.

A Balasuriya, N H L Pradeepa

PROJECT D-22 (D/STEMDC) – Control of Stem Diseases

Wood Rots

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.

This trial was visited at regular intervals to effect the required treatments.

PP/WRG1/99 - Replicated experiment to assess the effect of different protective paints in reducing the extent of wood-rot, St. Coombs Estate - Field 8

Objective: Since pruning cuts serve as one of the focal points in wood rotting, different protective paints were used to establish a suitable method to quantify such decay under different treatments.

Trial was maintained with periodic spraying of fungicides against blister blight. The bushes were marked with permanent labels.

A Balasuriya, J W K K Jayasundara

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

Objective: It has been suggested that K plays an important role in the wood matrix by resisting the decay of wood frame due to the involvement of natural microorganisms. The study seeks to assessing this phenomenon by using an already available trial of the SPND where different levels of K is being maintained.

The initial round of assessment was concentrated on three selected treatment combinations namely, $N_2K_1Mg_2$, $N_2K_2Mg_2$ and $N_2K_3Mg_2$. Two branches (snags) each of ten bushes were measured in each plot of the three replicates. With the increasing level of K in the treatment, there was a steady decline in the volume of dead wood snags at pruning cuts *i.e.* 2.68, 1.68 and 1.38 cc respectively, the two extremes being significantly different (Table 1). A full assessment of the trial is pending.

TABLE 1 *Effect of the levels of 'K' on the volume of wood rotting in the pruning cut ends*

Treatment	Decay volume (cc)
$N_2K_1Mg_2$	2.66 a
$N_2K_2Mg_2$	1.68 ab
$N_2K_3Mg_2$	1.37 b

A Balasuriya, N H L Pradeepa, J W K K Jayasundara, R M A Ratnayake

PROJECT D-24 (D/PNDC) – Control of Phloem Necrosis Disease

Objective: Being the only known virus related disease, this did not receive priority until lately due to its limited spread. It is now intended to identify the causal organism with certainty with the objective of recommending appropriate remedial measures.

Two year old plants were raised in pots, using infected cuttings from St. Coombs Estate. These are already showing typical symptoms of PN. They are intended for Electron Microscopic studies in collaboration with Universities and related Institutions.

PROJECT D-25 (D/MISCEL) - Miscellaneous Activities

Microbial contamination of made tea

Objective: In the recent past, there have been numerous queries on the incidence of microbial contaminations in made tea. Since no standards have so far been established, the objective here is to monitor over time the moisture build up and the associated microbial contaminants.

All the 24 tea chests were opened up for microbial assessments in 12 rounds. At the last sampling, about one year since commencement, it recorded a moisture level of 7.89% (an increase from 4.66%), with a fruity taste. A considerable reduction of bacterial colonies was observed at the end of one year (from 4000 to 46). Colony reduction in fungi was from 400 to 21 for the same period. The only increase was seen in the number of yeasts colonies (from 100 to 341) (Table 2).

TABLE 2 Overall performance of made tea in storage in relation to total microbial count and percent moisture per gramme dry matter

Attribute	Initial	1 month later	6 months later	1 year later
Bacteria	4000	650	591	46
Yeasts	100	50	25	341
Fungi	400	83	33	21
Total microbes	4500	783	649	408
Moisture	4.66	→	→	7.89

Three isolates of organisms collected from made tea were sent to IMI for identification. One of them was tentatively identified as *Geotrichum candidum* Link., a member of the Ascomycete in the order Endomycetales. The presence of different microbes is presented in Figure 1.

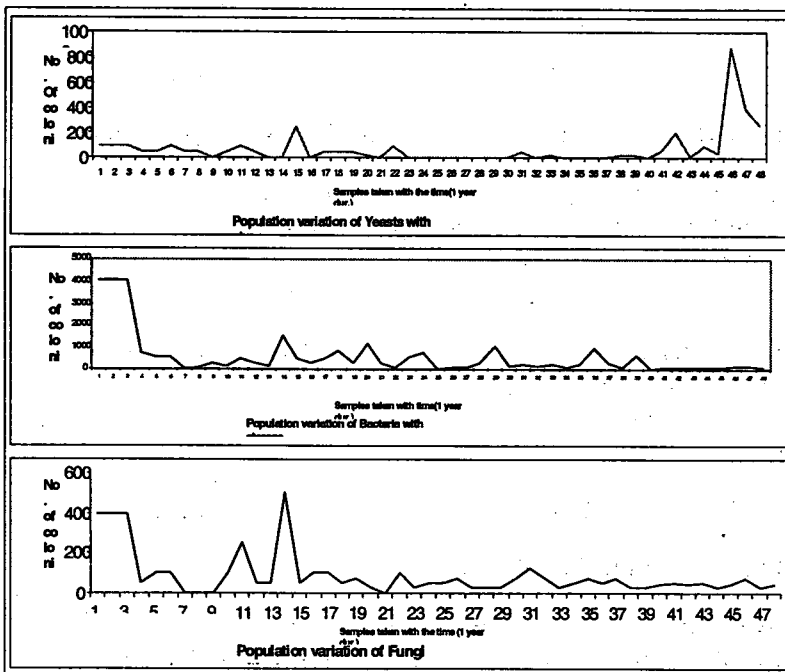


Fig 1. Population variation of microorganisms with storage (over a period of one year)

A Balasuriya, J W K K Jayasundara

High Forest problem

Objective: To understand the exact nature of the problem and to propose remedial measures

Several attempts were made to collect plant sap. The sap collected from affected and unaffected bushes were used as inoculum on TRI 2025 plants raised in pots in the glass house.

Microtome sections of diseased plants indicated necrotic spots in the vascular system (xylem tissues). They were also found to be brittle and dry compared with healthy tissues.

An observational trial to study the effect of 'Plantomycin' (commercial streptomycin+tetracyclin) sprays was commenced. After four rounds of spraying (0.67 & 1.0 g/l), no significant effect was found on the treated plants.

Prof. JMRS Bandara of the Faculty of Agriculture, University of Peradeniya, was invited to visit infected fields in Nuwara Eliya Estate and to make his observations. He confirmed our earlier observations that the problem is not primarily of pathogenic origin. This is probably due to physiological and senescence factors.

Leaf surface micro-organisms

Objective: To understand the composition of naturally occurring leaf surface microorganisms and their contribution towards final made tea quality

An enumeration of the organisms was done using clones (2nd leaf) TRI 2023, 2025, DT1 & N2. It was observed that there are more bacteria present than yeasts and other fungi. DT1 recorded the highest number of yeast and other microbial colonies. Incidence of some of the microbes (pink & yellow yeasts) was more during drier periods than in wet ones. Different growth media (PDA, CDA, Yeast Extract and several other modified media) were tested for the growth of yeast. Yeast grew better on CDA medium.

Pink yeast was sprayed in a seedling field in Haputale Estate. There were 4 treatments (46,000 cells/ml, 23,000 cells/ml, sugar solution at 0.05% and the control). The flush was harvested about 9 days after treatment and processed. The yeast concentration at 23,000 cells/ml and the control yielded highest numbers (in excess of 3000/g) of microbial counts following processing, but no residual pink yeast was found. However, the biochemical tests did not reveal any quality differences among treatments. It was decided to repeat this experiment in St. Coombs Estate.

Recalibration of spray volumes

Objective: Reservations have been expressed on several occasions about the spray volumes used in the control of blister blight leaf disease. India is presently using a rate of 250 l ha⁻¹. It is intended proposed to clarify this situation.

Preliminary rounds of spraying confirmed that about 250 l of spray volume is required to spray a hectare of tea in plucking and tea recovering from pruning. It is now proposed to be corroborated in a proper disease control trial using different fungicides.

A Balasuriya, J W K K Jayasundara

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 is causing a smut of its panicle, the situation is considered favourable for 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 controlling tool.

Twelve beds were prepared for a field trial, isolating them from the rest of the land area, using (roof) tiles. They will serve as the basis for an *in situ* experiment for the control of *P. repens*.

Horse Hair Blight (HHB)

Objective: It is well known that HHB causing fungus is an epiphyte, not capable of causing any disease on the tea bush. Since of late, its incidence has been pronounced, causing concern among growers in the low-country districts. Therefore, it is intended to start a series of experiments to investigate whether any direct damage is caused by the organism and also to undertake possible control measures using fungicides to mitigate such incidence.

An area was located in Kirinda, Nagoda, for the control of Horse Hair Blight (HHB). The trial was started in October, the treatments being the application of hydrated lime, Systemic fungicide (Propiconazole) and Copper fungicide (Copper Hydroxide).

- Treatments :-
1. Stem pieces only
 2. Leaves + small stems (attached)
 3. Fungal mycelium only
 4. Stems + Fungal mycelium
 5. Leaves + small stems (attached) + Fungal mycelium

TABLE 3. *Comparison of moisture loss percentages between different treatments*

Treatment Comparison	Difference between means	Significance level
1-2	-0.5390	.001
1-3	0.1017	ns
1-4	-0.1860	ns
1-5	1.7652	.001
2-1	0.5390	.001
2-3	0.6407	.001
2-4	0.3530	ns
2-5	2.3043	.001
3-1	-0.1017	Ns
3-2	-0.6407	.001
3-4	-0.2877	ns
3-5	1.6635	.001
4-1	0.1860	Ns
4-2	-0.3530	Ns
4-3	0.2877	Ns
4-5	1.9512	.001
5-1	-1.7652	.001
5-2	-2.3043	.001
5-3	-1.6635	.001
5-4	-1.9512	.001

A parallel *in vitro* experiment was initiated to study whether there is any direct influence by the fungus in further dehydrating tissues (stems and leaves) of the tea bush. All the treatments were replicated three times and the weight losses (moisture) were recorded every three days. This trial had to be repeated and the results of the second is summarised in Table 3.

The most significant observation is the very highly significant differences noted between treatment numbers 2 and 5. An additional contribution to the percentage water loss could have been effected by the presence of fungal mycelium attached to the leaves and small stem pieces. Therefore, it could be suggested that although the fungus (*Marasmius equicrinus*) is not saprophytic, it may contribute positively to the stress condition faced by the tea bush under unfavourable conditions.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake

Tea cider

Objective: 'Kombucha fungus' has potential to yield an alcoholic beverage of about 1% strength. It is therefore proposed to maintain this fungus for any interested parties while refining its growth requirements.

The keeping quality of cultures ('Kombucha fungus') was tested under different containment conditions. Cotton wool plugs in volumetric flasks indicated better keeping quality.

The 'Kombucha fungus' when grown in 5% sugar and tea decoction can be kept alive for a period of 6 weeks without adversely affecting quality. The culture did not grow in pure sugar solution of the same strength. For optimum results, the medium should be changed every 3 weeks.

Velvet blight (*Septobasidium* species)

An unusual spread (patch) of this problem was recorded from a smallholder in Nagoda, Kalutara. About 90% of the stand was found to be affected by this problem/fungus. Though this had been known to be only epiphytic, it is now reportedly doing more damage. Thin sections revealed that the bark underneath is discoloured, showing signs of some damage. Of the systemic fungicides tested, 'Tilt' (propiconazole) was found to be superior. This field has been pruned. Hydrated lime spray (10 kg in 50 l of water) at the time of pruning was recommended and it proved successful in controlling the problem.

A heavy presence of *Rhizopus*

A heavy growth (under) of *Rhizopus* fungus was reported in Field No. 6 in St. Coombs Estate that was to be planted with tea although not rehabilitated. The *in vitro* tests carried out with Propiconazole (Tilt) and Bitertanol (Baycor) (different concentrations) were not able to control the fungus. Nursery plants introduced to the field after 3 weeks did not show any sign of damage or of infection. However, this did not cause any alarm or adversely affect the newly planted teas.

3. Divisional Activities (Overheads)

PROJECT D/PLPA

The following estate visits were undertaken during the year:

Three on collaborative work, two on general bush debilitation, two on debilitation of TRI 2025 bushes of about 25 years old, one on seedling bush debilitation, two on Poria root disease, one on white root, one on Charcoal root disease, one on *Macrophoma* canker and one on deaths in new clearing.

In addition, one smallholding in Wilpita/Akuressa on a suspected *Thelaphora* incidence in the past, another in Nagoda, Kalutara, on a heavy infestation by velvet blight and one in Kandy.

Identification of Organisms

Ten isolates (6 fungal and 4 bacterial) were sent to the CABI Bioscience Centre in the UK for identification purposes. Confirmed identifications of five fungal and one yeast isolate were received. They were *Glomerella cingulata*, *Fusarium solani*, *F. oxysporum*, *Apiospora montagnei*, *Rhodosporidium* sp. and *Geotrichum candidum*.

4. General

Dr A Balasuriya was designated as Acting Head of the Plant Pathology Division with effect from 8th October, 1998. Ms NK Karunatilake (EO) was transferred to Hantana station, with effect from 10th April. Ms PKK Vijayanthi (TA) resigned from TRI service on 31st April to take up employment with the Department of Agriculture. Ms NHL Pradeepa (RA) completed her estate training programme at the Great Western Estate by end of January. Mr RMA Ratnayake registered for a one-year advanced course in Laboratory Techniques conducted by the Open University of Sri Lanka, Nawala. Mr BL de Silva from Naiwala Training School, Mr WS Nuwarapaksa from Hardy Technical Institute, Ampara, and Ms DDNK Dangalla, from Aquinas College, Colombo, completed their training assignments during the year.

Seminars/Workshops/Lectures

Dr. A. Balasuriya participated in the following activities:

- 200th E&E and the 5th (Sinhala) E&E in Athurugiriya with a presentation
- Workshop organised by the SLASS on Irrigation techniques and green house planting in Gannoruwa
- Workshop organised by the CARP on Impact Assessment in Gannoruwa
- Seminar organised by the NSF on the role of 'Media in Strengthening Science & Technology in Developing Countries'
- Lecture and practical class for Graduate Trainees from the Ministry of Plantation Industries
- Conducted a seminar on 'New problem fungus' describing the new experience of *Thelephora* sp. on tea
- Workshop on bio-technology in the Ruhunu University
- Seminar on tea clone related specific problems in Dickoya
- RSC-Ratnapura, 12th PGIA annual congress and 56th Annual sessions of SLAAS, in Kandy

Meetings

Dr. A. Balasuriya coordinated 7 HOD meetings and other related meetings with the Director, TRI, on the use of cess funds in 1999, implementation of the Corporate Plan and two meetings on Work Plan. He also took part in two Advisory & Research Linkage meetings and one ACSC meeting, besides attending Grades I-IV meeting.

New Capital Items

During the year under review, the Division received a new refrigerated incubator, Vortex shaker, electronic balance and a much awaited Video-Microscopy system.

Visitors/Trainees

- A group of smallholders from Galle
- Two groups of undergraduates from University of Peradeniya and Eastern University, Faculties of Agriculture, a group of students from Wayamba University
- Two undergraduate trainees from University of Colombo (Botany)
- Two groups of Aquinas students
- Two Assistant Superintendent Trainees from Agalawatte Plantations Ltd.
- One trainee Assistant Superintendent from Moray Estate
- Two Assistant Superintendent Trainees from Agarapatana/Kotagala Plantations Ltd.
- Dr Jimmy Mirchandani of Aries Agro-Vet Industries Ltd., India, accompanied by Mr. Nelson Fernando

PLANT PHYSIOLOGY DIVISION
Acting Head – A. Anandacoomaraswamy

1. Basic Research Projects

B 11-Studies in Photosynthesis and Dry Matter Partitioning

1.1. Partitioning of assimilates in relation to aging of clonal tea in a pruning cycle, St. Coombs Estate – (1992)

In this study, variation of yield with age was investigated for two clones, TRI 2025 and DT 1, with different canopy architecture and leaf morphology.

1.1.1 Annual Yield

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	1846	1584
2	2861	2153
3	2809	2197
4	1692	1450
SE	71.5	80.7
LSD (P=0.05)	220.0	248.7
CV%	6.9	9.8

TRI 2025 gave the highest yield compared to DT 1. Yield increased with age upto the second year and remained steady in the third year and declined in the fourth year. There was no significant difference in yield between the second and third year of the cycle.

1.1.2. Total Dry Matter Production and Nutrient profile of the Canopy

TRI 2025 plants were excavated in October 1999 and separated into different parts as follows: flush, mature leaves, branches and roots. The branches were separated into five categories as follows: type 1: consisting the collar region, type 2: secondary branches emerging and dividing from the collar region, type 3: branches emerging and dividing from secondary branches, type 4: branches emerging and dividing from type 3 branches, type 5: all the branches emerging and dividing from type 4 branches. The roots were separated into four categories as follows: roots below 45cm from the surface of the ground, feeder roots in the top 45cm from the ground, roots that are between 0.25-0.5 cm diameter (medium roots) and more than 0.5 cm diameter (big roots).

The dry weights were determined in each category and the N, P, K, total soluble sugar and starch contents were determined. The results are presented in Tables 2 to 7.

The differences in the dry matter were evident only in type 4 and 5 branches. During later years of the cycle, the dry matter of the bush increases only by addition of young branches. The N, P, K contents showed no difference between different years, except in mature leaves. The sugar and starch contents showed no difference between different years.

TABLE 2 *Dry weights of each part of the bush (g bush⁻¹), at different years of the pruning cycle, TRI 2025*

Part of Bush		Year 1	Year 2	Year 3	Year 4	LSD
Leaves	Flush	22.1	19.6	19.4	22.3	NS
	Mature Leaves	363	396	346	449	NS
	Total	385	416	365	471	
Branches	Type 1 (Collar)	610	525	667	834	NS
	Type 2	661	881	749	839	NS
	Type 3	698	698	881	652	NS
	Type 4	290	479	756	688	219
	Type 5	563	850	1339	1722	501
	Total	2822	3433	4392	4735	
	Below 18" Feeder Roots	0	54	0	16.5	NS
Roots	Medium Roots	224	138	221	142	NS
	Big Roots	1178	1371	1182	1317	NS
	Total	1748	1925	1689	1735	
	Total	4954	5773	6449	7219	

TABLE 3 *Total N content (%) in each part of the bush, at different years of the pruning cycle, TRI 2025*

Part of Bush		Year 1	Year 2	Year 3	Year 4	Mean	LSD
Leaves	Flush	3.57	3.38	3.33	3.67	3.49	NS
	Mature Leaves	3.00	3.10	2.87	2.84	2.95	NS
Branches	Type 1 (Collar)	0.65	0.82	1.02	0.67	0.79	NS
	Type 2	0.75	0.99	0.63	0.84	0.80	NS
	Type 3	0.84	0.82	0.70	0.84	0.80	NS
	Type 4	0.72	0.81	0.68	0.86	0.77	NS
	Type 5	0.84	0.21	0.77	1.42	1.06	NS
Roots	Feeder Roots	1.31	1.19	1.33	1.28	1.28	NS
	Medium Roots	0.91	0.84	0.81	0.84	0.85	NS
	Big Roots	0.76	0.70	0.74	0.84	0.76	NS

TABLE 4 *Total P content (%) in each part of the bush, at different years of the pruning cycle, TRI 2025*

Part of Bush		Year 1	Year 2	Year 3	Year 4	Mean	LSD
Leaves	Flush	0.131	0.129	0.114	0.108	0.121	NS
	Mature Leaves	0.073	0.066	0.092	0.085	0.079	0.0099
Branches	Type 1 (Collar)	0.034	0.037	0.035	0.038	0.036	NS
	Type 2	0.054	0.045	0.037	0.028	0.041	NS
	Type 3	0.035	0.030	0.032	0.028	0.031	NS
	Type 4	0.053	0.032	0.039	0.029	0.038	NS
	Type 5	0.039	0.030	0.041	0.034	0.036	NS
Roots	Feeder Roots	0.055	0.060	0.069	0.068	0.063	NS
	Medium Roots	0.039	0.034	0.032	0.038	0.036	NS
	Big Roots	0.038	0.025	0.030	0.031	0.031	NS

TABLE 5 *Total K content (%) in each part of the bush, at different years of the pruning cycle, TRI 2025*

Part of Bush		Year 1	Year 2	Year 3	Year 4	Mean	LSD
Leaves	Flush	1.93	1.83	1.76	1.8	1.83	NS
	Mature Leaves	1.27	1.15	1.08	1.09	1.15	0.14
Branches	Type 1 (Collar)	0.60	0.63	0.57	0.58	0.595	NS
	Type 2	0.71	0.61	0.59	0.48	0.595	NS
	Type 3	0.6	0.56	0.58	0.52	0.56	NS
	Type 4	0.482	0.57	0.65	0.45	0.53	NS
	Type 5	0.51	0.67	0.74	0.53	0.61	NS
	Feeder Roots	0.87	0.78	0.43	0.76	0.71	NS
Roots	Medium Roots	0.71	0.69	0.64	0.70	0.68	NS
	Big Roots	0.58	0.48	0.50	0.60	0.54	NS

TABLE 6 *Total soluble sugar content (%) in each part of the bush, at different years of the pruning cycle, TRI 2025*

Part of Bush		Year 1	Year 2	Year 3	Year 4	Mean	LSD
Branches	Type 1 (Collar)	10.16	10.54	11.35	13.33	11.35	NS
	Type 2	10.07	8.27	9.59	8.61	9.13	NS
	Type 3	9.75	11.55	8.66	8.78	9.69	NS
	Type 4	10.20	1.09	11.66	8.73	7.92	6.46
Roots	Type 5	9.83	16.31	13.05	10.54	12.44	NS
	Feeder Roots	17.21	18.77	11.97	18.36	16.58	NS
	Medium Roots	25.40	30.00	34.64	26.38	29.10	NS
	Big Roots	23.30	15.13	16.50	16.51	17.86	NS

TABLE 7 *Total soluble starch content (%) in each part of the bush, at different years of the pruning cycle, TRI 2025.*

Part of Bush	Year 1	Year 2	Year 3	Year 4	Mean	LSD	
Branches	Type 1 (Collar)	0.806	1.992	1.898	1.613	1.577	NS
	Type 2	1.376	1.376	5.361	2.894	2.75	NS
	Type 3	1.044	1.898	2.609	2.372	1.98	NS
	Type 4	1.471	1.067	1.850	2.514	1.726	NS
	Type 5	2.609	0.901	2.894	1.138	1.886	NS
	Feeder						
Roots	Roots	0.759	0.949	1.044	1.186	0.984	NS
	Medium						
	Roots	5.693	5.883	7.638	7.353	6.641	NS
	Big						
	Roots	11.196	9.630	17.031	21.208	14.766	NS

J Mohotti, V Sithakaran, S Navaratne

1.1.2 Canopy characteristics, photosynthesis rate and shoot extension rate

In this study, leaf area distribution, leaf photosynthesis, shoot extension rate, thermal time requirement for the bud to become a pluckable shoot, density of active and dormant shoots were measured in the above experiment from April to October 2000.

Leaf Area Index (LAI) increased from 1st year to 3rd year in DT 1 and to 2nd year in TRI 2025. Highest LAI was observed for DT 1. Leaf photosynthesis was highest in the first year and decreased with age in both clones. TRI 2025 had the lower photosynthesis compared to DT 1. The thermal time requirement for an axillary bud to become a pluckable shoot of 10-12cm is about 370 day degrees for DT 1 and about 350 day degrees for TRI 2025. Shoot extension rate was high in the first year for both clones. Active shoot density decreased with age with a corresponding increase in dormant shoot density.

C.K.Senevirathne, S.P.Nissanka, A.Anandacoomaraswamy

1.2. Effect of low night temperature on the productivity of high grown tea

Temperature fluctuation influences the quality and quantity of tea. An investigation was carried out to evaluate the impact of night temperature fluctuation on the physiological process over the next day of the popular up-country tea clones. Tea clones were exposed to low night temperatures using the two growth chambers at the department of crop science, University of Peradeniya.

The temperature levels used were 23/20, 23/10, 23/6 and 23/2°C (Day/night). The clones used in this study were TRI 2025 TRI 2027, TRI 3015, TRI 3018, TRI 3019 TRI 4052, TRI 4053, PK2 and DN.

At low temperatures, DN, TRI 3015 and TRI 2027 had a high photosynthesis. TRI 2025 and TRI 3019 had a lower photosynthesis for a period of seven hours after exposed to lower temperature. The highest electrical conductivity was observed in DN while TRI 3019 had the lowest electrical conductivity.

The results indicated that DN and TRI 3015 are more tolerant to low temperatures. TRI 2027 and TRI 2025 exhibited lower tolerance to cold stress. Other clones were found to have moderate tolerance

M.N.S.Wickramaratne, S.P.Nissanka, D.M.S.Navaratna, A.Anandacoomaraswamy

2. Effect of shade and nitrogen nutrition on made tea quality

A field experiment was laid out in 1997 with 3 different shade levels: no shade (NS), 30% shade (MS) and 70% shade (HS), and 3 nitrogen levels: no N application (NN), 360 kg N ha⁻¹ year⁻¹ (MN) and 720 kg N ha⁻¹ year⁻¹ (HN). Shade was supplied with black nylon netting. All the management practices and other fertilizer were given as per TRI recommendations. Black tea was manufactured twice, in February (flavour season) and in November (non-flavour season). Some quality aspects were monitored and the results are presented in Tables 8 and 9.

There was a significant decrease of the quality characteristics with the increase in N application and a tendency for it to decrease with increased shade.

TABLE 8 *Some quality parameters of the made tea during flavour season, field experiment on shade and nitrogen*

	No Shade			Medium Shade			Heavy Shade			LSD
	NN	MN	HN	NN	MN	HN	NN	MN	HN	
Quality Index	0.55	0.61	0.50	0.48	0.44	0.39	0.72	0.43	0.52	NS
TF	0.41	0.43	0.42	0.38	0.46	0.44	0.55	0.45	0.48	0.07
TR	12.8	12.7	12.9	11.9	12.4	12.1	12.5	12.5	12.8	NS
Total Colour Liquor	2.25	2.62	2.28	2.34	2.61	2.64	2.62	2.73	2.95	NS
Brightness	13.6	14.2	11.7	10.8	11.7	11.1	13.8	11.3	11.2	NS
TR:TF Ratio	31.7	32.9	32.4	31.8	27.8	29.2	22.9	27.7	28.1	4.42

TABLE 9 *Some quality parameters of the made tea during non-flavour season, field experiment on shade and nitrogen*

	No Shade			Medium Shade			Heavy Shade			LSD
	NN	MN	HN	NN	MN	HN	NN	MN	HN	
Quality Index	0.30	0.19	0.18	0.17	0.18	0.21	0.26	0.17	0.21	NS
TF	0.43	0.42	0.38	0.41	0.47	0.54	0.50	0.63	0.51	0.07
TR	12.5	12.9	12.8	13.1	13.2	12.2	12.3	12.5	13.3	NS
Total Colour	3.72	3.19	3.42	3.81	4.05	3.61	3.35	3.64	4.09	NS
Liquor Brightness	9.42	11.5	9.11	10.4	10.1	12.5	10.9	13.9	9.01	NS
TR:TF Ratio	31.7	32.7	34.3	34.9	28.9	23.0	24.9	20.9	27.1	4.42

J Mohotti, P Baddage

3 Experiments on "High Forest Problem"

3.1 Conductance of a dye, 'Eosine'

The conductance of the dye 'Eosine' (1.2 g/15 L distilled water) was tested for affected and non-affected bushes of clone TRI 2025 of High Forest and Nuwara Eliya Estates, with the healthy bushes from St Coombs Estate as a control. After the immersion of the plants in the dye for 3 nights, the branches of the bushes were cut longitudinally to check the path of the dye.

This revealed that in the affected bushes, the conductance of the dye was extremely low compared with the healthy bushes.

J Mohotti, S Navaratne, M D L P Gunatilake

3.2 Microtome sections of different parts of the bushes

Microtome sections (done with the help of Botany Department, Faculty of Science, University of Peradeniya) of different parts of the healthy and affected bushes of clone TRI 2025 from High Forest, Nuwara Eliya and St Coombs Estates were taken. Microscopic examination of the sections revealed that restrictions in the xylem vessels called 'tyloses' were present in the affected bushes. No tyloses were observed in healthy xylem tissues in bushes of any of the estates.

J Mohotti, S Navaratne, A S T B Wijetunga

3.3 Glass house experiments with different extracts of xylem sap of affected bushes

A rapid method for the collection of large quantities of xylem sap was developed by modifying the previous method by Selvendran and Sabaratnam (1972). Two glass house experiments were conducted.

Experiment 1: Xylem sap was collected using this method from affected and unaffected bushes from High Forest and Nuwara Eliya Estates. 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. 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 mixed with soil as treatments.

No symptoms were developed in any of the plants for a period of 10 months.

M D L P Gunatilake, S Navaratne, J Mohotti, 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 2 months.

S Navaratne, J Mohotti

3.4 Biochemical analysis of xylem sap of affected and unaffected bushes

Xylem sap from affected and unaffected bushes were collected from High Forest and Nuwara Eliya Estates. These were analysed for the N, P, K, Mg contents, total soluble sugar and amino acid contents. The results are presented in Table 10.

The affected bushes had significantly low N, K and Mg contents than the unaffected bushes of the same estate. Xylem sap collected from healthy bushes of St. Coombs Estate had significantly large N and Mg contents than in bushes of High Forest Estate. The total amino acid and sugar contents were not significantly different. However, the affected High Forest samples had the largest total sugar contents and smallest total amino acid contents.

TABLE 10 *N, P, K, Mg, total soluble sugar and amino acid contents of xylem sap of affected and unaffected bushes of High Forest and Nuwara Eliya Estates*

	N (ppm)	P (ppm)	K (ppm)	Mg (ppm)	Total soluble suger content (g L ⁻¹)	Total soluble suger content (g L ⁻¹)
High Forest Estate: Affected	19.13	3.13	70.17	1.06	0.00552	12.79
High Forest Estate: Unaffected	31.15	2.94	88.88	1.75	0.00202	66.15
St Coombs Estate: Healthy	62.65	1.39	55.75	2.5	0.00298	73.56
LSD	23.74	NS	16.03	0.495	NS	NS

S Navaratne, J Mohotti

4. Drought Studies

4.1. Drought effects on physiology of young tea

This experiment was conducted to find out the drought effects on tea photosynthesis and some partial processes and to ascertain the possibilities of developing a rapid method to screen tea plants for drought resistance. Tea clones B 275 (drought resistant clone), K 150 (drought susceptible clone) and two unknown clones KEN 15/7 and TRI 3058 were used. The experiment was conducted in Passara TRI sub-station at an elevation of 1120 m. Two treatments were given; well watering (near field capacity) and no watering after commencement of experiment.

Changes in the rate of photosynthesis, fluorescence, stomatal conductance, leaf water potential (LWP), leaf relative water content (RWC), sugar, starch and proline contents were monitored in two top most mature leaves for 4 days. In stressed plants, the rate of photosynthesis decreased gradually with time irrespective of clone; in K 150 and TRI 3058, photosynthesis was more sensitive to drought. LWP and RWC decreased less in clones of B 275 and KEN 15/7 than K 150 and TRI 3058. Stomatal conductance also decreased rapidly with time in clones of K 150 and TRI 3058. There was no significant difference in fluorescence measurements and stomatal density between clones. Soluble sugar content slightly increased with time in clones B 275 and KEN 15/7 while TRI 3058 showed only a slight decrease. Soluble starch content showed a considerable decline in the clones of B 275 and KEN 15/7, and there was no

change in K 150 and TRI 3058. In K 150 and TRI 3058, proline content increased with decrease in LWP, while B 275 and KEN 15/7 remained at a constant level.

Results showed that the clone KEN 15/7 has more drought resistant characters while the clone TRI 3058 has more drought susceptible characters. To screen tea plants for drought resistance, a combination of photosynthesis, LWP and RWC can be successfully used.

V Liyana Gunawardena, J Mohotti, D C Bandara, S Navaratne

4.2 Drought mitigation in mature tea (TRI 2025)- St Coombs Estate (1995)

Two studies were conducted to compare the effect of spraying commercial potassium sulphate and potassium chloride on yield using knapsack sprayer during dry weather. The plants were in the second year (Experiment 1) and fourth year (Experiment 2) of the cycle. The annual yield is presented in Table 11.

TABLE 11 *Yield (kg ha⁻¹) Made Tea*

Treatments	Experiment 1	Experiment 2
1. Control	6259	4305
2. Water and Urea (4%)	5770	4549
3 Water +Urea(4%) + Potassium sulphate (1%)	—	4491
4 Water +Urea(4%) + Potassium sulphate (2%)	5770	4765
5 Chitosan	5886	—
6 Water +Urea(4%) + Potassium chloride (2%)	5779	4765
7 Water +Urea(4%) + Potassium chloride (1%)	—	4872
SE	252.1	132.1
LSD (P=0.05)	NS	NS
CV (%)	8.6	4.0

None of these treatments was significantly different due to well distributed rainfall.

H.P.Baddage, A.Anandacoomaraswamy

5. Physiological studies on organic tea

5.1 Experiment 1

An investigation was carried out to study the physiological aspects of 4 year old organic tea plants grown in Field No. 13 of the St Coombs Estate. The experimental plots were maintained under IFOAM guidelines since 1996. The treatments were tea waste, neem oil cake and compost. The conventional practices with TRI recommendations served as the control. Shoot growth, soil and foliar nutrient status, root starch content, weekly yield and yield components were monitored.

Yield was highest in plants grown with compost, followed by tea waste and the inorganic fertilizers. The higher yield in compost grown plants was due to the larger dry weights and shoot extension rates. The tea waste treated plants had the largest shoot density and active:banji ratio. In contrast, plants grown with neem oil cake had the lowest shoot density, extension rate and active: *banji* ratio. This was probably due to lower nitrogen content supplied by the applied amounts as shown by foliar nitrogen content.

All plants grown with organic material had higher root starch contents than the conventionally grown plants. Compost treated plants had the highest root starch content which would contribute to higher yields. They were also the least stressed as shown by root respiration measurements. In contrast, neem oil cake treated plants had the highest root respiration and most stressed probably caused by its phytotoxic effects. Hence, in practice, in instances where root starch content is very low prior to pruning etc., the compost application could be advocated.

Nutrient contents of soils under organic manure were similar to that of inorganic fertilizer, except for soil K. Soils incorporated with tea waste and inorganic fertilizer had significantly high K content than with neem oil cake and compost. However, soils incorporated with different organic manure had a greater micro nutrient content.

The results suggested that tea waste and compost have the feasibility of replacing inorganic fertilizers in young tea. However, these results are valid for the first pruning cycle, and the measurements are being monitored in the subsequent pruning cycles.

M P T Premaratne, J Mohotti, K Mohotti, U R Sangakkara

5.2 Experiment 2

Two bushes from each plot (eight bushes per treatment) were uprooted and dry matter partitioning with each treatment was studied. The results are presented in Table 12.

Bushes grown with compost and tea waste showed very good growth, comparable to the conventional fertilizer. The neem oil cake treatment had significantly small leaf weights and areas than other treatments.

TABLE 12 *Dry matter partitioning and leaf area in tea exposed to organic and conventional treatments, Field No. 13, St. Coombs Estate*

Part of Bush		Tea Waste	Neem Oil Cake	Compost	Inorganic (Conventional)	LSD
Leaves	Flush	11.6	2.1	7.8	9.1	5.32
	Mature					
	Leaves	222	116	146	222	80.6
	Total	234	118	154	231	
Branches	Collar	187	102	161	153	NS
	Primaries	93	50	89	106	NS
	Secondaries	109	70	99	120	NS
	Tertiaries	319	189	294	309	NS
	Total	708	411	643	688	
Roots	Small Roots	40.5	36.1	65.2	49.3	NS
	Big Roots	180	119	141	217	NS
	Total	241	155	206	266	
Flowers & Fruits	32	1.13	1.34	3.31	NS	
Total	1194	685	1004	1188	NS	
Leaf Area	21583	10081	13988	20121	7196	

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5.3 Experiment 3

The bushes were pruned in November 2000. The pruning weights and diameters of the pruned edges of stems are presented in Table 13. The pruning weights, mean diameter of prune cuts and the number were not significantly different between tea waste, compost and conventional treatments, but were significantly larger than the neem oil cake treatment.

TABLE 13 *Pruning weights and diameters of the pruned edges of stems in tea exposed to organic and conventional treatments, Field No. 13, St. Coombs Estate*

	Tea Waste	Neem Oil Cake	Compost	Inorganic (Conventional)	LSD
Pruning Weight (kg FW/bush)	2.001	0.689	1.891	1.744	0.635
Mean diameter of prune cuts (cm)	1.406	1.221	1.405	1.399	0.200
Number of pruned stems	18	12	19	17	3.5

J Mohotti, K Mohotti, V Sithakaran, P Baddage

Seminars/Conferences

1. J Mohotti attended the International Conference on 'Microbiology of Composting and other biodegradation processes' held in Innsbruck, Austria, 18-20 October 2000 and presented a paper entitled 'Growth and photosynthesis of field grown tea (*Camellia sinensis* L.) plants as affected by incorporation of organic soil amendments'.
2. J Mohotti attended the 12th annual Congress of the Post Graduate Institute of Agriculture of the University of Peradeniya, held at the PGRC, Gannoruwa, 16-17 November 2000 and presented a paper titled 'Electron Transport as a limitation to photosynthesis of tea (*Camellia sinensis* (L.) O. Kuntze); a comparison with sunflower (*Helianthus annuus* L.) with special reference to irradiance'.
3. V.Sithakaran attended a training course on Agro-Meteorology at Central Research Institute for Dry Land Agriculture, Hyderabad, India, from 27th November- 9th December.
4. D.M.S.Navaratne attended a workshop on 'INFORM' organized by CARP at PGIA.
5. H.P.Baddage attended a four day workshop on 'Climate Forecasting' organized by the Meteorology Department in August.

Publications

1. Mohotti, J. and Mohotti, K. M. (2000). Growth and photosynthesis of field grown tea (*Camellia sinensis* L.) plants as affected by incorporation of organic soil amendments. Proceedings of the International Conference on

Microbiology of Composting and other biodegradation processes, held in Innsbruck, Austria, 17-22 October, 2000, 16pp.

2. Mohotti A. J., Dennett M. D. and Lawlor, D. W. (2000). Electron Transport as a limitation to photosynthesis of tea (*Camellia sinensis* (L.) O. Kuntze); a comparison with sunflower (*Helianthus annuus* L.) with special reference to irradiance. *Tropical Agricultural Research*, 12, 1-10.
3. Rajapakse R. P. N. P., Bandara D. C. and Mohotti A. J. (2000). Changes in photosynthesis and some related processes during source / sink manipulation in young tea (*Camellia sinensis* L.), Proceedings of the 56th Annual Session, Part 1- Abstracts, Sri Lanka Association for the Advancement of Science, 114pp.

PLANT PROPAGATION AND BREEDING DIVISION

Officer-in-Charge – V.Shanmugarajah

General

- Studies on flowering, fruiting and seeding were completed in various seed gardens in different climatic regions to generate basic information for use in seed production and hybridisation.
- Evaluation of 1921 lines/clones in Phase I –II trials was undertaken in up-, mid-, low-country and Uva to develop region specific clones.
- Trials were established at Talawakelle, Hantane, Passara and Ratnapura for the evaluation of 10 - 11 bi-clonal and polyclonal seed stocks, for use as seed cultivars. These have already been evaluated in the nursery.
- Mature bushes of seed stocks already available were evaluated for use as seed cultivars.
- Two crossing blocks in the form of micro-seed gardens were established in the up-country to create genetic variability and to broaden the genetic base.
- Part of the germplasm at Talawakelle was duplicated at Kottawa and that at Ratnapura was extended.
- Clonal herbarium was prepared as an identification tool.
- Quality profile of promising lines of Phase II trials in the up-country was assessed.
- Morphological characterisation of germplasm accessions and their documentation were undertaken.
- Major portion of the cuttings of TRI 3000 and 4000 series clones was supplied to the Asian Development Bank (ADB) Project for establishment of large-scale multiplication blocks.

In accordance with 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 781 breeding lines under Phase I and II trials (Table 1), 103 have been identified as being promising. Of the 53 entries in Phase II trials, 6 are promising of which 1 – 2 are expected to be released on completion of the trials.

TABLE 1 *Clones under evaluation for up-country*

Serial No.	Trial No.	Year of planting	Origin ¹	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha ⁻¹)	Remarks
1.1 Phase I Trials								
1.1.1	VP 71	1994	A	St Coombs, Field No.14	81	03	3219 – 3450 3003*	cv% 35 SE 618
1.1.2	VP72	1994	B		107	08	2526 – 3741 2494*	cv% 25 SE 469
1.1.3	VP73	1994	C		77	27	2269 – 3692 2242*	cv% 29 SE 603
1.1.4	VP75	1995	N		28	15	2385 – 4217 4091*	cv% 38 LSD 1914
1.1.5	VP 76	1995	O		58	25	2837 – 4178 3225*	cv% 24 LSD (0.05) 1346
1.1.6	VP 77	1996	P	St Coombs Field No.12	121	9	1902 – 2545 1712*	cv% 28 LSD(0.05) 680
1.1.7	VP78	1996	K		210	10	1802 – 2379 1504**	cv% 26 LSD 581
1.1.8	VP82	1998	F		46	—	—	Plucking commenced in October
Sub total					728	97		
1.2 Phase II Trials								
1.2.1	VP 80	1996	D	St. Coombs Field No.12	31	6	2392 – 3163 1735*	CV 20 LSD 792
1.2.2	VP 81	1998	E		22	—	—	Plucking commenced in October
Sub-total					53	06		
Total					781	103		

* and ** - Yields of control clones TRI 2025 and TRI 4006 respectively

*** Origin of the clones in the pipeline**

- 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, SM 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)]

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1.3 Phase III Trials: Regional testing of clones

Evaluation of 3000 and 4000 series clones in Venture Estate, Norwood

Of all the clones tested, TRI 4071, 3072, 3018 and 3016 yielded considerably higher than the control TRI 2025 (Table 2), the highest yielder (32%) being TRI 3071.

TABLE 2 Mean yield of clones in first pruning cycle

Clone	Yield (1 st cycle average) Kg/ha/yr.	% yield increase or decrease over control
TRI 4071	3025	+32%
TRI 3072	2554	11
TRI 3018	2329	1
TRI 3016	2329	1
TRI 2025	2298	0
TRI 4063	1900	-17
TRI 3069	1893	-18
TRI 3073	1770	-23
TRI 4052	1634	-29
TRI 3015	1409	-39
TRI 3019	1399	-39
TRI 3020	1336	-42
TRI 4053	1335	-42
TRI 3017	662	-72

1.3.2 Evaluation of 3000 and 4000 series clones in Luckyland Estate, Udapussellawa

Out of 16 clones under evaluation, 11 yielded higher than the control (Table 3). The highest yielding clone was TRI 3019, followed by TRI 3015.

TABLE 3. *Yields of clones in the first year of the first cycle*

<i>Clone</i>	<i>Yield - 1st year of 1st cycle (kg/ha/yr.)</i>
TRI 4079	3750
TRI 4078	4246
TRI 3013	4320
TRI 3073	4492
TRI 3072	4609
TRI 2025	4611
TRI 3049	4612
TRI 4071	4661
TRI 4053	4763
TRI 3020	4769
TRI 3016	4840
TRI 4052	5065
TRI 3069	5086
TRI 3014	5163
TRI 4006	5271
TRI 3015	5673
TRI 3019	5903
Cv %	26.63
SE	1302.7

Project 1.2 - Development of shot hole borer resistant clones

The Entomology Division screened 31 lines planted in a Phase II Trial (VP 80) in the up-country (St. Coombs). Details of the experiment are given in Table 4.

TABLE 4 *Lines screened for shot-hole borer infestation and their resistance/ susceptibility rating*

Lines screened	Resistant*	Moderately Susceptible*	Susceptible*
21, 55, 216, 208, 215, 557, 582, 20, 43, 50, 498, DN, 40, 99, 190, 230, 22, 24, 39, 89, 210, 35, 110, 225, 497, 15, TRI 2025, 88, 101, 189, 193, 213, 272, 53	21, 55, 216, 208	215, 557, 582, 20, 43, 50, 498, DN, 40, 99, 190, 230,	22, 24, 39, 89, 210, 35, 110, 225, 497, 15, TRI 2025, 88, 101, 189, 193, 213, 272, 53
Total = 32 + 2 control clones	4	12	18

* Resistant = 0-3; Moderately susceptible = 3.1-6; Susceptible = more than 6.1
(Rating for resistance is based on the number of galleries present in 30cm branch).

Of the 34 lines tested, 4 were rated as resistant and 12 as moderately susceptible to shot-hole borer. This study will be continued to confirm these results.

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Project 1. 6 - Screening lines for nematodes

Two clones 2000 series, five clones of 4000 series and three estate selections were transferred to nematode infested beds in order to evaluate their resistance/ susceptibility for *P. loosi* (Nematology division Trial No. reference N1A).

The following 10 clones are under evaluation: TRI 2024, 2025, 4042, 4046, 4047, 4052, 4053, DT 95,

K 145 and NIL 153. Their screening is expected to be completed in 2001.

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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

Of the 11 clones under evaluation, 3 clones (TRI 4046, 3018 and 4006) performed better than the control, TRI 2025, in first cycle yield (Table 5). However, in the second cycle in the first year, clones TRI 4046, 4006, 3015, 3013, 3014, 4053, 3019 and 4047 yielded higher than the control. A more or less similar trend continued in the second year as well.

TABLE 5 *Mean yield of clones in the first pruning cycle and year wise yield in the second pruning cycle*

Clone	Yield- 1 st cycle average (kg/ha/yr.)	% yield increase or decrease over control	Yield 2 nd cycle (kg/ha/yr.)	
			1 nd Yr.	2 nd Yr.
4046	5922	34	6843	5974
3018	4918	11	4759	5147
4006	4792	8	5202	4583
2025	4417	0	4998	5428
3015	4369	-1	5489	5340
4042	4162	-6	4520	4548
3013	4247	-4	6864	6316
3020	3864	-13	4926	4302
3014	3849	-13	5151	5143
4053	3619	-18	5145	5536
3019	3556	-20	6907	5087
4047	2583	-42	5066	5939
CV%			21.7	21
LSD			-	1562
SE			592	

Of the 11 clones under evaluation, three (TRI 4046, 3018 and 4006) performed better than the control clone TRI 2025 in terms of their first cycle yield average.

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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. Details of the trials are given in Table 6.

TABLE 6. Location of trial and clones under screening in each trial

Location	Trial No: Clones under screening	Remarks
Mid country station, NIB – 1 Hantana	TRI 2025, 3015, 3019, 3025, 3055, 3069, 4006, 4014, 4052, 4053 and DN	Plants of these clones were transferred to nematode infested beds prepared in cement lined tanks
Hantana Estate	N1B – 2 TRI 2025, 3015, 3019, 3025, 3055, 3069, 4006, 4014, 4052, 4053 and DN	-do-

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3. Thrust A 3 - Development of clones for the mid-country dry zone (Uva)

Project 3.1 - Evaluation of clones for the mid-country dry zone

Of the 64 lines under evaluation, 24 are in Phase II from which 2-3 clones may be released on completion of the trials (Table 7).

TABLE 7. Clones under evaluation in phase I and II trial in mid-country dry zone

Serial No.	Trial No.	Year of planting	Origin*	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg Mlha ⁻¹)	Remarks
3.1 Phase I Trials								
3.1.1	UVP 10	1998	F	Field No. 4 Passara station	40	–	–	Brought in to bearing
Sub total					40			
3.2 Phase II Trials								
3.2.1	UVP 9	1998	D	Field No. 4 Passara station	24		–	Brought in to bearing
Sub total					24			
Total					64			

Refer foot note under Table 1

3.3 Phase III trials: Regional testing of clones

Evaluation of 3000 and 4000 series clones at Verallapatana Estate (Doomo Division)

Of the 6 clones under evaluation, TRI 4046 and 4042 yielded higher than the control TRI 2025 during the first cycle (Table 8).

TABLE 8 Mean yield of clones in first pruning cycle

Clone	Yield -1 st cycle average kg/ha/yr	% yield increase or decrease over control (TRI 2025)
TRI 4046	4506	3
TRI 4042	4440	2
TRI 2025	4359	0
TRI 3022	4351	0
TRI 3019	3370	-23
TRI 3018	3152	-28
TRI 3044	2037	-33

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4. Thrust A 4 - Development of clones for the low-country**Project: 4.1 - Evaluation of clones for the low country**

Evaluation of 1140 breeding lines was continued in Phase I and II trials. Of these, 233 lines were planted during the year. Out of 193 lines in Phase II trials, 4 – 5 clones are expected to be released as TRI 5000 series after the completion of trials. (Table 9).

TABLE 9 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 Mha ⁻¹)	Remarks
4.1 Phase I								
4.1.1	LVP 66	1994	A	Field No. 2 St. Joachim Estate	78	Refer LVP 80		
4.1.2	LVP 67	1994	B		106	Refer LVP 81		
4.1.3	LVP 68	1994	C		74	Refer LVP 82		
4.1.4	LVP72	1994	D		59	26 Selections were propagated in the nursery, to be tested in the Phase II		
4.1.5	LVP 73 (1)	1996	K	Field No. 1 St.Joachim Estate	27	13	6052-8371	CV 21 LSD 2622
	LVP 73 (2)				27	6	6064-7843	CV 19 LSD 1946
	LVP73 (3)				23	1	8397	CV 29 SE 920
	LVP73 (4)				26	6	6154-6953	CV 24 LSD 2494
	LVP73 (5)				30	6	5490-7681	CV 15 SE 491
	LVP73 (6)				25	9	7022-8133	CV 20 SE 988
	LVP73 (7)				27	6	6310-7195	CV 16 LSD 1795
	LVP73 (8)				24	3	7226-7557	CV 18 SE 964

TABLE 9 *Contd.*

	LVP73 (9)				27	3	7270-8288	CV 17 SE 698
	LVP73 (10)				25	2	7471-7535	CV 17 SE 782
	LVP73 (11)				24	8	7006-8324	CV 17 SE 766
	LVP73 (12)				28	1	9159	CV 16 SE 863
	LVP73 (13)				27	9	4336-6959	CV 25 LSD 2228
	LVP73 (14)				23	1	7724	CV 26 SE 980
	LVP73 (15)				26	3	7920-8467	CV 14 SE 738
	LVP73 (16)				25	5	7242-9386	CV 19 SE 743
	LVP73 (17)				23	3	7547-9886	CV 20 SE 815
	LVP73 (18)				17	5	6066-6191	CV 22 SE 743
4.1/6	LVP 84	2000	Q	Field No. 1 St. Joachim Estate	176	.....	.....	.....
Sub. total					947	90		

4.2 Phase II

4.2.1	LVP 74	1997	G	Deniyaya Station	35	10	4100-490 4830****	CV 26.6 SE 877	
4.2.2	LVP 75 (I)	1997	D		11	2	4926-7398 5091***	CV 14 SE 432	
4.2.3	LVP 75 (II)	1997	H	Field No. 1 St. Joachim Ratnapura	21	3	5636-8182 5560***	CV 12 LSD 1212	
4.2.4	LVP 75 (III)	1997	I		5	3	4339-4960 3735***	CV 26 SE 809	
4.2.5	LVP 75 (IV)	1997	J		8	1	5314 5316***	CV 16 SE 608	
4.2.6	LVP 76	1999	H		22			2 nd centering was done	
4.2.7	LVP 77	1999	L		13			2 nd centering was done	
4.2.8	VP 78	1999	J		15			2 nd centering was done	
4.2.9	LVP 79	1999	M		6	.....	.....	2 nd centering was done
4.2.10	LVP 80	2000	A		12	.....	.....	.....
4.2.11	LVP 81	2000	B		15	.....	.....	.....
4.2.12	LVP 82	2000	C		12	.....	.....	.....
4.2.13	LVP 83	2000	L		18	.....	.....	.....
Sub-total					193	09			
Total					1140	99			

Refer foot note under Table 1

4.3 Phase III trials: Regional testing of clones

4.3.1 Evaluation of 3000 and 4000 series at Greenrock Estate, Dehiowita

All the 12 clones tested yielded more than the control TRI 2026, except TRI 2023 in the first pruning cycle (Table 10). Clones TRI 4006, 4053, 2023, 4061, 4033, 2027, 4055, 4059 and 4004 have also yielded considerably higher than TRI 2025. A more or less similar trend is being observed in the second cycle as well.

TABLE 10. *Mean yield of clones in the first pruning cycle and year wise in the second pruning cycle*

Clone	Yield-1st cycle average (kg/ha/yr)	% yield increase or decrease over TRI 2026	% yield increase or decrease over TRI 2025	2nd cycle	
				1st yr.	2nd yr.
4006	6199	92	36	3845	5057
4053	6868	113	51	6230	5005
2023	6252	94	37	4453	4553
4061	6912	114	51	5391	5172
4033	5343	65	17	4101	4316
2027	5154	0	13	4938	5386
4055	6221	93	36	4522	2344
2025	4563	41	0	4981	5819
2059	5855	81	28	5163	4810
4004	5007	55	10	5198	4533
4049	4064	26	-11	4367	3881
4054	4160	29	-9	4390	3915
4048	3328	3	-27	4184	4281
4024	3489	8	-24	3666	3676
2026	3230	0	-29		

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5. Thrusts A 5 - A 8 Development of bi-clonal and polyclonal seed cultivars

Projects 5.1, 6.1, 7.1 and 8.1 - Development of seed varieties for up -, mid -, Uva and low-country

Seedlings raised in the nursery from 16 bi-and polyclonal stocks collected from various seed gardens (established during 1987 – 1994) were planted in 4 field trials in different regions with the aim of developing seed cultivars (Table 11).

TABLE 11 *Field trials established for evaluation of seed varieties (stocks)*

Particulars	Up-country (A 5.1)	Mid-country (A 6.1)	Uva (A 7.1)	Low-country (A 8.1)
Date/month of planting	July	July	July	February
Location	St. Coombs	Hantana	Passara	St. Joachim
No. of stocks	11	09	10	10
No. of replicates	2	2	2	3
Control clones	TRI 2025 TRI 3020 TRI 4006 DT 1	TRI 2025 TRI 4053 DG 7	TRI 2023 DN	TRI 2023 DN

Based on their nursery performance, four to five seed stocks were found to be promising.

Establishment of Micro-seed gardens

Two micro-seed gardens were planted in St. Coombs in September as a crossing block to produce bi-clonal seeds to be used in the development of clones as well as seed cultivars (Table 12).

TABLE 12 *Details of micro seed gardens established in up country*

Field No. & (Code)	Combination	No. of plants
9 (a)	TRI 2142	13
	& TRI 3069	14
9 (b)	TRI 2142	25
	& TRI 3041	18

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6. Other Experiments

6.1 Collection, evaluation and documentation of germplasm

Characterisation of tea germplasm numbering over 350 accessions collected in the field gene bank at St. Coombs Estate was continued. Over 25 accessions were assessed morphologically and morphological descriptors were documented in a database.

Assessment of their physiological, biochemical characteristics and tolerance to biotic and abiotic stresses are planned. A survey of old seedling fields to collect valuable germplasm was initiated.

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6.2 Flowering, fruiting and seed setting in bi-clonal and polyclonal seed gardens established in different regions

A detailed study, commencing from June 1999, was undertaken to monitor the above parameters in order to find out the period of flowering, fruiting and seeding in different regions. The details of seed gardens and the criteria assessed were given in Annual Report 1999. This study was concluded in August 2000. Results are presented in Table 13.

TABLE 13 *Time of flowering and seed dropping in tea*

Region	Flowering		Seed dropping/ seeding	
	Period	Peak	Period	Peak
Up-country	March-June	April-May	April-Sept.	May-June
Low-country	Sept.-Nov.	October	April-July	May-June
Uva	May-Oct.	June/July Aug./Sept.	May-Sept.	June/July Aug./Sept.

All Divisional Staff

6.3 Polyploid breeding

Characterisation of tetraploid clones and their diploid counterparts was completed using the following indirect methods:

6.3.1 Morphological characterisation

Tetraploid clones, TRI 2023, 2024, 2025, 2026, DT95 and their diploid clones were characterized morphologically for vegetative descriptors developed for tea by the International Plant Genetic Resource Institute (IPGRI).

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In addition, some leaf, flush and bush characters were measured. The parameters considered for this purpose were leaf area of 5th leaf, dry weight of 5th leaf, dry weight of flush (two and a bud) and pruning weights (Table 14).

TABLE 14 *Comparative leaf and bush characteristics of tetraploids and their diploid clones*

<i>Clone</i>	<i>Leaf area (cm²)</i>	<i>Dry wt. (g) of 5th leaf</i>	<i>Dry wt. (g) of 2 and a bud</i>	<i>Pruning wt/bush (kg)</i>
TRI 2023	51.6	0.54	3.00	1.12
TRI 2023 4x	52.9	0.33	3.18	0.70
TRI 2024	33.2	0.24	1.82	0.84
TRI 2024 4x	32.9	0.25	2.83	2.46
TRI 2025	42.9	0.28	2.19	2.08
TRI 2025 4x	48.9	0.27	3.18	4.69
TRI 2026	34.8	0.24	2.23	0.60
TRI 2026 4x	52.7	0.44	2.26	1.21
DT 95	24.6	0.18	2.01	—
DT 95 4x	25.0	0.16	1.57	2.21

These results will be used to establish a correlation between indirect parameters and direct measurements to develop criteria for rapid screening of polyploid genotypes.

K. Gunasekare, J.D. Kottawa Arachchi

6.3.2 Chemical evaluation

Green leaf (two and a bud) of tetraploid clones (TRI 2023, 2024, 2025, 2026 and DT 95), their diploid clones and natural triploid clones (HS 10A, GF 5/1) were analysed to detect quantitative variations of the following chemical constituents:

Total polyphenol, Total Chlorophyll, Gallic Acid, Caffeine, Epigallo catechine, Catechin, Epi Catechin, Epigallo catechin gallate, Epi catechin gallate and Total flavanol

Another set of analysis of the above parameters of the same clones is due during the dry weather to obtain more precise data on the chemical variations of these clones.

I.S.B. Abeysinghe*, J. Jayasundara*, Y.G.P de Silva*, U. Senarath Bandara*, K.Gunasekare, J.D. Kottawa Arachchi *Biochemistry Division)

6.3.3 Anatomical characterization

Stomatal frequency in the leaf abaxial and pollen grain diameter of the tetraploid and their diploid counterparts were assessed (Table 15). This assessment will be repeated during 2001 to confirm the results.

TABLE 15 *Variations in anatomical characteristics of tetraploid and their diploid counterparts*

Clone	Stomatal density (No. of stomata/ 0.19 mm ²)	Pollen grain diameter (μ)
TRI 2023	37.93	50-60
TRI 2023 4x	31.18	70-80
TRI 2024	38.49	50-60
TRI 2024 4x	27.55	50-60
TRI 2025	41.39	55-60
TRI 2025 4x	28.00	70-80
TRI 2026	34.00	—
TRI 2026 4x	35.18	—
DT 95	21.80	—
DT 95 4x	21.28	—

Establishment of a correlation between above parameters and ploidy level will be attempted after completing the direct assessment to measure the ploidy level. The objective is to develop a rapid screening method for identification of polyploids in tea.

K.Gunasekare

6.4 Morphological characterisation of tea clones used for molecular characterisation study

Of the 40 clones used for molecular characterization of tea clones in a collaborative project carried out by the Biochemistry Division, 30 were morphologically characterised. Some quantitative and qualitative variations of vegetative characteristics were taken into consideration by adopting the plant descriptors for tea developed by International Plant Genetic Resource Institute (IPGRI), Italy. The following characteristics were documented:

Leaf size, Leaf length and width, Leaf shape, Leaf pose, Leaf apex habit, Leaf color (Immature & mature), Petiole length, Pigmentation (leaf & petiole) and Pubescence (leaf & young shoot)

These data will be used for cluster analysis to see whether any kind of relationship can be established between genetic diversity estimates obtained with DNA marker analysis and some morphological descriptors.

K. Gunasekare, J.D. Kottawa Arachchi, A. K. Mudalige

6.5 Characterization and evaluation of *Camellia sasanqua*

Characterization and evaluation of *Camellia sasanqua* seedling bushes (planted in 1990) available in St. Coombs Estate were initiated to assess their potential value for using them in hybridization program to generate interspecific hybrids.

6.5.1 Morphological characterization

Randomly selected 10 seedling bushes of *C. sasanqua* were characterised for vegetative descriptors in comparison with *C. sinensis*, clone TRI 2025 (Table 16).

TABLE 16 Morphological variations between *C. sasanqua* and *C. sinensis*

Species/ clone	Leaf					
	size	Shape	pose	apex habit	Color (immature)	Color (mature)
<i>C. sasanqua</i>	small	Elliptic	Semi-erect	Down turned	Green/gray purple	green
<i>C. sinensis</i> TRI 2025	large	Oblong/ Obovate	horizontal	Down turned	Light green	green

Species/ clone	petiole Length (mm)	Pubescence		Pigmentation	
		leaf	Young shoot	leaf	petiole
<i>C. sasanqua</i>	5.0	spars	dense	purple	Bronze
<i>C. sinensis</i> TRI 2025	5.0	Spares	spares	Nil	Nil

K. Gunasekare, M. Ratnayaka, B.A. Rathnagoda,
J.D. Kottawa Arachchi, A. K. Mudalige

6.5.2 Chemical evaluation

A preliminary analysis of the following parameters of green leaf was undertaken in collaboration with Biochemistry Division. *Camellia sinensis* (clone – TRI 2025) was also analysed for the same chemical constituents to compare with samples of *C. sasanqua* (Table 17).

TABLE 17. Quantitative variations of some chemical constituents in green leaf of *C. sasanqua* and *C. sinensis*

Species	Moisture (%)	Total polyphenols (mg/g)	Amino acids (mg/AN)	Total Chlorophyll (mg/g)	PPO activity (nmol/ml/min)
<i>C. sasanqua</i>					
Sample I	71.8	550.8	1.07	2.73	nil
Sample II	72.6	639.8	1.03	3.42	nil
<i>C. sinensis</i>					
TRI 2025	75.0	400.0	10.00	3.0-4.0	0.04

EGC, EC, EGCG, Catechin and Caffeine, which are characteristics tea compounds, were not found in leaf samples of *C. sasanqua*. Considerable variation was found between amino acid content of *C. sasanqua* and *C. sinensis*. Amount of polyphenol was found more in *C. sasanqua* than in *C. sinensis*.

I.S.B. Abeysinghe*, P.A.N. Punyasiri, *, J. Jayasundara*, D. Kumarasinghe*,
K. Gunasekare, J.D. Kottawa Arachchi (* Biochemistry Division)

6.5.3 Evaluation for biotic stresses

Shot-hole borer

Out of 134 individual bushes assessed, only 17 were found with shot-hole borer infestation. The rate of infestation was very low and it was observed that number of galleries were in the range of 1-4 with an average of 1.5 in those infested bushes. It is proposed to carry out the same assessment next year for confirmation of the results obtained.

S.I. Vitharana*, L.D. Amarasinghe*, A. Abeyssekara*,
K. Gunasekare (* Entomology Division)

Blister blight

All seedling plants (134 numbers) available were assessed initially for the presence or absence of blister blight. It was observed that no blister blight attack was found in any growing stages of leaf. However, to obtain results that are more meaningful, it is proposed to evaluate them at the time of recovery after pruning and during monsoon period.

A. Balasooriya*, K. Gunasekare (* Pathology Division)

7. Project D/ IN VITRO - Use of *in vitro* techniques

Work on this project was carried out according to the priorities set out last year.

High Priority

7.1 Application of embryo rescue technique to overcome early embryo abortion in wide hybridization

To monitor the growth of zygotic embryo, the following crosses were carried out. The details of the crosses and percentage fruit set after 8-12 weeks from pollination are given in Table 18.

TABLE 18. *Number of flowers pollinated and percentage fruit set 8-12 weeks after pollination*

Crosses	No. of flowers pollinated	Per cent fruit set (8 – 12 weeks after pollination)
TRI 2025 x <i>C. sasanqua</i>	100	2.0
DG 39 x <i>C. sasanqua</i>	75	0.0
TRI 2025 x DG 39	200	7.5
DG 39 x TRI 2025	200	5.0

S.K.Sathyapala, U Sritharan, K. Sarathchandra, H. Jayaweera

7.1.1 Studies on different plant growth regulators on immature embryo cultures of tea

Effect of ABA and BAP on the growth of embryos of 5 MAP, 4 MAP and 3 MAP

Isolated zygotic embryos of crosses TRI 2025 x DG 7 and *C.sasanqua* x TRI 2023 were used to study the effect of abscisic acid (ABA), BAP and coconut water on the growth of immature embryos. Germination rate, mean shoot and root length are being monitored. The treatments used are:

1. Control- 1/2 MS medium without growth regulators
2. 0.5 mg/l ABA only
3. 0.5 mg/l ABA + 0.2 mg/l BAP
4. 0.2 mg/l ABA + 0.1 mg/l BAP
5. 20% Coconut water

This experiment is in progress.

S. K. Sathyapala, H. Jayaweera, K. Sarathchandra

7.2 Micropropagation of tea

7.2.1 Studies on effect of surface sterilants in combination with antibiotic on surface sterilization of nodal explants

An experiment was carried out to control common contaminants that are found to interfere with the establishment of tea nodal explants. "Cefatoxim", an antibiotic that is widely used and reported to be effective in surface sterilisation of woody plant tissue culture, was used for this study. A two-step procedure was adopted. Explants were surface sterilised, using $\text{Ca}(\text{OCl})_2$ followed by Cefatoxim (Table 19). Each treatment consisted of 20 replicates.

TABLE 19 Concentrations of $\text{Ca}(\text{OCl})_2$ and Cefatoxim used as treatments

Surface sterilent	Treatments
$\text{Ca}(\text{OCl})_2$ (Primary sterilant)	25%, 50% and 75% (w/v) in combination with different soaking periods (15, 30 and 45 min.)
Cefatoxim (secondary sterilant)	5%, 10% and 15% (w/v) in combination with different soaking period (5, 10 and 15 min.)

It was found that 75% $\text{Ca}(\text{OCl})_2$ for 30 min. followed by 10% Cefatoxim for 15 min. was the most effective treatment. Using this treatment, 20% aseptic cultures could be obtained.

T.M.Sarathchandra

7.2.2 Development of improved direct rooting method for *in vitro* multiplied shoots

The requirements necessary for *ex vitro* rooting of microshoots are being investigated to improve rooting ability of *in vitro* multiplied shoots and to reduce the time period required for hardening of plantlets. *In vitro* multiplied shoots were treated by dipping the basal ends in different concentration and combination of growth regulators before planting them in various soil mixtures. The following combination of growth regulators and soil media were used for the study.

Growth regulator combinations:

1. Control – Without growth regulators
2. 2 mg/l IBA solution
3. A mixture of IBA : NAA (2: 0.5) as powder form

Soil mixtures:

1. Control – Ordinary soil
2. Sand : vermi compost- 2: 1

This study is in progress.

S.K.Sathyapala, Umah Sritharan, N.Karunatillake

7.2.3 Direct and indirect somatic embryogenesis for clonal multiplication and screening of variants for biotic and abiotic stresses

7.2.3.1 Somatic embryogenesis in stem explants

Callus formation in stem explants was observed when stem explants were cultured on MS medium supplemented with 2, 4-D, NAA and Kinetin. In some of the cultures, organogenesis was observed in the form of roots only.

This experiment is in progress to study the regeneration ability in the callus.

T.M Sarathchandra, N. Karunatilake

7.3 Mutation breeding with γ radiation

As a preliminary study, VP cuttings of clone TRI 2025 were exposed to radiation doses from 2Kr to 10 Kr (2, 4, 6, 8 and 10 Kr) to find out the LD50 value. LD 50 value for VP cuttings was found at 5.4 Kr. Steps are also being taken to find out the LD 50 value for *in vitro* shoot cultures of clone TRI 2025.

T.M.Sarathchandra

Low priority

7.4 Induction of homozygous double haploids through anther and pollen culture for their use in tea breeding program

Experiments to induce embryogenesis in anther callus and microspore cultures of tea are in progress.

S. K Sathyapala, K Sarathchandra, H.Jayaweera

8. Issue of cuttings

8.1 Up-country

Cuttings of the following clones were issued to the Tea Development Project funded by the Asian Development Bank (ADB):

TRI 3000 series: 3013, 3014, 3016, 3018, 3019, 3020, 3025, 3047, 3051, 3052, 3055, 3069, 3072, 3073

TRI 4000 series: 4006, 4024, 4042, 4049, 4052, 4053, 4054, 4055, 4059, 4061

Date of issue	Place	TRI 3000 Series	No. of shoots	TRI 4000 Series	No. of shoots
24.04.00	Hantana Estate	3013, 3015, 3018, 3019	200-300	4079	300
26.04.00	Gartmore Estate	3015, 3025	1000, 125	4052	125
22.11.00	Great western	3047, 3067	500, 100		
08.12.00	Noorwood Estate	3072, 3073	200		
08.12.00	TSHDA, Gampola	3072	150	4052, 4053, 4071, 4078	200-300
08.12.00	TSHDA, Kandy	3013, 3018, 3072	300, 600, 200	4052, 4053, 4071, 4078	600, 500, 500, 300
26.04.00	Nematology Division, TRI	3015, 3025	1000, 125	4052	125

8.2 Low-country

Details of issue of cuttings for TSHDA:

Date of issue	Place	TRI 3000 Series	No. of shoots	TRI 4000 Series	No. of shoots	Other Clones	No. of Shoots
19.09.00	Matugama	3047	100	4004, 4049, 4052, 4059	50-100		
08.02.00	Ratnapura	3014, 3024, 3043, 3046, 3058, 3043, 3060, 3063	100-300	4014, 4047, 4046	100		
09.10.00	Kegalle	3047, 3063	50-100	4014, 4047, 4049, 4054, 4059	50-100		

Details of issue of cuttings for smallholders in low-country

Date of issue	Smallholder	TRI 3000 Series	No. of shoots	TRI 4000 Series	No. of shoots	Other Clones	No. of Shoots
01.02.00	Mr. J.A.D. Jayanadan	3047	100	4045, 4046, 4047, 4049	100		
31.01.00	Mr. U.Wimalasooriya.	3057	100	4014, 4044, 4056, 4071	100		
24.01.00	Mr. I.H.L.K. Samarajeewa	3014, 3065	100	4014, 4041	100		
26.01.00	Mr. W.M. Jayasekara	3014	125	4059	125		
19.01.00	Mr. A.R.M. Hassim	3058, 3059, 3060	100	4049	100	62/6, H 1/58, 2027	50, 100

18.01.00	Mr. H.K.G. Ranjith	3057, 3058	100	4014,4044, 4046	100		
10.01.00	Mr. R.A.B. Rajapaksha	3014	200	4049	200	2027	100
10.01.00	Mr. H. Sunil	3014	200				
01.11.00	Mr. P.M. Gunadasa	3046	100	4044, 4056, 4059	100		
13.11.00	Mr. W. Rajapaksha					2025	400
24.03.00	Mr. J.N. Kathirarachchi					2025	400
05.10.00	Mr. K.M.R. Gunathilaka	3060,3065	50	4047,4049, 4059	50		
05.10.00	Mr. C. Amarasinghe	3060	50	4049	50	62/1, 62/6, 62/9	200 100 200
06.10.00	Mr. D.C. Senasekara	3047,3060, 3063,3058	50	4004, 4014,4047, 4049, 4059	50-100		
16.10.00	Mr. V.Kudaligama	3055	100	4014,4049, 4059	50	2027	150
01.11.00	Mr. A. Priyantha					2026	100
31.10.00	Mrs. S. Karunawathi					2026	100
31.10.00	Mr. J. Athukorala					2027	100
31.10.00	Mrs. J. M. Siriyawathi					2026	100
31.10.00	Mr. H. Dayawansa					2025	50
02.11.00	Mr. J.A. Gunathilaka	3063	25	4004,4014,	25	2027	25
05.01.00	Mr. S. Thanayamwatta	3047,3058, 3060	50	4014,4049	50	2027	50
03.11.00	Mr. G.G. Nishantha	3058	25			2027	25
30.11.00	Mr. M. Liyanage					2027	300
27.11.00	Mr. J. Athula	3058	50			2027	50
10.01.00	Mr. Y. Ranasinghe			4042	400		
18.01.00	Mr. R.A.D. Abeyratna			4059	100		

9. General

Mr S.W.Gunadasa, who was closely associated with the development of clones, retired on 21st October after completing 34 years of service with the Institute.

9.1 Visitors

- A group of 20 Plantation Monitoring Officers from the Ministry of Plantation Industries were given a lecture on 'Clonal Selection' by Mr. V.Shanmugarajah and demonstration on selection and on identification of clones by Mr. M. Ratnayake and Mr. S.W.Gunadasa – January 16
- A group of 33 Agriculturists, (clients of John Keels Ltd.), from the Netherlands visited the nursery – January 18
- Mr. Sylvain Regollet, a German Student, observed the activities in the Division -February 23
- Groups of final year agriculture students from the Aquinas College visited the laboratory and nursery – March 14 and 15

- A group of third year agriculture students from the Eastern University were given a lecture on 'Development of clones' by Mr. V.Shanmugarajah and demonstration on identification of clones by Mr. M.Ratnayake and Mr. S.W.Gunadasa – June 26
- Two trainee Assistant Superintendents of Agalawatte Plantations Ltd. spent a day in the Division on a familiarization programme – July 07 and 24
- A group of Students of the Dept. of Molecular Biology and Biotechnology visited the laboratory – July 19
- A trainee Assistant Superintendent of Moray Estate spent a day in the Division on a familiarization programme – August 02
- Two Botany special students of the University of Colombo observed the activities of the Division – September 6 – 8.
- Agriculture students and staff of Rajarata University (Wayamba Campus) visited the Division and the nursery. Demonstration on the nursery practices was arranged for them – November.

9.2 Workshops/ Seminars/ Training Programmes/ Meetings

I.D.Singh, Commonwealth Consultant, attended the following:

- 200th E & E meeting and made a presentation on 'Planting materials for sustained productivity and quality' – January 28
- Low-country RSC meeting held at Ratnapura and made a presentation on 'Planting materials for sustained productivity and quality' – March 23
- Workshop on 'National Programme in Plant Breeding' held at the Postgraduate Institute of Agriculture and made a presentation on Tea breeding in Sri Lanka – March 28
- National seminar on 'Protection of Plant Varieties' organized by the Department of Agriculture at the Plant Genetic Resources Centre – April 27
- Seminar on 'Genetically Modified Organisms and their products. Do we need?', organized by the students of the Postgraduate Institute of Agriculture – April 27
- RSC meeting at Ratnapura – September 20
- National workshop on 'Plant Genetic Resources', organized by and held at the Plant Genetic Resources Centre, Gannoruwa, Peradeniya, and presented a paper on 'Tea Genetic Resources in Sri Lanka and their Conservation' – November 8 – 10
- Low-country RSC meeting held at Galle – November 17

V. Shanmugarajah attended the following:

- 200th E & E meeting and made a presentation on 'Planting materials for sustained productivity and quality' – January 28
- Low-country RSC meeting held at Ratnapura and made a presentation on 'Planting materials for sustained productivity and quality' – March 23
- Workshop on 'National Programme in Plant Breeding' held at the Postgraduate Institute of Agriculture – March 28
- National seminar on 'Protection of Plant Varieties' organized by the Department of Agriculture at the Plant Genetic Resources Centre – April 27
- Seminar on 'Genetically Modified Organisms and their products. Do we need?', organized by the students of the Postgraduate Institute of Agriculture – April 27
- Low-country RSC meeting held at Ratnapura – September 20
- National workshop on 'Plant Genetic Resources', organized by and held at the Plant Genetic Resources Centre, Gannoruwa, Peradeniya, and presented a paper on 'Tea Genetic Resources in Sri Lanka and their Conservation' – November 8 – 10
- Low-country RSC meeting held at Galle – November 17
- ADB mother bush project meetings held at Ratnapura, Talawakelle and Colombo

All Divisional Staff continued to participate in the various programmes relating to their respective disciplines. In particular, these involved Messrs M.T.K. Gunasekare, M. Ratnayake, P.D. Upali, S.W. Gunadasa, A.K. M. Jayasena and J.H.N. Piyasundara.

9.3 Publications /Posters

Gunasekare, M.T.K and Evans, P.K. (2000). *In vitro* rooting of microshoots of tea (*Camellia sinensis* L.). Sri Lanka J. Tea Sci. Vol. 66, Part 1& 2 (In press)

Gunasekare, M.T.K and Evans, P.K. *In vitro* shoot organogenesis in callus derived from stem tissue of tea (*Camellia sinensis* L.). Sri Lanka J. Tea Sci., Vol. 66, Part 1& 2 (In press)

Gunasekare, M.T.K and Evans, P.K Isolation and *in vitro* culture of mesophyll protoplasts from tea (*Camellia sinensis* L.). Sri Lanka J. Tea Sci., (In press)

Mewan, K.M. Liyanage, A.C. Everard, J.M.D.T., Gunasekare, M.T.K. and Karunanayaka, E.H. (2000). Random Amplified Polymorphic DNA (RAPD) markers reveal genetic relatedness of tea (*Camellia sinensis L.*) clones in Sri Lanka. Proc. of 56th Annual Session of SLAAS, 93p

Singh, I.D. and Gunasekare, M.T.K. (2000). Conservation of Tea Genetic Resources. TRI UPDATE, Vol. 5(1):1-2

Singh.I.D., Ratnayake. M, Gunasekare.M.T.K. and Shanmugarajah.V. Tea Genetic Resources in Sri Lanka and their Conservation. Proceedings of the National Seminar on Plant Genetic Resources (in press)

Singh I.D. Genetic base of tea plantations in Sri Lanka. TRI Jubilee Volume (In press)

Singh.I.D., Shanmugarajah.V , Ratnayake. M, Sritharan, U and Gunadasa S.W. Tea Breeding in Sri Lanka (A review). TRI Jubilee Volume (In press)

9.4 Papers submitted

Singh.I.D., Paskarathewan.R. and Shanmugarajah.V. Tea seed and its handling for raising seedlings (submitted for Tea Bulletin)

9.5 Training Programmes conducted

Dr I.D.Singh, Commonwealth Consultant, continued to conduct monthly training programmes for the Divisional Staff.

9.6 Services

Divisional staff advised the growers on propagation of cuttings and seeds and on the maintenance of seed gardens. They also helped several estates in the identification of clones.

9.7 Correspondence

The Division had 222 correspondences with growers on various matters.

SOILS AND PLANT NUTRITION DIVISION

Acting Head - L.S.K.Hettiarachchi

Applied Research

Thrust A 15 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

The Soils and Plant Nutrition Division has been involved in the work, recently carried out by the Soil Science Society of Sri Lanka, in relation to establishing benchmark soil profiles at provisional series level with a view to upgrading information. This project is funded by the Canadian Soil Science Society. The result of the first phase of the project has been published by the Soil Science Society of Sri Lanka as a reference book. A map of wet-zone soils in Sri Lanka characterized provisionally at series level was also released. The activities in the second phase covering soils in the Intermediate Zone are in progress.

a) Characterization of soils in tea growing estates in mid country

A detail description of the work carried out, along with the objective/s, appeared in the Annual Reports 1998 and 1999.

Soil series and depth maps were prepared 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 Soil and Fertilizer Nitrogen Studies

A15.2.1.1 Application of different proportions of sulphate of ammonia and urea on soil/plant sulphur status and yield Clone TRI 2025, St. Coombs Estate, Talawakelle (May 1979)

The yield obtained during the 4th year of the cycle is given in Table 1.

TABLE 1 *Effect of different proportions of S/A:Urea on yield (kg MT ha⁻¹ yr⁻¹) of mature tea*

<i>Proportions (%)</i> <i>S/A:Urea</i>	<i>Level of N</i> <i>(kg ha⁻¹ yr⁻¹)</i>		<i>Mean</i>	
	240	360		
100:0	2694	3376	3035	
75:25	2732	3111	2922	
50:50	2766	2956	2861	SE 96.6
25:75	2672	2777	2725	
0:100	2555	2954	2754	
Mean	2684	3035	2859	
	SE 61.1			SE 136.6(18 df) CV 8.3%

The yield in the 4th year was significantly higher for the application of N at 360 kg ha⁻¹ yr⁻¹ than 240 N, as in the 3rd year. The yields in the 1st and 2nd years of the cycle were also higher for the application of N at 360 kg ha⁻¹ yr⁻¹ than 240 N, but statistically not significant. During this year as well, the effects of S/A: Urea ratio and the interaction on yield were not significant.

The effect of application of S/A and Urea on soil pH and sulphate sulphur levels (0-15 & 15-30 cm) and leaf sulphur concentrations are given in Tables 2, 3, 4 and 5 respectively.

TABLE 2 *Effect of application of different proportions of S/A: Urea on soil pH at 0-15 cm depth*

<i>Proportions (%)</i> <i>S/A:Urea</i>	<i>Level of N</i> <i>(kg ha⁻¹ yr⁻¹)</i>		<i>Mean</i>	
	240	360		
100:0	4.11	3.98	4.05	
75:25	4.42	4.15	4.28	
50:50	4.73	4.07	4.40	SE 0.097
25:75	4.57	4.30	4.43	
0:100	4.61	4.58	4.59	
Mean	4.49	4.21	4.35	
	SE 0.062			SE 0.138(18 df) CV 5.5%

TABLE 3 *Effect of application of different proportions of S/A:Urea on soil pH at 15-30 cm depth*

Proportions (%) S/A:Urea	Level of N (kg ha ⁻¹ yr ⁻¹)		Mean	
	240	360		
100:0	4.18	4.14	4.16	
75:25	4.19	4.18	4.18	
50:50	4.52	4.14	4.33	SE 0.086
25:75	4.45	4.26	4.36	
0:100	4.67	4.71	4.69	
Mean	4.40	4.29	4.34	
	SE 0.055			SE 0.122(18 df) CV 4.9%

After applying dolomitic limestone at the rate of 1000 kg ha⁻¹ at the time of pruning in 1996, soil pH levels determined in the 4th year, at the 0-15 cm depth where N applied at the rate of 360 kg ha⁻¹ yr⁻¹, was significantly lower compared to 240 N. At 15-30 cm depth as well, it was lower although not quite significant. In spite of this, soil pH levels had decreased significantly and linearly as the proportion of S/A increased in S/A + Urea combinations at both 0-15 and 15-30 cm depths.

TABLE 4 *Effect of application of different proportions of S/A and Urea on soil sulphate sulphur levels at 0-15 and 15-30 cm depths*

Proportions (%) S/A:Urea	$(SO_4)^{2-}S$ (mg kg ⁻¹)	
	0-15 cm	15-30 cm
100:0	274	368
75:25	211	329
50:50	161	251
25:75	159	215
0:100	49	132
SE	24.6	19.9
LSD (0.05)	73.1	59.1
CV %	35.3	18.8
Level of N (kg ha ⁻¹ yr ⁻¹)		
240	162	251
360	180	267
SE	15.6	12.6
LSD (0.05)	46.4	37.4

TABLE 5 *Effect of application of different proportions of S/A and Urea on total Leaf sulphur concentration*

<i>Proportions(%) S/A:Urea</i>	<i>(Total S) (%)</i>
100:0	0.32
75:25	0.27
50:50	0.32
25:75	0.29
0:100	0.32
SE	0.018
LSD (0.05)	0.054
CV %	14.1
<i>Level of N (kg ha⁻¹ yr⁻¹)</i>	
240	0.32
360	0.29
SE	0.011
LSD (0.05)	0.032

As invariably observed, this time there was no significant difference in soil sulphate sulphur levels between the two N rates at either depth, although in the 1999 estimation, a significant difference was seen at 0-15 cm depth. As has been observed and can be expected, 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, as can be seen from Table 5.

Plants (80 per plot) in this experiment were pruned in July and fresh pruning weights taken. Data analysis revealed that there was no significant effect either due to S/A + Urea combination or rate of N on it. This experiment continues.

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A15.2.1.2 Improvement of soil organic matter status and efficiency of uptake of inorganic fertilizer nutrients by incorporation of different sources of organic manure. Clone TRI 2025, Bearwell Estate, Talawakelle - (1990)

The yields obtained in the 5th year of the cycle, soil pH at 0-15 and 15-30 cm depths, and K and Mg levels at 0-15 cm depth are given in Table 6, and 7, 8 and 9 respectively.

During the period October 1999 to September 2000 as well as in the last 2 years, there was no effect of N on yield, although in some previous years such an impact had been noticed. As has been observed, even in this year no effect was found for source and level of organic manure.

TABLE 6 *Effect of different organic manures at 5 and 10 t/ha, and N at 0 and 240 kg ha⁻¹ yr⁻¹ on the yield of tea (kg MT ha⁻¹ yr⁻¹) - Main effects only*

Grand mean 1604					
N	0	240			
	1606	1601	SE	15.9	
Organic Manure	Compost	Cow dung	Mana grass	Guatemala grass	
	1603	1616	1574	1621	SE 22.5
Rates	5t/ha	10t/ha			
	1607	1600	SE	15.9	
CV%	4.9				

TABLE 7 *Effect of different organic manure at 5 and 10 t/ha, and N at 0 and 240 kg ha⁻¹ yr⁻¹ on soil pH at 0-15 and 15-30 cm depth - Main effects only*

Depth(cm)	Grand mean					
0-15	4.69					
15-30	4.65					
	N	0	240			
0-15	4.76	4.62	SE	0.06		
15-30	4.73	4.56	SE	0.05		
	Organic Manure	Compost	Cow dung	Mana grass	Guatemala grass	
0-15		4.58	4.67	4.76	4.76	SE 0.09
15-30		4.57	4.63	4.61	4.78	SE 0.08
	Rates	5t/ha	10t/ha			
0-15		4.63	4.75	SE 0.06		
15-30		4.58	4.71	SE 0.05		
	CV%					
0-15	6.6					
15-30	5.6					

TABLE 8 *Effect of different organic manure at 5 and 10 t/ha, and N at 0 and 240 kg ha⁻¹ yr⁻¹ on soil K at 0-15 cm depth - Main effects only*

Grand mean	298				
N	0	240			
	315	281	SE	18.2	
<i>Organic Manure</i>	<i>Compost</i>	<i>Cow dung</i>	<i>Mana grass</i>	<i>Guatemala grass</i>	
	305	319	296	271	SE 25.7
<i>Rates</i>	5t/ha	10t/ha			
	318	277	SE	18.2	
CV%	30.0				

Although it had been observed earlier that the soil pH level at 0-15cm depth decreased significantly where N was applied at 240 kg ha⁻¹ yr⁻¹ compared to zero, the level estimated in this year did not show this trend although at 15-30cm depth it was seen. However, no effect on soil pH levels has so far been found for source and level of organic manure.

In respect of soil K and Mg, this year's estimation also showed no significant difference either due to organic manure or their levels. Further, no consistent pattern in variation was seen except that in some previous occasions, marginal differences occurred.

In general, both soil K and Mg levels where N has been applied at the rate of 240 kg ha⁻¹ yr⁻¹ were lower than without any N application. This is probably because of the replacement of K and/or Mg from the readily labile exchangeable pool, resulting from lower pH following the added N fertiliser and ionic competition. However, the differences became significant in some occasions although not so in some others. In this year's estimation, soil Mg level where N has been applied at the rate of 240 kg ha⁻¹ yr⁻¹ was significantly lower than without any N application but not the K level although it was lower.

TABLE 9 - *Effect of different organic manure at 5 and 10 t/ha, and N at 0 and 240 kg ha⁻¹ yr⁻¹ on soil Mg at 0-15 cm depth - Main effects only*

Grand mean	52.8				
N	0	240			
	60.9	44.8	SE	4.05	
<i>Organic Manure</i>	<i>Compost dung</i>	<i>Cow grass</i>	<i>Mana grass</i>	<i>Guatemala</i>	
	52.3	57.1	52.7	49.2	SE 5.73
<i>Rates</i>	5t/ha	10t/ha			
	52.5	53.2	SE	4.05	
CV%	37.6				

Plants (50 per plot) in this experiment were pruned in December and fresh pruning weights taken. Data analyses are being carried out. This experiment continues.

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A15.2.1.3 Effect of seven different levels of nitrogen (0 to 720 kg ha⁻¹ yr⁻¹) with compost manure (at 0 and 5 t ha⁻¹ yr⁻¹) soil/plant - N status and yield

Clone DT1, St.Coombs Estate, Talawakelle - (1992)

The yields obtained during the period August 1999 to July 2000, 2nd year of the cycle, soil pH, K and Mg levels at 0-15 cm depth, and leaf K and Mg are given in Tables 10, 11, 12 and 13, and 14 respectively.

As observed in the most of the years, yields in the 2nd year of the cycle also showed a significant increase with increasing rates of N but the pattern of increase was more linearly pronounced. During most of the previous years, this pattern was curvi-linear. So far, compost had no statistically significant overall effect, nor was there an interaction. However, as observed previously, even this year, the increasing rates of N applied together with compost resulted in better yields compared to without compost treatment, and more importantly the difference becoming wider (i.e. 88 MT kg ha⁻¹)

TABLE 10 *Effect of different levels of nitrogen with and without compost on yield*

Treatments N level	Yield (MT kg ha ⁻¹)		
	Compost		
	Nil	5t	Mean
N			
0	1762	1713	1737
120	2030	2156	2093
240	2092	2262	2177
360	2303	2224	2263
480	2196	2386	2291
600	2242	2327	2284
720	2321	2496	2409
Mean	2135	2223	2179
		SE 30.8	SE 81.6
			CV% 5.3

TABLE 11 *Effect of different levels of nitrogen with and without compost on soil pH*

Treatments N level	Soil pH			
	Compost			
	Nil	5t	Mean	
N				
0	4.70	4.65	4.68	
120	4.40	4.50	4.45	
240	4.55	4.45	4.50	
360	4.45	4.30	4.38	SE 0.091
480	4.45	4.45	4.45	
600	4.45	4.35	4.40	
720	4.30	4.65	4.48	
Mean	4.47	4.48	4.48	
		SE 0.049		SE 0.128
				LSD (0.05) 0.391
CV%	4.1			

TABLE 12 *Effect of different levels of nitrogen with and without compost on soil ex. K*

Treatments N level	Soil ex. K (mg kg ⁻¹)			
	Compost			
	Nil	5t	Mean	
N				
0	189	195	192	
120	64	133	98	
240	109	77	93	
360	56	91	73	SE 20.8
480	112	45	79	
600	62	209	135	
720	64	168	116	
Mean	94	131	112	
		SE 11.1		SE 29.4
				LSD (0.05) 89.8
CV%		37.0		

TABLE 13 *Effect of different levels of nitrogen with and without compost on leaf K concentration*

Treatments N level	Leaf K (%)			
	Compost		Mean	
	Nil	5t		
N				
0	1.33	1.48	1.40	
120	1.25	1.43	1.34	
240	1.35	1.31	1.32	
360	1.25	1.30	1.28	SE 0.055
480	1.28	1.35	1.31	
600	1.36	1.40	1.38	
720	1.38	1.31	1.34	
Mean	1.31	1.37	1.34	
		SE 0.029		
				SE 0.078
				LSD (0.05) 0.238
CV%		8.2		

TABLE 14 *Effect of different levels of nitrogen with and without compost on leaf Mg concentration*

Treatments N level	Leaf Mg (%)			
	Compost		Mean	
	Nil	5t		
N				
0	0.23	0.27	0.25	
120	0.29	0.25	0.27	
240	0.26	0.27	0.27	
360	0.24	0.26	0.25	SE 0.012
480	0.25	0.26	0.26	
600	0.28	0.26	0.27	
720	0.27	0.29	0.28	
Mean	0.26	0.26	0.26	
		SE 0.006		
				SE 0.017
				LSD (0.05) 0.052
CV%		9.0		

Surprisingly, pH levels determined in July 2000 from 0-15 cm depth did not vary significantly. Yet, even the levels determined in July 1999 from same depth decreased significantly with the increasing rates of N, despite dolomitic-limestone application at the rate of 1500 kg ha⁻¹ in August 1998. However, trends in relation to both with and without compost treatment still exist. Soil K levels in general are expected to drop when nitrogen is applied excessively to soil, but at this site, no such trends have so far been observed. The quantity of potash supplied is 180 kg ha⁻¹. Magnesium levels estimated in July 2000 from soil at 0-15 cm depth where compost has been applied were significantly higher than without compost treatment application. This could be due to cation exchange capacity improvement and/or the presence in compost. Also, soil Mg levels in general are expected to drop when nitrogen and/or potassium is applied excessively to soil, such a trend being observed with increasing rates of N although quite consistent. The quantity of potash supplied is 180 kg ha⁻¹.

However, as far as leaf K and Mg concentrations are concerned, no significant influences have so far been found with increasing rates of N fertiliser or compost application. This experiment continues.

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A15.2.1.4 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180kg N increments) And K (120-480 kg ha⁻¹ yr⁻¹ K at 180 kg K₂O increments), and frequencies(6, 8 & 12 weekly intervals) on soil/plant nutrient status and yield Clone TC9, Brunswick Estate, Maskeliya - (1998)

The yields obtained from the 3rd year after pruning (i.e. Oct 99 – Sept 00) are presented in Table 15.

No significant increase in yield was observed with increasing rates of N 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 15 *Effect of different rates of N and K applied at different frequencies 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 ₂ O)				SE 22.1
	120	300	480	Mean	
240	5165	5134	5139	5146	
420	5161	5137	5159	5153	
600	5209	5156	5238	5201	

Mean	5178	5142	5179		
		SE 22.1			SE 38.2
<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>Frequency (weeks interval)</i>				
	6	8	12	Mean	
240	5148	5130	5160	5146	
420	5151	5114	5193	5153	SE 22.1
600	5221	5221	5161	5201	
					SE 38.2
<i>K Level</i> (kg ha ⁻¹ yr ⁻¹ K ₂ O)	<i>Frequency (weeks interval)</i>				
	6	8	12	Mean	
120	5224	5130	5182	5178	
300	5146	5162	5119	5142	SE 38.2
480	5150	5173	5213	5179	

Soil pH, K and Mg levels from the 0-15cm depth, and leaf N, K and Mg concentrations, determined in the 3rd year after pruning are presented in Tables 16, 17 and 18, and 19, 20 and 21 respectively.

TABLE 16 *Effect of different rates of N and K applied at different frequencies on the soil pH (3rd year) from the 0-15cm depth - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			
	120	300	480	Mean
3 rd year				
240	4.60	4.63	4.68	4.64
420	4.35	4.33	4.42	4.37
600	4.17	4.36	4.28	4.27
Mean	4.38	4.44	4.46	4.43
		SE 0.060		SE 0.104

TABLE 17 *Effect of different rates of N and K applied at different frequencies on the soil K (ppm; in 3rd year) from the 0-15 cm depth - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			
	120	300	480	Mean
3 rd year				
240	281	379	395	352
420	227	278	388	297
600	250	346	386	328
Mean	252	335	390	231
		SE 14.3		SE 24.8

TABLE 18 *Effect of different rates of N and K applied at different frequencies on the soil Mg (ppm; in 3rd 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 ₂ O)			
	120	300	480	Mean
3 rd year				
240	144	107	97	116
420	86	58	79	74 SE 10.9
600	62	97	55	72
Mean	97	88	77	87
		SE 10.9		SE 18.9

TABLE 19 *Effect of different rates of N and K applied at different frequencies on the leaf N% (3rd year) Main effects only*

N Level (kg ha ⁻¹ yr ⁻¹ N)	K level (kg ha ⁻¹ yr ⁻¹ K ₂ O)			
	120	300	480	Mean
3 rd year				
240	3.32	3.35	3.14	3.27
420	3.40	3.44	3.51	3.45 SE 0.035
600	3.51	3.55	3.51	3.52
Mean	3.41	3.45	3.39	3.41
		SE 0.035		SE 0.061

TABLE 20 *Effect of different rates of N and K applied at different frequencies on the leaf K% (1st and 2nd years) Main effects only*

N Level (kg ha ⁻¹ yr ⁻¹ N)	K level (kg ha ⁻¹ yr ⁻¹ K ₂ O)			
	120	300	480	Mean
3 rd year				
240	1.27	1.30	1.38	1.32
420	1.27	1.31	1.36	1.31 SE 0.014
600	1.23	1.30	1.33	1.29
Mean	1.26	1.30	1.36	1.31
		SE 0.014		SE 0.024

TABLE 21 *Effect of different rates of N and K applied at different frequencies on the leaf Mg% (1st and 2nd years) Main effects only*

<i>N Level</i> (<i>kg ha⁻¹ yr⁻¹ N</i>)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>				
	120	300	480	Mean	
3 rd year					
240	0.18	0.17	0.18	0.18	
420	0.18	0.18	0.18	0.18	SE 0.003
600	0.18	0.19	0.18	0.18	
Mean	0.26	0.26	0.26	0.26	
		SE 0.003			SE 0.004

Soil pH levels determined in the 3rd year also registered a significant decrease with increasing rates of N. The pattern was linear as observed in both the 1st and 2nd years but no significant effect has so far been found in relation to increasing rates of K.

Soil K levels determined in the 3rd year also showed a significant increase with increasing rates of K. Yet, a declining trend was seen with increasing rates of N although in the 2nd year's estimation, it significantly declined. 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 3rd year as well as in the 1st and 2nd years were not influenced significantly with increasing rates of K, while the levels determined this year decreased with increasing rates of N, as in the 2nd year.

Leaf N concentration determined in the 3rd 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 year's estimation as well. So far, leaf Mg concentration has not been influenced either due to increasing rates of N or K, despite the fact that soil Mg level decreased with increasing rates of N this year as well. This experiment continues.

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**A15.2.1.5 Effect of different rates of N (100 to 500 kg ha⁻¹ yr⁻¹ N at 100kg N increments) and K (in 100-500 kg ha⁻¹ yr⁻¹ K at 200 kg K₂O increments), on soil/plant nutrient status and yield
Clone TRI 2025, St. James Estate, Hali Ela - (1990)**

The yields obtained in the 5th year of the cycle are given in Table 22.

TABLE 22 *Effect of increasing levels of potash with N on yield of tea*

N (kg ha ⁻¹ yr ⁻¹)	Yield(kg MT ha ⁻¹ yr ⁻¹)			Mean	
	100	300	500		
100	2567	2622	2584	2591	
200	2648	2616	2698	2654	
300	2567	2670	2561	2599	SE 42.4
400	2686	2724	2751	2720	
500	2598	2609	2609	2605	
Mean	2613	2648	2641	2634	
		SE 32.8			SE 73.5
					LSD(0.05) 206.8

CV % 6.8

So far, no significant influences in yield have been observed due to increasing rates of N or K fertilizers. However, an incremental rate of 10 kg MT in yield per 100kg N was observed in this year also, due to the fitted linear response, but this was not significant. The effects of N and potash applications on soil pH and K status, and leaf N and K are given in Tables 23, 24 and 25 respectively.

TABLE 23 *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	5.12	4.67
200	5.07	4.79
300	5.14	4.87
400	5.03	4.68
500	4.97	4.66
SE	0.061	0.051
Level of K ₂ O (kg ha ⁻¹ yr ⁻¹)		
100	4.98	4.76
300	5.12	4.74
500	5.09	4.70
SE	0.048	0.039
CV %	5.1	4.5

TABLE 24 *Effect of increasing levels of potash with N on soil ex. K status at two depths (main effects only)*

Level of N (kg ha ⁻¹ yr ⁻¹)	Soil ex. K (mg kg ⁻¹)	
	0-15 cm	15-30 cm
100	201	263
200	211	269
300	191	265
400	201	256
500	180	257
SE	9.0	12.1
Level of K ₂ O (kg ha ⁻¹ yr ⁻¹)		
100	163	215
300	200	263
500	229	308
SE	6.9	9.4
CV %	19.3	19.6

Although significant linear reductions in soil pH have been observed with the increasing rates of N fertiliser at both depths, estimations made in 2000 did not show it clearly; yet, such a trend exists. As observed previously, there was no influence with increasing K fertiliser rates.

TABLE 25 *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	3.51	1.52
200	3.47	1.51
300	3.55	1.47
400	3.57	1.49
500	.58	1.47
SE	0.055	0.025
Level of K ₂ O (kg ha ⁻¹ yr ⁻¹)		
100	3.55	1.48
300	3.57	1.49
500	3.49	1.51
SE	0.043	0.019
CV %	6.6	7.1

As has been observed and can be expected, this year's estimation on soil K levels showed a significant increase with increasing potash rates at both depths linearly. But there was no significant influence with increasing N rates, although the K levels estimated in 1997 appeared to decrease with N rates. Leaf N concentration measured this year did not significantly vary either with the increasing rates of N or K fertiliser, unlike in most of the previous years. Leaf K concentration also did not significantly vary either with the increasing rates of N or K fertiliser, except in 1999. Estimation in 1999 showed that leaf N concentration increased with increasing rates of N while it was uninfluenced by increasing K fertiliser rates. This is despite a significant increase in K concentration, unlike in most of the previous years where it was not quite significant. This experiment continues.

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**A15.2.1.6 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield
Clone PK2, Field No 15B, Court Lodge Estate, Kandapola - (1999)**

A mature, tea field pruned in November 1998 was chosen in December 1998. Soil and leaf samples were obtained from the field and analysed for required parameters and thereafter 81 plots each consisting of 40 plants was marked and the experiment commenced in February 1999. In order to ascertain weather there was significant variation among plots, yields were recorded during the period of May 1999 to August 1999 providing 2 N applications at the rate of 60 kg ha⁻¹ yr⁻¹. The covariance analysis carried out did not show any significant variation. The yields obtained in the 2nd year after pruning are presented in Table 26.

TABLE 26 *Effect of different rates of N, K and Mg applied at different rates on the yield (2nd year) of tea (MT kg ha⁻¹) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>				
120	210	300	Mean		
240	4005	3809	3930	3915	
420	4118	4246	4020	4128	SE 79.2
600	4461	4506	4347	4438	
Mean	4195	4187	4099		
		SE 79.2			SE 137.2
<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>Mg level (kg ha⁻¹ yr⁻¹ MgO)</i>				
60	105	150	Mean		
240	3936	3849	3959	3915	
420	4354	3916	4113	4128	SE 79.2
600	4580	4452	4283	4438	
					SE 137.2
<i>K Level</i> (kg ha ⁻¹ yr ⁻¹ K ₂ O)	<i>Mg level (kg ha⁻¹ yr⁻¹ MgO)</i>				
60	105	150	Mean		
120	4285	4195	4104	4195	
210	4356	3846	4359	4187	SE 79.2
300	4229	4176	3892	4099	
					SE 137.2

Yield in the 2nd year increased significantly with increasing rates of N, and the pattern was linear. No significant effect was found for increasing rates of K. There was no interaction either between N and K or between N and Mg.

Soil pH, K and Mg levels from the 0-15 and 15-30 cm depths, determined in the 2nd year (July 2000) after pruning are presented in Tables 27, 28, 29, 30, 31 and 32 respectively.

The pH levels in soil at 0-15 cm depth estimated in July 2000 varied significantly with increasing rates of N but not with K, and the levels decreased linearly with increasing rates of N. However, soil pH levels at the 15-30 cm depth have not so far varied significantly. The trend observed in 0-15 cm depth exists. Soil K levels significantly increased with increasing rates of K at both depths, but these were not influenced with increasing rates of N. Soil Mg levels at both depths did not so far vary significantly either with increasing rates of N or K.

Nitrogen, K and Mg concentrations estimated from the leaf samples obtained in July 2000 did not show any significant influence with increasing rates of N and K fertilisers, except leaf Mg being somewhat influenced by increasing rates of N.

TABLE 27 *Effect of different rates of N, K and Mg applied at different rates on the soil pH - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
0-15 cm					
240	4.40	4.42	4.41	4.41	
420	4.28	4.33	4.31	4.31	SE 0.039
600	4.33	4.28	4.23	4.28	
Mean	4.34	4.34	4.32		
	SE 0.039				SE 0.068
15-30 cm					
240	4.26	4.28	4.29	4.27	
420	4.18	4.17	4.17	4.17	SE 0.043
600	4.11	4.23	4.12	4.16	
Mean	4.18	4.23	4.19		
	SE 0.043				SE 0.075

TABLE 28 *Effect of different rates of N, K and Mg applied at different rates on the soil K(ppm) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
0-15 cm					
240	259	315	327	300	
420	227	284	292	267	SE 13.3
600	250	298	347	298	
Mean	245	299	322		
	SE 13.3				SE 23.0
15-30 cm					
240	228	250	259	246	
420	185	245	281	237	SE 13.5
600	203	261	295	253	
Mean	205	252	278		
	SE 13.5				SE 23.3

TABLE 29 *Effect of different rates of N, K and Mg applied at different rates on the soil Mg(ppm) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
0-15 cm					
240	140	92	122	118	SE 12.9
420	92	102	119	104	
600	100	101	111	104	
Mean	111	98	117		
	SE 12.9				SE 22.3
<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
15-30 cm					
240	80	96	118	98	SE 11.5
420	104	131	106	114	
600	106	143	122	123	
Mean	97	123	115		
	SE 11.5				SE 19.8

TABLE 30 *Effect of different rates of N, K and Mg applied at different rates on the leaf N concentration (%) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
240	3.61	3.51	3.51	3.54	SE 0.054
420	3.65	3.51	3.57	3.58	
600	3.42	3.57	3.61	3.53	
Mean	3.56	3.53	3.56		
	SE 0.029				SE 0.082

TABLE 31 *Effect of different rates of N, K and Mg applied at different rates on the leaf K concentration (%) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
240	1.23	1.22	1.22	1.22	
420	1.24	1.24	1.23	1.24	SE 0.012
600	1.23	1.25	1.21	1.23	
Mean	1.23	1.24	1.22		SE 0.024
	SE 0.017				

TABLE 32 - *Effect of different rates of N, K and Mg applied at different rates on the leaf Mg concentration (%) - Main effects only*

<i>N Level</i> (kg ha ⁻¹ yr ⁻¹ N)	<i>K level (kg ha⁻¹ yr⁻¹ K₂O)</i>			Mean	
	120	210	300		
240	0.20	0.21	0.20	0.21	
420	0.20	0.21	0.20	0.20	SE 0.003
600	0.20	0.20	0.19	0.19	
Mean	0.20	0.21	0.20		SE 0.006
	SE 0.004				

S.Ananthacumaraswamy, P.L.K.Tennakoon, T.C.N.Pieris,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.7 **Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield**
Clone TRI 2026 Field No. 1, Tokatiyamulla Estate, Galle - (1999)

A mature tea field was chosen and soil and leaf samples were obtained from the field and analysed for required parameters. Thereafter, 81 plots each consisting of 40 plants were marked and the experiment commenced in September 1999.

Soil and leaf samples were collected for analysis. Plants in the experimental plots were pruned in May 2000 and pruning weights taken. Stem circumference at 5 cm height from the base, circumference at 2.5 cm below the pruned cut, and number of pruning sticks in the frame were measured and counted in June 2000. In the recovery from pruning, photosynthesis was measured in September 2000

along with soil moisture in the treatments where N given at the rate of 240 kg ha⁻¹ yr⁻¹ at all levels of K and Mg. Data collected over the above period are being analysed for statistical significance. The experiment continues.

H.A.P.Warnasiri, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.8 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield Clone TRI 2027 Field No.8, Talgaswela Estate, Galle - (1999)

A mature, tea field last pruned in August 1998 was chosen in September 1999. Soil and leaf samples were obtained from the field and analysed for required parameters. Thereafter, 81 plots each consisting of 40 plants were marked. The experiment was commenced in September 1999 and treatments have been given. Soil and leaf samples were obtained in August 2000 following 2 treatment applications, and the analyses are being carried out. Data collected are also being analysed for statistical significance. The experiment continues.

H.A.P.Warnasiri, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.9 Application of different proportions (Urea - SA %) of sulphate of ammonia and urea at 200, 300, 400 and 500 kg ha⁻¹ yr⁻¹ N (100-0, 75-25, 50-50, 25-75 and 0-100) on soil/plant-S status and yield Clone TRI 2027, Field No.8, Talgaswela Estate, Galle - (1999)

A mature, tea field last pruned in August 1998 was chosen in September 1999. Soil and leaf samples were obtained from the field and analysed for required parameters. Thereafter, 60 plots each consisting of 40 plants were marked. The experiment was commenced in September 1999 and treatments have been given. Soil and leaf samples were obtained in August 2000 following 2 treatment applications, and the analyses are being carried out. Data collected are also being analysed for statistical significance. The experiment continues.

H.A.P.Warnasiri, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.10 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield Clone TRI 2025 Field No.85,Houpe Estate, Kahawatte - (1999)

A mature tea field was chosen and soil and leaf samples were obtained from the field and analysed for required parameters. Thereafter, 81 plots each consisting of 30 plants were marked in order to commence the experiment in November which is in progress.

C.S.K.A.Ratnayake, T.C.N.Pieris, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.11 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield Clone TRI 2026 Field No4B, Lumbini Estate, Deniyaya - (1999)

A mature, tea field last pruned in June 1998 was chosen in December 1999. Soil and leaf samples were obtained from the field and analysed for required parameters. Thereafter, 81 plots each consisting of 40 plants were marked. The experiment was commenced in December 1999 and treatments have been given. Soil and leaf samples were obtained in August 2000 following 2 treatment applications, and the analyses are being carried out. Data collected are also being analysed for statistical significance. The experiment continues.

M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.12 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield Clone TRI 3019 Field No.2, Ury Estate, Passara - (1999)

A mature, tea field last pruned in September 1997 was chosen in December 1999. Thereafter, 81 plots each consisting of 30 plants were marked. The experiment was commenced in December 1999 and treatments have been applied. Soil and leaf samples were obtained in May 2000 following a treatment application, and the analyses are being carried out. Data collected are also being analysed for statistical significance. The experiment continues.

S.Ananthacumaraswamy, C.S.K.A.Ratnayake, P.L.K.Tennakoon, T.C.N.Pieris, E.M.S.L.Bandara, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

- A15.2.1.13 Application of different proportions (Urea - SA %) of sulphate of ammonia and urea at 200, 300 and 400 kg ha⁻¹ yr⁻¹ N (100-0, 75-25, 50-50, 25-75 and 0-100) on soil/plant-S status and yield**
Clone TRI 3018, Field No.2, Ury Estate, Passara - (1999)

A mature, tea field last pruned in September 1999 was chosen in December 1999. Thereafter, 60 plots each consisting of 30 plants were marked. The experiment was commenced in December 1999 and treatments have been applied. Soil and leaf samples were obtained in May 2000 following a treatment application, and the analyses are being carried out. Data collected are also being analysed for statistical significance. The experiment continues.

S.Ananthacumaraswamy, C.S.K.A.Ratnayake, P.L.K.Tennakoon, T.C.N.Pieris,
 E.M.S.L.Bandara, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

- A15.2.1.14 Effect of three different levels of nitrogen (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) soil/plant - N status and yield**
Clone TRI 2025, Baddegama Estate, Baddegama - (2000)

A mature tea field last pruned in March 1999 was chosen and soil and leaf samples were obtained from the field and analysed for the required parameters. Thereafter, 36 plots each consisting of 30 plants were marked. The experiment, which commenced in June 2000, continues.

H.A.P.Warnasiri, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha,
 G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

- A15.2.1.15 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield Clone TRI 2025 Field No.23, Rangala Estate, Karaliyadda - (2000)**

A mature, tea field last pruned in June 1996 was chosen in May 2000. Soil and leaf samples were obtained from the field and analysed for the required parameters. Thereafter, 81 plots each consisting of 30 plants were marked. The experiment also commenced in May 2000 and it continues.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.1.16 Effect of different rates of N (240-600 kg ha⁻¹ yr⁻¹ N at 180 kg N increments) and K (120-300 kg ha⁻¹ yr⁻¹ K at 90 kg K₂O increments), and Mg (90-150 kg ha⁻¹ yr⁻¹ MgO at 45 increments) on soil/plant nutrient status and yield

Clone TRI 2025 Field No NC5, Midlands Estate, Ratthota - (2000)

A mature, tea field last pruned in July 1999 was chosen in November 2000. Soil and leaf samples were obtained from the field and analysed for the required parameters. Thereafter, 81 plots each consisting of 30 plants were marked. The experiment also commenced in November 2000 and it continues.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.2 Soil and Fertilizer Potassium Studies

A15.2.2.1 Split application of nitrogen and potassium fertilizer in mature tea in relation to N/K antagonism

Clone TRI 2025, St. Coombs Estate, Talawakelle - (1990)

Yields obtained in the 4th year of the cycle, and soil pH, and ex. K and Mg levels at 0-15 cm depth are presented in Tables 33,34,35 and 36 respectively.

TABLE 33 *Effect of split application of potassium on yield of tea (kg MT ha⁻¹ yr⁻¹)*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)			
Initially	6 weeks after	120	240	Mean	
100	0	1798	1978	1888	
80	20	2102	2026	2064	
60	40	2034	1974	2004	SE 85.3
40	60	1831	1947	1889	
20	80	1805	1930	1867	
0	100	1859	1978	1910	
Mean		1905	1972	1938	
		SE 49.3			SE 120.7
					LSD (0.05) 346.5
CV %		12.5			

As has been observed, like in previous years, no significant differences were observed either due to split applications or due to K fertilizer rates. The rate of N supplied is 240 kg ha⁻¹ yr⁻¹.

TABLE 34 *Effect of split application of potassium on soil pH*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)		
Initially	6 weeks after	120	240	Mean
100	0	4.38	4.35	4.36
80	20	4.38	4.15	4.26
60	40	4.43	4.30	4.36
40	60	4.43	4.25	4.34
20	80	4.48	4.20	4.34
0	100	4.35	4.35	4.35
Mean		4.40	4.27	4.34
		SE 0.049		SE 0.118
				LSD (0.05) 0.34
CV %		5.5		

TABLE 35 *Effect of split application of potassium on soil ex: K (mg kg⁻¹)*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)		
Initially	6 weeks after	120	240	Mean
100	0	163	274	218
80	20	229	244	236
60	40	183	250	216
40	60	215	271	243
20	80	195	219	207
0	100	196	254	225
Mean		197	252	224
		SE 11.7		SE 28.6
				LSD (0.05) 82.1
CV %		25.5		

TABLE 36 - *Effect of split application of potassium on soil ex: Mg (mg kg⁻¹)*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)		
Initially	6 weeks after	120	240	Mean
100	0	51.2	47.7	49.5
80	20	58.5	38.5	48.5
60	40	79.0	38.5	58.7
40	60	39.5	57.2	48.4
20	80	55.0	40.5	47.7
0	100	74.0	53.0	63.5
Mean		59.5	45.9	52.7
		SE 4.98		SE 12.19
				LSD (0.05) 35.0
CV %		46.2		

So far, no effect has been seen on soil pH either due to split applications or potash rates. Soil exchangeable K levels estimated after 7½ years of application of potash and N (240 kg ha⁻¹ yr⁻¹) along with split applications has not shown any significant difference, although the 1998 data showed that it significantly dropped linearly due to split applications. Moreover, like in last year's data, the level of soil K where K fertilizer has been applied at 240 kg ha⁻¹ yr⁻¹ was significantly higher compared to 120 potash rate. Until the 1999 estimations, no significant effect was seen on soil Mg levels due to potash rates; however, the level estimated this year showed that it varied for 2 rates of potash although not quite significant. The tendency was that where potash has been applied at 240 kg ha⁻¹ yr⁻¹, the Mg level was lower.

The experimental plots (40 bushes per plot) were pruned in June 2000. Pruning and tipping weights are presented in Tables 37 and 38 respectively.

TABLE 37 *Effect of split application of potassium on fresh pruning weight (kg plot⁻¹)*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)			
Initially	6 weeks after	120	240	Mean	
100	0	62.7	62.0	62.4	
80	20	76.2	68.7	72.5	
60	40	63.2	61.5	62.4	SE 5.39
40	60	68.2	57.0	62.6	
20	80	66.2	70.0	68.1	
0	100	68.2	66.5	67.4	
Mean		67.5	64.3	65.9	
		SE 3.11			SE 7.62
					LSD(0.05) 28.88
CV %		23.1			

TABLE 38 *Effect of split application of potassium on tipping fresh weight (kg plot⁻¹)*

% K fertilizer applied		Rate of K (kg K ₂ O ha ⁻¹ yr ⁻¹)			
Initially	6 weeks after	120	240	Mean	
100	0	2.75	3.25	3.00	
80	20	3.25	3.00	3.13	
60	40	2.38	2.63	2.50	SE 0.146
40	60	2.75	3.00	2.88	
20	80	2.63	3.50	3.06	
0	100	3.38	3.13	3.25	
Mean		2.85	3.08	2.97	
					SE 0.084
		SE 0.207			LSD(0.05) 0.594
CV %		13.9			

No significant variations were found for split K applications and rates of potash on both pruning and tipping fresh weights. However, a trend in improving tipping weight was seen for the rates of potash. Investigations in this experiment were concluded with the completion of two pruning cycles following the recording of tipping weight in December 2000. The data collected over the 2 pruning cycles are to be analysed in detail.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.2.2 Effect of application of 6 levels of potash (60-360 kg ha⁻¹yr⁻¹) with 2 levels of N (240 and 360 kg ha⁻¹ yr⁻¹) on soil/plant K and Mg status and yield of tea Clone TRI 2025, Halgolla Estate, Yatiyantota - (1984)

After the completion of the third pruning cycle and assessments of data, investigations have been concluded. Part of the data was presented to the 195th E & E forum, and the overall results will be published as a scientific paper.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K. Hettiarachchi

A15.2.2.3 Effect of application of 6 levels of potash (48 to 480 kg ha⁻¹ yr⁻¹ K₂O) and 2 levels of Mg (0 and 60 kg ha⁻¹ yr⁻¹ MgO) on soil/plant K/Mg status and yield TRI 2025, Glenanore Estate, Haputale - (1991)

The yields obtained in the 5th year of the cycle are given in Table 39.

As observed from previous years, the yields in the 5th year also did not show any significant variation either with increasing rates of potash or with and without Mg supply.

TABLE 39 *Effect of different N:K₂O ratios and MgO on yield of tea (kg MT ha⁻¹ yr⁻¹) (all plots received 240 kg ha⁻¹ yr⁻¹ of N)*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	1985	2018	2001	
60	4:1	2056	2045	2051	
80	3:1	2052	2058	2055	
120	2:1	2062	2068	2065	SE 28.7
240	1:1	2127	2042	2085	
360	2:3	2006	2065	2036	
480	1:2	2011	2100	2056	
Mean		2043	2057	2050	
		SE 15.4			SE 40.6
					LSD(0.05) 115.4
CV %		4.4			

The effect of N:K₂O ratios and of MgO on soil K and Mg status at 0-15 and 15-30 cm depths are given in Tables 40, 41, 42 and 43 respectively.

As could be expected and has been seen, there was a significant increasing trend in soil K level with increasing K fertilizer rates, at both depths. Although it was evident that this occurred particularly when potash rate exceeded 120 kg ha⁻¹ yr⁻¹ in 1999 estimations, this year's estimation did not show such a rate of potash. There was no significant effect of Mg fertilizer application on soil K level at either depth.

With regard to soil ex: Mg levels estimated in 2000, the increasing rates of K fertilizer did not influence at both depths, although previously a decreasing trend was seen. Although significantly higher Mg levels have been observed where Mg was applied at the rate of 60 kg ha⁻¹ yr⁻¹ compared to nil Mg, estimations in 2000 did not clearly depict this feature except at 15-30 cm depth, the level where Mg applied was higher.

TABLE 40 *Effect of different N:K₂O ratios and MgO on soil ex: K status (mg kg⁻¹) at 0-15 cm soil depth*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	150	160	155	
60	4:1	178	148	163	
80	3:1	178	228	203	
120	2:1	218	160	189	SE 19.0
240	1:1	223	178	200	
360	2:3	248	218	233	
480	1:2	223	220	222	
Mean		202	187	195	
		SE 10.1			SE 26.8
CV %		30.8			LSD (0.05) 76.2

TABLE 41 - *Effect of different N:K₂O ratios and MgO on soil ex: K status (mg kg⁻¹) at 15-30 cm soil depth*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	148	140	144	
60	4:1	153	145	149	
80	3:1	163	168	165	
120	2:1	200	160	180	SE 14.9
240	1:1	215	173	194	
360	2:3	258	208	233	
480	1:2	228	223	225	
Mean		195	174	184	
		SE 8.0			SE 21.1
CV %		25.6			LSD (0.05) 60.0

TABLE 42 *Effect of different N:K₂O ratios and MgO on soil ex: Mg status (mg kg⁻¹) at 0-15 cm soil depth*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	182	215	198	
60	4:1	190	206	198	
80	3:1	206	223	215	
120	2:1	203	223	213	SE 17.2
240	1:1	226	199	213	
360	2:3	185	226	206	
480	1:2	216	204	210	
Mean		201	214	207	
		SE 9.2			SE 24.3
CV %		26.2			LSD (0.05) 69.1

TABLE 43 - *Effect of different N:K₂O ratios and MgO on soil ex: Mg status (mg kg⁻¹) at 15-30 cm soil depth*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	142	174	158	
60	4:1	191	211	201	
80	3:1	188	224	206	
120	2:1	175	177	176	SE 17.3
240	1:1	167	204	186	
360	2:3	147	195	171	
480	1:2	177	209	193	
Mean		170	199	184	
		SE 9.3			SE 24.5
CV %		29.8			LSD (0.05) 69.6

The effect of N:K₂O ratios and MgO on leaf K and Mg is given in Tables 44 and 45 respectively.

TABLE 44 *Effect of different N:K₂O ratios and MgO on leaf K (%)*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	1.45	1.48	0.80	
60	4:1	1.26	1.32	0.82	
80	3:1	1.28	1.26	0.87	
120	2:1	1.24	1.21	0.89	SE 0.045
240	1:1	1.37	1.38	0.89	
360	2:3	1.47	1.54	0.95	
480	1:2	1.47	1.38	0.96	
Mean		1.37	1.37	1.37	
			SE 0.024		SE 0.063
CV %			10.4		LSD(0.05) 0.179

TABLE 45 *Effect of different N:K₂O ratios and MgO on leaf Mg (%)*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	0.28	0.28	0.28	
60	4:1	0.30	0.30	0.30	
80	3:1	0.30	0.29	0.30	
120	2:1	0.28	0.32	0.30	SE 0.006
240	1:1	0.28	0.30	0.29	
360	2:3	0.27	0.30	0.29	
480	1:2	0.28	0.30	0.29	
Mean		0.28	0.30	0.29	
			SE 0.003		SE 0.008
CV %			6.3		LSD(0.05) 0.023

Data for this year as well showed a linear increase in leaf K concentration with increasing rates of K fertilizer. Magnesium concentration however remained unchanged although there was a declining tendency last year. Potassium concentration was not significantly affected by Mg fertilizer application as previously observed, and there was no interaction either.

As previously observed, a significant increase in leaf Mg concentration was observed for the Mg fertilizer treatment at 60 kg ha⁻¹ yr⁻¹, in comparison to nil Mg treatment. In the 1999 estimation, this was not quite shown.

The experimental (50 bushes per plot) plots were pruned in December 2000. Fresh pruning samples were obtained and the weights are given in Table 46. No significant variation was found for the application of either increasing rates of potash or Mg fertilizer, over about 2 pruning cycles.

TABLE 46- *Effect of different N:K₂O ratios and MgO on fresh pruning weight (kg plot⁻¹)*

K ₂ O	N:K ₂ O ratio	MgO		Mean	
		Nil	60kg		
48	5:1	109	97	103	
60	4:1	106	87	97	
80	3:1	111	89	100	
120	2:1	94	82	88	SE 7.5
240	1:1	107	106	106	
360	2:3	101	122	111	
480	1:2	108	88	98	
Mean		105	96	101	
			SE 4.0	SE 10.5	
CV %			23.4	LSD (0.05) 29.8	

Investigations in this experiment are to be concluded soon with the completion of two pruning cycles following recording tipping weight and sample analyses. This experiment is to be continued until April/ May 2001.

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A15.2.2.4 Effect 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
Clone TRI 2025, Field No. 5, St. Coombs Estate, Talawakelle - (1999)

The trial commenced in January, and yield records were maintained during 2000, following treatment applications along with soil fertilisations. Treatments are to be imposed again and plans are under way to make assessments. The trial will continue.

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A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.3 Soil and Fertilizer Magnesium Studies

A15.2.3.1 Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite at 2 levels of N on soil/plant nutrient status and yield of tea
Clone TRI 2025, Kiruwanaganga Estate, Deniyaya - (1993)

Investigations in this experiment were concluded after completing two pruning cycles in 1999. The data collected over 2 pruning cycles are to be analysed in

detail, and as well as collectively with other investigations where sul-po-mag is being tested for its suitability for tea.

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A15.2.3.2 Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite with and without dolomitic-limestone on soil/plant nutrient status and yield
Clone TRI 2025, Hopton Estate, Passara - (1993)

The yields obtained in the 3rd year of the cycle, and the soil pH and ex. Mg levels are presented in Tables 47, 48 and 49 respectively.

TABLE 47 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield of tea*

<i>Treatments</i>	<i>Yield (kg MT ha⁻¹ yr⁻¹)</i>			
	<i>- dolomite</i>	<i>+ dolomite</i>	<i>Mean</i>	
U 709 (Urea)	3777	3658	3717	
U 709 + Kieserite	3603	3555	3579	
U 750 Sul-Po-Mag	3655	3457	3556	SE 74.8
UT Mix. (Urea & S/A)	3461	3652	3556	
T 1130 (S/A)	3893	3792	3843	
Mean	3678	3623	3650	
	SE 47.3			SE 105.7
				LSD (0.05) 306.4
CV %	5.8			

As has been observed from previous years, no significant effect in yield has been found this year as well between these fertilizer treatments, with or without dolomitic-limestone applications.

As observed in previous years, pH levels determined in the 2nd year at both depths significantly dropped where T1130 was applied. However, so far no significant effect was found, with and without dolomitic-limestone treatment. This is probably because the lower rates applied have not significantly influenced the soil pH level.

TABLE 48 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil pH levels at 0-15 and 15-30 cm depths*
Soil pH at 0-15 cm

Treatments	Dolomite		Mean	
	-	+		
U 709 (Urea)	4.64	4.79	4.71	
U 709 + Kieserite	4.59	4.74	4.66	
U 750 Sul-Po-Mag	4.70	4.76	4.73	SE 0.081
UT Mix. (Urea & S/A)	4.51	4.49	4.50	
T 1130 (S/A)	4.06	3.97	4.01	
Mean	4.50	4.55	4.52	SE 0.114
SE	0.051			LSD (0.05) 0.332
CV %	5.1			
<i>Soil pH at 15-30 cm</i>				
U 709 (Urea)	4.78	4.38	4.58	
U 709 + Kieserite	4.79	4.71	4.75	
U 750 Sul-Po-Mag	4.51	4.70	4.60	SE 0.126
UT Mix. (Urea & S/A)	4.90	4.63	4.76	
T 1130 (S/A)	4.45	4.47	4.47	
Mean	4.69	4.58	4.63	SE 0.179
SE	0.080			LSD (0.05) 0.519
CV %	7.7			

No significant effect on soil Mg levels has so far been found, with and without dolomitic-limestone treatment. However, the addition of Mg containing NPK fertilizer mixtures marginally improved the level of soil Mg, at both depths. Moreover, considerably lower levels were found particularly from the plots that received T1130 mixture, and this is probably due to the lower soil pH values. The investigations in this experiment are to be concluded soon with the completion of two pruning cycles following pruning and recording tipping weight and sample analyses. The data collected over the 2 pruning cycles are to be analysed in detail, and also collectively with other investigations where sul-po-mag is being tested for its suitability for tea. This experiment is to be continued until April/ May 2001.

TABLE 49 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil ex. Mg levels at 0-15 and 15-30 cm depths*

<i>Soil ex. Mg at 0-15 cm (mg kg⁻¹)</i>				
<i>Treatments</i>	<i>Dolomite</i>		<i>Mean</i>	
	-	+		
U 709 (Urea)	49.5	44.7	47.1	
U 709 + Kieserite	40.0	43.0	41.5	
U 750 Sul-Po-Mag	30.8	60.0	45.4	SE 5.27
UT Mix. (Urea & S/A)	31.3	36.0	33.6	
T 1130 (S/A)			31.3	30.831.0
Mean	36.5	42.9	39.7	SE 7.46
SE		3.34		LSD (0.05) 21.6
CV %		37.6		

Soil ex. Mg at 15-30cm (mg kg⁻¹)

U 709 (Urea)	57.2	54.5	55.9	
U 709 + Kieserite	60.5	36.7	48.6	
U 750 Sul-Po-Mag	44.7	70.2	57.5	SE 7.53
UT Mix. (Urea & S/A)	30.0	31.5	30.7	
T 1130 (S/A)	33.7	29.2	44.8	
Mean	45.2	44.4	44.8	SE 10.7
SE		4.76		LSD (0.05) 31.0
CV %		47.5		

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.3.3 Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite at 2 levels of N on soil/plant nutrient status and yield
Clone TRI 2025, Waltrim Estate, Talawakelle - (1994)

The yield obtained in the 2nd year of the second cycle after commencement and the soil pH levels and ex. Mg levels are presented in Tables 50, 51 and 52 respectively.

Although during the last two years prior to pruning, significant increases in yield were observed for the application of N at 360 kg ha⁻¹ yr⁻¹ compared to 240 N, during this 2nd year following pruning, there was no such effect as in the 1st year. However, considerable difference was present unlike in the 1st year. Also, there were no significant differences between the other fertilizer treatments.

TABLE 50 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield of tea*

Treatments	Yield (made tea kg ha ⁻¹ yr ⁻¹)			
	Level of Nitrogen (kg ha ⁻¹ yr ⁻¹)			
	240	360	Mean	
U 709 (Urea)	4516	4597	4557	
U 709 + Kieserite	4573	5061	4817	
U 750 Sul-Po-Mag	4676	5259	4968	SE 124.2
UT Mix. (Urea & S/A)	4650	4640	4645	
T 1130 (S/A)	4614	5015	4815	
Mean	4606	4914	4760	
	SE 78.5			SE 175.6
				LSD (0.05) 521.5
CV %	6.4			

As has been observed, significant differences in soil pH levels were not found between 240 and 360 kg N ha⁻¹ yr⁻¹ at either depth. Even in this year's estimation, somewhat lower levels were not recorded at the higher rate of N, as observed in earlier estimations. The pH levels at both 0-15 and 15-30 cm depths determined during the year significantly dropped where T1130 was applied, particularly compared to U709 application, despite dolomitic limestone application in August 1998. The rate of dolomitic-limestone application was 1750 kg ha⁻¹.

The soil Mg levels determined during the year showed an overall improvement as in the last year compared to 1998 estimation (Grand mean was 24.9 for both depths). This was merely on the account of dolomitic limestone application in August 1998, which still persisted. As a result, the marginal improvements observed in the 1998 due to the application of Mg enriched NPK mixtures were no longer seen. As observed earlier, considerably lower level was found in soil Mg where T1130 mixture had been applied even after dolomitic limestone application in August 1998. Although there was no significant difference between the two rates of N, on soil Mg level estimated previously, a lower level was found in 1999. In this year's estimation, a significantly lower level was observed at 0-15 cm depth where N had been applied at the rate of 360 kg ha⁻¹ yr⁻¹ compared to 240 N.

TABLE 51 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil pH levels at 0-15 and 15-30cm depths*

Soil pH at 0-15 cm

Treatments	Level of Nitrogen (kg ha ⁻¹ yr ⁻¹)			
	240	360	Mean	
U 709 (Urea)	4.73	4.78	4.75	
U 709 + Kieserite	4.37	4.53	4.45	
U 750 Sul-Po-Mag	4.56	4.42	4.49	SE 0.107
UT Mix. (Urea & S/A)	4.33	4.38	4.36	
T 1130 (S/A)	3.77	3.95	3.86	
Mean	4.35	4.41	4.38	SE 0.151
SE	0.067			LSD (0.05) 0.448
CV %	6.0			

Soil pH at 15-30 cm

U 709 (Urea)	4.76	4.40	4.58	
U 709 + Kieserite	4.29	4.59	4.44	
U 750 Sul-Po-Mag	4.48	4.51	4.50	SE 0.071
UT Mix. (Urea & S/A)	4.33	4.41	4.37	
T 1130 (S/A)	3.80	4.03	3.92	
Mean	4.33	4.39	4.36	SE 0.101
SE	0.045			LSD (0.05) 0.300
CV %	4.3			

TABLE 52 *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil ex. Mg at 0-15 and 15-30cm depths*

Soil ex. Mg at 0-15 cm (mg kg⁻¹)

Treatments	Level of Nitrogen (kg ha ⁻¹ yr ⁻¹)			
	240	360	Mean	
U 709 (Urea)	86.7	65.0	75.8	
U 709 + Kieserite	85.0	55.0	70.0	
U 750 Sul-Po-Mag	84.3	71.7	78.0	SE 11.65
UT Mix. (Urea & S/A)	86.0	53.7	69.8	
T 1130 (S/A)	56.0	26.3	41.2	
Mean	79.6	54.3	67.0	SE 16.47
SE	7.37			LSD (0.05) 48.9
CV %	42.6			

<i>Soil ex. Mg at 15-30 cm (mg kg⁻¹)</i>			
U 709 (Urea)	53.3	52.7	53.0
U 709 + Kieserite	41.7	55.3	48.5
U 750 Sul-Po-Mag	77.7	60.0	68.8
UT Mix. (Urea & S/A)	50.0	52.0	51.0
T 1130 (S/A)	39.0	46.0	42.5
Mean	52.3	53.2	52.8
SE	6.43		SE 14.37
CV %	47.2		LSD (0.05) 42.7

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A15.2.3.4 Application of increasing levels of kieserite on soil/plant nutrient status and yield Clone TRI 2025, St. Coombs Estate, Talawakelle - (1990)

The yield obtained in the 4th year of the cycle and the effect of kieserite on soil pH levels, and soil Mg levels and leaf Mg concentration are given in Tables 53, and 54 and 55 respectively. The rates of N and K₂O supplied are 300 and 200 kg ha⁻¹ yr⁻¹ respectively.

TABLE 53 *Effect of increasing levels of kieserite application on yield*

<i>Level of kieserite (kg ha⁻¹ yr⁻¹ MgO)</i>	<i>Yield (MT kg ha⁻¹ yr⁻¹)</i>
0	3540
15	3364
30	3320
45	3359
60	3241
75	3262
SE	142.5
CV %	8.5

TABLE 54 - *Effect of increasing levels of kieserite on soil pH at two soil depths*

<i>Level of kieserite (kg ha⁻¹ yr⁻¹ MgO)</i>	<i>Soil pH</i>	
	<i>0-15 cm</i>	<i>15-30 cm</i>
0	4.25	4.85
15	4.05	4.70
30	4.03	4.73
45	4.00	4.55
60	4.38	4.63
75	4.30	4.60
SE	0.103	0.077
CV %	4.9	4.8

As observed in the previous years, no significant effect was found with increasing rates of kieserite fertilizer on yield and on soil pH levels, at both depths.

Soil Mg levels estimated during the year 10 years after completion showed that they increased significantly with increasing rate of kieserite, particularly at 0-15cm depth. This is in contrast to most of the previous estimations where the effect was not clear. It is also observed that soil Mg level at 15-30 cm depth began to increase particularly when the rate of kieserite exceeded 30 kg MgO ha⁻¹ yr⁻¹. Leaf Mg concentrations estimated in 1999 and 2000 were not significantly influenced by the increasing rates of kieserite.

TABLE 55 *Effect of increasing levels of kieserite on soil Mg (mg kg⁻¹) at two soil depths, and leaf Mg(%)*

Level of kieserite (kg ha ⁻¹ yr ⁻¹ MgO)	Soil Mg		Leaf Mg
	0-15 cm	15-30 cm	
0	46.7	38.9	0.27
15	38.7	31.6	0.26
30	47.1	35.0	0.25
45	58.7	71.6	0.27
60	77.9	84.4	0.27
75	102.9	77.5	0.27
SE	10.1	17.5	0.012
CV %	32.6	62.1	9.3

Investigations under this experiment are to be concluded after completing two cycles following pruning in 2001.

H.A.P.Warnasiri, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.2.4 Soil and Fertilizer Phosphorus Studies

A15.2.4.1 Application of increasing levels of phosphate (0 to 120 kg P₂O₅ ha⁻¹ yr⁻¹ at 20 kg increments) fertilizer on soil/plant P status and yield Clone TRI 2025, St. Coombs Estate, Talawakelle - (1989)

Investigations in this experiment were concluded after completing two pruning cycles in 1999. The data collected over this period are to be analysed in detail, and as well as collectively with other ERP fertiliser related investigations, under Item 5 of Basic Research.

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A15.2.4.2 Application of increasing levels of phosphate fertilizer with two methods of application (Broadcast and Incorporated) on soil/plant P status and yield
Clone TRI 2025, Walahanduwa Estate, Galle - (1994)

The yields obtained in the 3rd year of the cycle are given in Table 56. The rates of N and K₂O supplied are 360 and 180 kg ha⁻¹ yr⁻¹ respectively.

TABLE 56 - *Effect of increasing levels of surface applied and soil incorporated ERP on yield*

Levels of P fertilizer (kg ha ⁻¹ yr ⁻¹ P ₂ O ₅)	Yield (MT tea kg ha ⁻¹ yr ⁻¹)		Mean	
	Surface Applied	Soil Incorporated		
0	4481	5119	4800	
20	4813	4160	4486	
40	5067	4629	4848	
60	4928	4722	4825	SE 217.7
80	4938	4296	4617	
100	4846	4229	4537	
120	4955	4600	4778	
Mean	4861	4537	4699	SE 307.9
	SE 116.4			LSD (0.05) 897.0
CV %	11.3			

As observed earlier, no significant effect in yield was found either due to the rates of P as ERP or the mode of application.

The investigations in this experiment are to be concluded with the completion of two pruning cycles following recording tipping weight probably in February/ March 2001. The data collected over this period are to be analysed in detail and also collectively with other ERP fertilizer related investigations, under Item 5 of Basic Research.

H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.3 Estimating crop response to micro nutrients (Zn, B and Mn etc.) at regional level

A15.3.1 Effect of micronutrient foliar feeds such as Multiplex and Kiecite along with 03 conventional zinc sulphate solution combinations (11kg Zn ha⁻¹ yr⁻¹) on growth, quality and yield of tea Clone TRI 2025 Field No.3B, St. Coombs Estate, Talawakelle - (1999)

A trial was laid down in St. Coombs Estate in Talawakelle to compare the efficacy of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations.

A mature, tea field last pruned in August 1998 was chosen in April 1999. Thereafter, 20 plots each consisting of 40 plants were marked. The experiment was commenced in May 2000 and basal soil fertilisation along with foliar fertilisations are being carried out and yields recorded. The yield obtained in the 2nd year is given in Table 57. The rates of N and K₂O supplied are 300 and 150 kg ha⁻¹ yr⁻¹ respectively.

TABLE 57 *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations on yield*

<i>Foliar Fertilisation Formulation</i>	<i>Yield (MT kg ha⁻¹ yr⁻¹)</i>
Water(control)	2727
Zinc sulphate	2854
Zinc sulphate + CES	3052
Multiplex	3091
Kiecite	2901
SE	97.5
LSD(0.05)	300.5
CV %	6.7

No significant variation in yield has so far been found for the foliar fertilisation of the formulations.

The experiment will continue.

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G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.3.2 Effect of micronutrient foliar feeds such as Multiplex and Kiecite along with 03 conventional zinc sulphate solution combinations (11kg Zn ha⁻¹ yr⁻¹) on growth, quality and yield of tea Clone TRI 2025 Field No.3, Baddegama Estate, Baddegama - (2000)

A trial was laid down in Baddegama Estate in Baddegama to compare the efficacy of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with three commonly used foliar spray formulations. A mature, tea field last pruned in March 1999 was chosen in March 2000. Thereafter, 24 plots each consisting of 40 plants were marked. The experiment also commenced at the same time, and basal soil fertilisation and pre- and post-treatment yield records along with foliar fertilisations are being carried out and maintained. Only preliminary data was available as at the end December 2000. The trial is in progress.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa,
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.3.3 Effect of micronutrient foliar feeds such as Multiplex and Kiecite along with 03 conventional zinc sulphate solution combinations (11kg Zn ha⁻¹ yr⁻¹) on growth, quality and yield of tea Clone TRI 2025 Field No.9, Madulkelle Estate, Madulkelle - (2000)

A mature, tea field last pruned in July 1999 was chosen in May 2000. Thereafter, 24 plots each consisting of 40 plants were marked. The experiment also commenced in May 2000 and basal soil fertilisation and pre-treatments yield records are being carried out and maintained. The experiment continues.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

A15.3.4 Effect of micronutrient foliar feeds such as Multiplex and Kiecite along with 03 conventional zinc sulphate solution combinations (11kg Zn ha⁻¹ yr⁻¹) on growth, quality and yield of tea Clone TRI 2025 Field No.3B, Greenwood Estate, Nawalapitiya - (2000)

A mature tea field last pruned in July 1999 was chosen in October 2000 and thereafter 24 plots each consisting of 40 plants were marked. The experiment also commenced in October 2000 and basal soil fertilisation and pre-treatments yield records are being carried out and maintained. The experiment continues.

W.M.S.Wijayatunga, 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

A15.4.1 Effect 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 yield obtained in the 2nd year of the cycle for CY9 and DT1 clones are presented in Tables 58 and 59 respectively. The rates of N and K₂O supplied are 260 and 130 kg ha⁻¹ yr⁻¹ respectively.

As previously observed, no significant effect on yield was found either for type of P fertilizer sprays or concentration. In addition, clone TRI2025 was also tested for the application of TSP and DAP sprays, in order to compare its overall performance with CY9 and DT1. The yields obtained in the 2nd year of the cycle for TRI 2025 clone are presented in Table 60. Even on TRI2025, there was no effect on yield for the type of P fertiliser sprays or concentration.

TABLE 58 *Effect of foliar application of phosphate on yield of clone CY9*

Treatments	Yield (MT kg ha ⁻¹ yr ⁻¹)			
	Type of P fertilizer		Mean	
	TSP	DAP		
Control (water)	2522			
<i>P</i> concentration (%)				
1	2309	2408	2359	
2	2671	2454	2563	SE 80.2
3	2366	2450	2408	
4	2354	2410	2382	
Mean	2425	2431		
	SE 56.70			SE 113.5 (8 df)
				CV % 6.6

TABLE 59 *Effect of foliar application of phosphate on yield of clone DT1*

Treatments	Yield (MT kg ha ⁻¹ yr ⁻¹)			
	Type of P fertilizer		Mean	
	TSP	DAP		
Control (water)	2202			
<i>P</i> concentration (%)				
1	2139	2129	2134	
2	2198	2472	2335	SE 57.6
3	2286	2188	2237	
4	2272	2155	2214	
Mean	2224	2236		
	SE 40.7			SE 81.4 (8 df)
				CV % 5.2

TABLE 60 *Effect of foliar application of phosphate on yield of clone TRI 2025*

Treatments	Yield (MT kg ha ⁻¹ yr ⁻¹)		
	Type of P fertilizer		
Control (water)	TSP	DAP	Mean
<i>P</i> concentration (%)			
1	3036	3243	3140
2	3171	3082	3127
3	2882	2883	2883
4	3072	2972	3022
Mean	3040	3019	SE 63.8
			SE 127.6 (8 df)
			CV % 5.9

This experiment continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A 16 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

A16.4.1 Application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & yearly basis) on soil/plant nutrient status and yield, Clone TC 9, Field No.4, St. Coombs Estate, Talawakelle - (1989)

The experimental plots were pruned in December 1999. Pruning weights were recorded and different rates of dolomitic-limestone along with their strategies applied. 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 understand the overall effects. The yield obtained in the 1st year of the cycle is given in Table 61.

TABLE 61. *Effect of increasing level of dolomitic-limestone application on yield of tea*

Rate of dolomite (kg ha ⁻¹ pruning cycle ⁻¹)	Yield (MT kg ha ⁻¹ yr ⁻¹)				
	Frequency of dolomite application				
	Cycle	Mid-cycle	Yearly	Mean	
Control	1200	-	-	-	
1250	1121	1121	1159	1134	
2500	1073	1134	1075	1094	SE 21.9
5000	1038	1008	978	1008	
10000	912	935	-	924	SE 26.7
Mean	1036	1050	1071		
SE	19.0	19.0	21.9		SE 39.3 (44 df)
CV %		8.3			

As observed previously, there was no significant effect this year as well on yield for the frequency of dolomitic limestone application. But, it significantly varied with increasing rates of dolomitic-limestone, the pattern of decrease being linear and yields dropping sharply beyond 2500 kg ha⁻¹ application. No interaction was found between the rates and frequency of application. But, when considering the rates of applications and frequencies, 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. This experiment is in progress.

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A16.4.2 Application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & Yearly basis) on soil/plant nutrient status and yield

Clone TRI 2025, Field No.2, Moragolla Estate, Imaduwa - (1990)

The experimental plots were pruned in November 1999. Pruning weights were recorded and different rates of dolomitic-limestone along with their strategies applied. 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 understand the overall effects. The yield, obtained in the 1st year of the cycle is given in Table 62.

Even at this experimental site, as observed previously, there was no significant effect on yield this year for the frequency of dolomitic limestone application. Yield data during the last year, which was prior to pruning, showed that the applied dolomitic-limestone rates and yield varied significantly and the pattern of variation was curvi-linear. However, as far as the yield this year (1st year after pruning) is concerned, no significant variation was found for the rates of dolomitic-limestone applied (i.e among 1000, 3000 and 5000 kg ha⁻¹). But surprisingly, yield averaged from the plots where dolomitic-limestone was applied was significantly lower compared to nil dolomitic-limestone application. There was no interaction between the rates and frequency of application.

TABLE 62 *Effect of increasing levels of dolomitic-limestone application on yield of tea*

Rate of dolomite (kg ha ⁻¹ pruning cycle ⁻¹)	Yield (MT kg ha ⁻¹ yr ⁻¹)				
	Cycle	Frequency of dolomite application			
		Mid-cycle	Yearly	Mean	
Control	1598	-	-	-	
1000	1377	1500	1442	1440	
3000	1340	1356	1346	1348	SE 35.8
5000	1382	1463	1412	1419	
Mean	1367	1440	1400	1422	
SE		35.8			SE 62.1 (18 df)
CV %		7.6			

The investigations under this experiment are to be concluded after completing three pruning cycles following tipping in 2001.

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**A16.4.3 Effect of different particle sizes of applied dolomitic-limestone fertilizer on soil pH, soil/plant Mg status and yield
Clone TRI 2023, Mattakelle Estate, Talawakelle - (1991)**

The yield obtained in the 4th year of the cycle, and soil pH, and ex. Mg levels at 0-15 and 15-30 cm depths are presented in Tables 63, and 64 and 65 respectively.

As previously observed, no significant effect on yield was found for the application of dolomitic limestone with different particle size combinations.

TABLE 63 *Effect of different sizes (BS) of dolomitic-limestone particles on yield of tea*

<i>Particle size combinations of dolomitic-limestone</i>					
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
<i>Yield (MT kg ha⁻¹ yr⁻¹)</i>					
	2748	2489	2861	2676	2772
SE	103.0 (33 df)				
CV %	7.6				

* Presently recommended particle size of dolomitic-limestone fertilizer

TABLE 64 *Effect of different sizes (BS) of dolomitic-limestone particle on soil pH*

<i>Particle size combinations of dolomitic-limestone</i>					
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
<i>Depth (cm)</i>	<i>Soil pH</i>				
0-15	4.28	4.48	4.45	4.40	4.25
15-30	4.30	4.33	4.30	4.40	4.23
SE (0-15)	0.094 (33 df)				
CV % 4.3					
SE (15-30)	0.090 (33 df)				
CV % 4.2					

* Presently recommended particle size of dolomitic-limestone fertilizer

TABLE 65 *Effect of different sizes (BS) of dolomitic-limestone particle on soil ex: Mg level*

<i>Particle size combinations of dolomitic-limestone</i>					
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
<i>Depth (cm)</i>	<i>Soil ex: Mg (mg kg⁻¹)</i>				
0-15	44.2	77.2	74.7	74.2	44.2
15-30	52.5	64.7	66.0	60.2	47.0
SE (0-15)	15.5 (33 df)				
CV % 53.1					
SE (15-30)	13.1 (33 df)				
CV % 48.6					

* Presently recommended particle size of dolomitic-limestone fertilizer

As previously observed, no significant effect on soil pH and exchangeable Mg level was found for the application of dolomitic limestone with different particle size combinations, at both depths. This experiment continues.

H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

A16.4.4 Effect of different particle sizes of applied dolomitic-limestone fertilizer on soil pH, soil/plant Mg status and yield
Clone TRI 2025, Talangaha Estate, Nakiyadeniya - (1991)

The yield obtained in the 3rd year of the cycle and soil ex. Mg levels at 0-15 and 15-30 cm depths are presented in Tables 66 and 67 respectively.

TABLE 66 *Effect of different sizes (BS) of dolomitic-limestone particles on yield of tea*

<i>Particle size combinations of dolomitic-limestone</i>					
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	<i>Yield (MT kg ha⁻¹ yr⁻¹)</i>				
	2416	2502	2431	2437	2365
SE	68.5 (33 df)				
CV %	5.7				

* Presently recommended particle size of dolomitic-limestone fertilizer

TABLE 67 *Effect of different sizes (BS) of dolomitic-limestone particle on soil ex: Mg level*

<i>Particle size combinations of dolomitic-limestone</i>					
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
<i>Depth (cm)</i>	<i>Soil ex: Mg (mg kg⁻¹)</i>				
0-15	93.0	69.8	56.5	45.5	56.0
15-30	75.0	61.5	56.0	36.8	49.5
SE (0-15)	12.3 (33 df)				
CV %	39.6				
SE (15-30)	10.3 (33 df)				
CV %	39.0				

* Presently recommended particle size of dolomitic-limestone fertilizer

Even at this site, as previously observed, no significant effect on yield was found for the application of dolomitic limestone with different particle size combinations.

In general, as previously observed, no significant effect on soil exchangeable Mg levels was found for the application of dolomitic limestone with different particle size combinations at both depths, although in some years lower levels and differences were recorded.

Investigations in this experiment were concluded with the completion of two pruning cycles following recording pruning weight. 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 Item 6 of Basic Research.

H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A 17 Development of a fertilizer/dolomite applicator for improving broadcasting efficacy and to overcome labour shortage

Project A17.1 Evaluating and improving the efficiency of fertilizer applicators

A detail description of the work carried out, along with the objective/s, was given in the Annual Reports 1998 and 1999.

Plans are under way to undertake the required modifications to the power operated machine obtained from M/s Freudenberg Industries Ltd, through Tozai Boeki Kaisha Ltd, to test the recently imported portable type and hand operated applicators (Swissmex-dust and granule) that discharge a precisely set amount, and as well as to explore the possibility of developing a simple applicator. This work is to be carried out in collaboration with the Dept. of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya.

N.P.S.N.Bandara, C.S.K.A.Ratnayake, W.M.S.Wijayathunga,
S.M.Hulangamuwa, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A 18 Development of regional analytical laboratories for soil, plant and fertilizer analysis

18.1 Analytical laboratory accreditation

The Analytical Laboratory at Talawakelle participated with international laboratory evaluating programmes on chemical analysis of soil (International Soil-Analytical Exchange – ISE) and plants (International Plant–Analytical

Exchange-IPE). As this activity is being carried out in co-ordination with the Department of Environmental Sciences of the Wageningen University in Netherlands, it will enhance the validity of TRI's soil and plant analytical results.

18.2 Analytical laboratory service

The analytical capabilities at the Soils and Plant Nutrition laboratory in Walahanduwa acquired by the TRI have been greatly improved, with a view to providing better service to tea growers in the south.

18.3 Details of analysis

The number of fertilizer, soil and leaf samples analyzed for advisory purposes during 2000 are given in Tables 68 and 69 respectively:

TABLE 68 *Details of analysis carried out at TRI Laboratory, Talawakelle*

Element	Fertilizer	Soil	Plant	Organic	Total
Nitrogen	601	444	352	45	1442
Phosphorus	557	769	399	41	1766
Potassium	581	995	424	45	2045
Magnesium	413	1384	385	36	2218
Zinc	04	47	148	19	218
Copper		06	29	18	53
PH		2300		28	2328
Carbon		1967		44	2011
Particle size 100mesh	206				206
30 mesh	205				205
10 mesh	01				01
Biuret	02				02
Calcium	02	314	125	19	460
Manganese		31		18	49
Moisture	03				03
Boron			48	16	64
C.E.C.		08		01	09
Sulphur	01	165	26	16	208
E.C.		06		02	08
Sodium					
Lead				05	05
Ammonium nitrogen				12	12
Nitrate nitrogen				12	12
Molybdenum				02	02
Iron				18	18
Water solubility	02				02
Total	2578	8436	1936	397	13347

TABLE 69 *Details of analysis carried out at TRI Laboratory, Walahanduwa*

Element	Fertilizer	Soil	Plant	Organic	Total
Nitrogen	189	100	110	06	405
Phosphorus	159	238	110	06	513
Potassium	184	251	110	06	551
Magnesium	95	190	109	04	398
Zinc	03		80		83
Copper					
PH		822			822
Carbon		420			420
Particle size 100 mesh	16				16
30 mesh	16				16
10 mesh					
Biuret					
Calcium	03	39	32		74
Manganese			01		01
Moisture	01			01	02
Boron			14		14
C.E.C.		05			05
Sulphur					
E.C.	31	11		01	43
Sodium					
Lead					
Ammonium nitrogen					
Nitrate nitrogen					
Molybdenum					
Iron					
Water solubility					
Total	697	2076	566	24	3363

H.A.P.Warnasiri, R.G.A.Wijayawardhana, S.M.Dissanayake, T.C.N.Peries,
 E.M.S.L.Bandara, M.A.Wijedasa, J.R.Y.Abeywardane, W.T.B.D.Priyantha,
 G.P.Gunaratne, S.Ananthacumaraswamy, C.S.K.A.Ratnayake,
 P.L.K.Tennakoon, A.K.N.Zoysa, L.S.K.Hettiarachchi

Basic Research

1 Environmental studies

15 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

The monitoring of rain water quality was commenced, as part of the project in May 1999 in collaboration with the meteorological centers of the TRI Stations at Talawakelle, Ratnapura, Hantana, Passara, Kottawa and Deniyaya. Parameters

such as rainfall, in situ pH, $\text{NO}_3\text{-N}$, $\text{SO}_4\text{-S}$, Mg and Ca are being monitored.

P.L.K.Tennakoon, 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.Amaratunge, P.B.Ekanayake, S.T.Yatawatte,
K.D.Dahanayake, J.A.S.K.V.Jayasinghe, J.C.K.Rajasinghe.

2 Effect of incorporation of organic amendments in an acid soil on nitrogen uptake in tea (*Camellia sinensis* L.) plants

Tea cultivation in Sri Lanka requires environmental management. Presently, there is a growing trend in the production of organic tea in Sri Lanka due growing market for organic tea in the context of the increasing demand for chemical free foods. It is therefore important to undertake investigations on soil fertility issues in organic tea cultivation. Research carried out on the effect of incorporation of various organic amendments in acid tea soils on nitrogen (N) uptake in tea plants is limited. A study was accordingly undertaken using soils of Stasaan Bio Tea Estate, Haputale. Ten-month-old tea seedlings (TRI 2025) were grown in soils treated with three organic amendments (Tea waste, Capoc and Rubber seed meal) at 60, 90 and 120 kg N ha⁻¹ yr⁻¹ respectively. The pot plants were kept in a glasshouse at 60% of field capacity for 12 weeks. During the trial period, periodic changes in soil $\text{NH}_4^+\text{-N}$, $\text{NO}_3^-\text{-N}$, pH and microbial activity were measured.

Mineralization of organic amendments released $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$ to the soil. The $\text{NH}_4^+\text{-N}$ accumulated in the soil were converted to $\text{NO}_3^-\text{-N}$ by nitrification. The C : N ratio of the organic amendments is highly related to the N mineralization. Organic amendments with low C : N ratios had the highest $\text{NH}_4^+\text{-N}$ and $\text{NO}_3^-\text{-N}$ release. Addition of the organic amendments to the soils did not change the soil pH significantly from the desirable range for tea plants. The reduction of soil pH was strongly affected by the production of H⁺ by nitrification. The C : N ratio of organic amendments is the determinant factor for microbial activity in soils. The N uptake of tea plant in tea showed an increase in uptake with the increase of N rates. However, further studies have to be undertaken to corroborate this behavior with different organic amendments.

T.W. Sagarika, S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

3 Effect of applied nitrogen fertilizer in acid tea soil under glasshouse and field conditions

An understanding of nitrogen (N) nutrition of tea plants has mainly been derived from trials evaluating yield response to applied N fertilizers. Nitrogen is supplied to tea plants as urea or ammonium sulphate. At present, the sole source of N for immature tea is sulphate of ammonia. However, the possibility of using urea as a substitute for sulphate of ammonia in immature tea is considered crucial to

minimize the cost of production in tea plantations. It has been reported that urease inhibitors reduce the rate of hydrolysis of urea and thereby helps efficient utilization of applied N fertilizer. However, very little published information is available on the response of urea in the presence of urease inhibitor in tea soils. Therefore, an investigation was conducted under glasshouse and field conditions to ascertain the role of a urease inhibitor (Agrotain) on N nutrition. Additionally a comparison was made between urea and ammonium sulphate on periodic changes of soil pH, NH_4^+ -N and NO_3^- -N concentration and NH_3 volatilization losses.

A glasshouse trial was conducted at the Tea Research Institute, Talawakelle, using soils collected to a depth of 15 cm from Greenland Division, Moragalla Estate, Galle. Urea at three levels of N (200, 300 and 400 kg N ha⁻¹), with and without Agrotain, were used as treatments in a Complete Randomized Design. The soils were covered with polythene bags to trap NH_3 evolving from treated soils. The soils were kept at 60% field capacity for six weeks. During experimentation, changes in soil NH_4^+ -N, NO_3^- -N, pH (water and 0.01M CaCl_2) and volatilized NH_3 were measured.

A field trial was conducted at Greenland Division, Galle, where sulphate of ammonia, urea with and without Agrotain were used as treatments at 240 kg N ha⁻¹ yr⁻¹. The treatments were replicated four times and arranged in a Randomized Complete Block Design. A special structure was designed and installed at the base of the tea plant to trap volatilized NH_3 . During experimentation, periodic changes in soil NH_4^+ -N, NO_3^- -N, pH (water and 0.01 M CaCl_2) and volatilized ammonia were measured for six weeks.

Agrotain did not significantly reduce volatilization losses of ammonia under field conditions in immature tea. The results observed in the field trial were confirmed by the glasshouse study. The application of Agrotain had no significant effect on the changes of soil pH, Ex. NH_4^+ and NO_3^- compared to plane urea and sulphate of ammonia application. The ammonia losses from tea fields were greater in urea treatment compared to that of the ammonium sulphate. Yields obtained from 37 plucking rounds during the period of February to November 2000 were 2729, 2756 and 2896 kg made tea ha⁻¹ for ammonium sulphate, Agrotain treated urea and urea treatment respectively. There was no significant difference between any of the treatments on made tea yield. However, further studies have to be undertaken under different climatic conditions to assess the suitability of urea for immature tea.

D.M.S.Duminda, H.A.P.Warnasiri, A.K.N.Zoysa, L.S.K.Hettiarachchi

4 Effect of Agrotain (urease inhibitor) on the changes of applied urea fertiliser in different tea soils

A glasshouse study was carried out to study the effect of Agrotain (urease inhibitor) on the changes of applied urea fertiliser in soils of three great soil groups where tea is commonly grown. The great soil groups are Red Yellow Podzolic, Reddish Brown Latasolic and Immature Brown Loams. Representative soils were drawn from pits, air dried, passed through 2 mm sieve and used for the study. There were three levels of N (200, 300 and 400 kg N ha⁻¹ yr⁻¹) with and without Agrotain. Altogether, there were 18 treatments with 3 replicates. The treated soils were incubated under glasshouse conditions at 60% field capacity. The soils were analyzed periodically for pH (water and 0.01 M CaCl₂ at 1 : 2.5 soil : solution), NO₃-N, NH₄-N and volatilised NH₃.

Significant differences were observed in Ex. NH₄-N and NO₃-N concentration due to differences in soil groups. The rate of N fertiliser application significantly affected the concentration Ex. NH₄-N but not on NO₃-N. The application of Agrotain did not show any effect on Ex. NH₄-N concentration in the soil. However, Agrotain had a significant effect on NO₃-N concentration in the soil till the end of 2nd week.

In all three soils groups, soil pH (water and CaCl₂) decreased at the end of the trial. There were significant differences among soil pHs in the soil groups. This is due to nitrification of NH₄-N in soil. The level of N application had a significant effect on soil pH only until the second week from treatment application. Thereafter, the level of N showed no effect on soil pH.

P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi.

5 Effect of applied Eppawala Phosphate Rock Fertilizer in Acid Tea Soil in Sri Lanka

The soil used in this study was collected from a long-term phosphate fertilizer field trial started in 1994 located at Field No.7, lower division of Walahanduwa Estate, Galle. The trial comprised annual application of P fertilizer treatments applied at six rates i.e. 20, 40, 60, 80, 100 and 120 kg P₂O₅ ha⁻¹yr⁻¹ with a control treatment. The P fertilizer was provided in the form of Eppawala phosphate rock (ERP) and the P treatments were applied by two methods (broadcasting to the soil surface and incorporation to a depth of 15-20 cm). The nitrogen and potassium fertilizers were applied at the rate of 360 kg N and 180 kg K₂O as urea and Muriate of potash respectively.

In both methods of ERP application, the P-fractionation showed that the magnitude of NaOH-P_i and NaOH-P_o was much larger than that of the resin-P

fraction in all P fertilizer rates. The concentration of all P fractions increased with increasing rates of P fertilizer application. The dissolution of EPR in soil was higher when EPR was applied to soil surface by broadcasting compared to its incorporation.

In both methods, the dissolved P was greater at lower rates of P application compared to their higher rates. More than 50% of P from EPR was dissolved when it was broadcast and the dissolution was relatively lower when EPR was incorporated. Therefore, surface application of P is more preferred than incorporation.

B.C.Walpola, S.M.Dissanayake, H.A.P.Warnasiri,
A.K.N.Zoysa, L.S.K.Hettiarachchi

6 Application of dolomite to tea soils: nutrient availability and estimation of dolomite residues

Tea soils are generally acidic. The application of large amounts of nitrogen fertilizers to tea plantations further acidify the soils. Tea plants prefer to grow in acid soils, but they cannot provide sustainable yields under highly acidic conditions. Therefore, amelioration of soil acidity is important to maintain soil pH in a range (4.5 – 5.5) suitable for tea growing. The application of Dolomite has been recommended to ameliorate soil acidity in tea fields for a long time. Apart from amelioration of soil acidity, Dolomite supply Ca and Mg to tea plants.

The effect of particle size (0.15 mm, 0.5 mm, 1 mm and 2 mm) on the dissolution of Dolomite was studied in glasshouse. A higher dissolution of Dolomite was observed in finer particles (0.15 mm, 0.5 mm) than in coarser particles (1 mm, 2 mm). Higher soil pHs were observed in soils treated with finer particles of Dolomite compared to the coarse particles. This is due to the greater surface area in fine particles. The exchangeable Mg and Ca in soil increased significantly in all Dolomite treatments compared to the control treatment. The exchangeable Al and DTPA extractable Zn, Mn, Cu, and Fe were lower in the soil treated with fine particles of Dolomite.

The effect of different rates (250, 500, 625, 1000, 1250, 2500, 5000 and 10,000 kg ha⁻¹) and frequencies (annual, mid-cycle and end-cycle) of Dolomite application on the dissolution of Dolomite in the field were studied. About 70% of Mg and more than 90% of Ca were dissolved from the applied Dolomite in most of the treatments. The annual application of Dolomite at lower rates was more effective in increasing pH at short intervals compared to the longer intervals (mid-cycle and end-cycle). Irrespective of the frequency of application, the increasing rate of Dolomite application increased soil pH, exchangeable Mg

and Ca while decreasing exchangeable Al and DTPA extractable Mn, Cu, and Fe.

The concentration of K, Ca, and Al in the mother leaf was not significantly affected by the increasing rates of Dolomite application compared to the control treatment. However Mg concentration in the leaf had significantly increased with increasing rates of Dolomite. The Mn concentration in the mother leaf declined with increasing rates of Dolomite application.

N.S.W.Pathirana, S.M.Dissanayake, H.A.P.Warnasiri.
A.K.N.Zoysa, L.S.K.Hettiarachchi

38 Effect of chloride on rate of nitrification in soil with a view to estimating nitrate-nitrogen availability (Effect of incorporating Sulphate of Potash Magnesia SPM) and Kieserite to a recommended NPK mature-tea fertilizer-mixture on soil nitrogen availability)

Detail descriptions of the experiment, along with the objective/s, were given in the Annual Reports 1998 and 1999.

Four treatments imposed at 3 N rates are as follows:

Treatments:

- 1 Urea, Eppawela rock phosphate, Muriate of potash (KCl); as per U709 composition
- 2 Urea, Eppawela rock phosphate and Sulphate of potash (K_2SO_4); MOP in the U709 replaced with SOP totally
- 3 Urea, Eppawela rock phosphate and Muriate of potash, and Kieserite; as per U709 composition and additionally Kieserite
- 4 Urea, Eppawela rock phosphate and MOP, and Sulphate of potash magnesia; A part of MOP replaced with Sulphate of potash magnesia

In addition, 2 soil columns have also been kept fallow. Investigations in this study were completed, and the postgraduate study was also successfully completed. The abstract of the study is as follows.

Nitrogen rates are 240, 360 and 480 kg ha⁻¹ yr⁻¹. 100 cm³ distilled water per tube were applied over the surface of soil daily to simulate rain fall. Treatments along with the rates of N were imposed 4 times on the 4th February, 4th May, 4th August and 4th November 1999. Solutions leached out from the bottom of the tubes were collected daily prior to the commencement and after, and kept in the freezer for 5 days. Total solutions collected over each 5 day-interval were

analyzed for parameters such as pH, conductivity, potassium, calcium, magnesium, chloride, sulphate-sulphur, ammonium-nitrogen and nitrate-nitrogen. Three replicates from each treatment were destructively dismantled after 6 months. Fresh soil removed from each dismantled tube was analysed for pH, ammonium-nitrogen and nitrate-nitrogen. From fresh moist soils, soil solution was extracted by centrifuge method and analysed for potassium, calcium, magnesium, chloride, ammonium-nitrogen and nitrate-nitrogen. Air-dried soil was analysed for potassium, calcium, magnesium, chloride and sulphate-sulphur. Data collected are to be interpreted. This experiment continued till end February 2000.

Sulphate of potash magnesia (SPM; $K_2SO_4 \cdot 2MgSO_4$), an imported new fertilizer material, is now available in the local market. This material contains both K and Mg. Additionally, it supplies sulphur (S) as well. Generally, Mg fertilizers such as kieserite ($MgSO_4 \cdot H_2O$), Epsom salt ($MgSO_4 \cdot 7H_2O$) is not incorporated into urea based fertilizer formulations because of its poor storage and handling qualities. This is attributed to the hygroscopic nature of urea and degree of hydration in Mg containing fertilizers. Growers have inquired whether SPM could be used as a source of Mg fertiliser in the commonly used mixtures, as it has no hydration in its lattice and partly replaces K from MOP which may be economical. In the event of using SPM to formulate a Mg containing NPK mixture from a NPK mixture eg. U709, K supplied from MOP will be partly replaced by SPM as it also contains K. The use of a fertilizer mixture containing SPM may have better nutritional values than U709 because it supplies Mg as well as S. This may be particularly important for soils depleted in Mg. Several tea plantations in the country use considerable quantity of SPM. However, Tea Research Institute (TRI) has not recommended this material due to lack of information on its suitability for tea.

Chloride (Cl⁻) based compounds are said to be restricting nitrification by the interaction of chloride ions with ammonium ions. Therefore, it is hypothesised that the control of nitrification could be achieved by combining N fertilizers with a chloride containing fertilizer material such as MOP. This strategy may help the added N fertilizer to stay in the soil for a longer period, making it available for the plants to utilise for an extended period.

Therefore, a glasshouse leaching study was carried out by incorporating SPM as a Mg source to the most commonly used mature tea fertilizer mixture U709 replacing some amount of MOP along with kieserite in soil profile columns, in order to investigate the effect of chloride (Cl⁻) content in soil on the extent of nitrification.

To fulfil the objectives of the experiment, the presently recommended fertilizer mixture U709 (F1) by the TRI and in fact mostly used, was compared with kieserite and SPM containing fertilizer mixtures (F3) and (F4). Both the mixtures contained the same quantity of Mg, but supplied from kieserite and SPM respectively. Instead of MOP (i.e. KCl) in F1, fertilizer grade K_2SO_4 (SOP) was also chosen and formulated another treatment, and referred as F2, in order to investigate the effects of complete replacement of KCl on nitrification.

The way that the NO_3^- -N content percolated down the profile in F1 and F3 treatments was similar, and the content decreased with increasing levels of N, while the NH_4^+ -N content percolated increased in the same way. In F2 treatments, NO_3^- -N content percolated down the profile decreased with increasing N levels, and in fact the contents were higher compared to F1 and F3, while the NH_4^+ -N content percolated increased, but compared to F1 and F3 fertilisations the contents percolated were considerably low. In F4 treatment, NO_3^- -N content percolated down the profile decreased with increasing N levels, and the contents were higher compared to F1 and F3 but lower compared to F2, while the NH_4^+ -N content percolated increased in the same pattern as F4 fertilization. However, contents of NH_4^+ -N percolated down the profile in F4 and F2 fertilisations were considerably lower than those of F1 and F3. Therefore, it can be concluded that even the partial replacement of commercial MOP with SPM in the F4 treatment that resulted from the supply of Mg while keeping the K content same also allowed the nitrification to take place fairly freely.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi, N.Priyantha

34 Development of a network based programme, for the interpretation of soil, plant and fertilizer analytical data

At the Talawakelle laboratory, a local computer network has been established with a view to developing multi-user accessible software running on Microsoft Windows NT Workstation. This work is in progress.

Support Projects

I) Adaptive fertilizer trials - TRI and TSHDA collaboration

The primary objective of these set of trials is to investigate the efficacy of supplying nitrogen from U709 and T1130 mature tea fertilizer mixtures under smallholder conditions. The field operations of these trials are carried out in collaboration with TRI's and TSHDA's Advisory and Extension centres.

Detail descriptions of the trials, along with the objective/s and some of the 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

to be analyzed collectively in detail in order to draw the final conclusions. However, the results confirm that the application of urea based mixture, U709, for mature tea is superior to sulphate ammonia based mixture, T1130, in smallholder lands. Detail analyses are in progress. 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.Wimaladharm

II) High Forest Estate Problem: Clone TRI 2025 - Die back of shoots

Details of the problem were given in the Annual Report for 1994.

No extensive investigations were undertaken during the year.

S. Ananthacumaraswamy, A.K.N.Zoysa, L.S.K.Hettiarachchi

III) Soil and Plant Sulphur Survey

A preliminary field study was undertaken in four tea growing areas to estimate the sulphur reserves in these soils. Soil and leaf samples were collected from 4-5 tea estates from each region, where solely urea based fertilizer mixtures were used as N-source for the past ten years or more. The sulphate-sulphur content of these soils were extracted using five commonly used extractants. The amounts of sulphur extracted by water, CaH_2PO_4 , 0.25N KCl, 0.5M NaHCO_3 , and $\text{CH}_3\text{COONH}_4$ ranged 5-102, 3-265, 1-96, 25-1606 and 9-317 respectively. Continuous use of urea as a sole source of nitrogen fertiliser for mature tea over a decade has not depleted the exchangeable soil- sulphur reserves considerably. However, some fields show soil sulphur at lower than the critical level with some extractants. The work in relation to this study was completed and will be published.

S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

IV) Estimation of amount of dolomite residues in soil with a view to understanding the rate of dissolution of rate of dolomite (0,2000 & 4000 kg ha⁻¹ cycle⁻¹) from 5 particle size combinations (100% pass through 100 mesh and 100 % pass through 30 mesh, 75: 25, 50:50, and 25:75 respectively)

A new glass house experiment commenced in order to investigate the effect of the rate and size of dolomite particle on its rate of dissolution. An attempt was made to develop a suitable strategy to quantify the amount of dolomite that

remained undissolved in the soil as time passes. Samples were obtained three times. Results are being analysed, and it is intended to extend this study to assess the effect on the plants.

V) Effect of incorporation of organic amendments on nitrogen release in an acid tea soil

A glasshouse incubation study was carried out using soil (Hapludult) collected to a depth of 150 mm from Stassen Bio-tea project at Haputale. The organic materials used in this study were neem seed meal, capock seed meal, rubber seed meal and waste tea. The pattern and the amount of N-release from soils amended with organic materials were compared with those from soils that received urea at 60 and 120 kg N ha⁻¹ and an untreated control (un-amended soil). The quantity of organic matter required to provide 60 and 120 kg N ha⁻¹ was estimated assuming 5% N-releasing efficiency. The treated soils were incubated for 12 weeks at 60% field capacity.

The mineralization of organic materials resulted in the release of NH₄⁺ and NO₃⁻ to the soil. Its magnitude was in the order of capock seed meal > neem seed meal > rubber seed meal > waste tea. The ammonification process reached a maximum in the third week and thereafter the NH₄⁺ was converted to NO₃⁻ by nitrification. The organic materials with low C : N ratios had the highest N-release in the soil. The mean N-mineralisation efficiency of neem seed meal, capock seed meal, rubber seed meal and waste tea in this soil are 35%, 32.5%, 17.5% and 7.5% respectively. Neem seed meal, capock seed meal, rubber seed meal treatments gave the maximum pH reduction. But waste tea did not significantly reduce soil pH. The reduction of soil pH was mainly due to acidity produced through nitrification. The soils amended with waste tea had the highest microbial activity followed by rubber seed meal, capock seed meal, neem seed meal, urea amended soil and control soils. The C : N ratio of the organic materials seems to be the critical factor that determines the microbial activity in soil.

K.G.M.C.P.B.Gajanayake, A.K.N.Zoysa,
L.S.K.Hettiarachchi, A.Anandacoomaraswamy

Publications

Zoysa, A. K. N. (2000) The fate of phosphate fertilizers in an Ultisol in Sri Lanka: phosphorus availability to tea (*Camellia sinensis* L.) In Plantation Tree Crops in the New Millennium: The Way Ahead. (Vol 1) (Ed. E. Pushparaj) pp 347-364. The Incorporated Society of Planters, Kuala Lumpur, Malaysia.

Zoysa, A. K. N., Gajanayake, K. G. M. C. P. B., Hettiarachchi, L. S. K. and Anandacoomaraswamy, A. (2000) Effect of incorporation of organic materials

on nitrogen release pattern in an acid tea soil in Sri Lanka. Proceedings of the 13th International IFOAM Scientific Conference (Eds. T Alfoldi, W Lockeretz and U Niggli) p 79, Basel, Switzerland.

Gunaratne, G.P., Jayakody, A.N., and Hettiarachchi, L.S.K., (2000). Effects of intensive cropping on potassium status of soils in tea growing areas in Sri Lanka. *Tropical Agricultural Research*, **12**, Accepted for publication and released on 16th November 2000, at the 12th Annual congress of the PGIA.

Thesis

Gunaratne, G.P. (2000). Characterization of Sri Lankan acid tea soils in relation to soil K dynamics and K uptake by tea (*Camellia sinensis*. L) M.Phil thesis, University of Peradeniya, Sri Lanka.

General

Dr L.S.K.Hettiarachchi served as:

- a) A member of the Working Group on Fertiliser to the Sri Lanka Standards Institute
- b) A member of the Technical Committee on Organic Fertiliser to the Sri Lanka Standards Institute
- c) A member of the Steering Committee of the second phase of project on Establishment of Benchmark soil profiles at provisional series level, jointly carried out by the Soil Science Society of Sri Lanka and Canadian Soil Science Society

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 G.P.Gunaratne was enrolled on a post graduate degree programme leading to PhD, on Sulphur Nutrition in Tea in Sri Lanka, at the PGIA of the University of Peradeniya, Peradeniya w.e.f. 01st October. Mr E.M.S.L.Bandara, Technical Assistant, tendered his resignation from the services of TRI w.e.f. 30th April. Mr W.M.S. Wijayatunga, Experimental Officer, continued his Master of Science programme on Analytical Chemistry at the PGIS, University of Peradeniya.

Meetings and Seminars

Dr L.S.K.Hettiarachchi delivered a lecture on “Research findings and recommendations on ERP for tea” for a seminar on “Advantages of using ERP fertiliser for tea plantations” organised by the Lanka Phosphate Limited (LPL), and held at Ratnaloka Tour Inns, Ratnapura, on 31st January.

Dr A.K.N.Zoysa attended the 05th E & E (Sinhala) meeting held at NIPM Auditorium, Athurigiriya, on 11th February.

Dr L.S.K.Hettiarachchi attended the RSC I (Nuwara Eliya) meeting, held at the TRI Auditorium, Talawakelle, on 29th February.

Dr L.S.K. Hettiarachchi participated at a meeting organised by the Lanka Phosphate Limited (LPL) for ascertaining problems associated with the use of Eppawela Rock Phosphate in tea sector, along with the Director, National Fertilizer Secretariat (NFS), and the officials of LPL, held at NFS's office in Colombo on 15th March.

Dr A.K.N Zoysa attended the RSC VI (Ratnapura) meeting, held at the Silver Ray Hotel, Pelmadulla, on 20th March.

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa attended the RSC VII (Galle) meeting, held at the Conference Hall, Walahanduwa, on 5th May.

Dr A.K.N.Zoysa attended the International Planters' Conference: Plantation Tree crops in the New Millenium- The Way Ahead, held in Kuala Lumpur, Malaysia during 17th to 20th May, where he presented a poster entitled “The Fate of Phosphate Fertilisers in an Ultisol in Sri Lanka: Phosphorus Availability to Tea (*Camellia sinensis* L.)”.

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa attended the RSC III (Uva) meeting, held at the Bandarawela Hotel Conference Hall, Bandarawela, on 27th June.

Drs L.S.K.Hettiarachchi, A.K.N.Zoysa, Mr G.P.Gunaratne and Mrs S.Ananthacumaraswamy attended the 200th and 201st E & E meeting, held at the TRI Auditorium, Talawakelle, on 28th January and July.

Dr L.S.K.Hettiarachchi attended the RSC (Ratnapura) meeting, held at the TRI low country station's Sports Club Hall, Ratnapura, on 20th August.

Dr L.S.K.Hettiarachchi delivered a lecture on “Research findings and recommendations on ERP for tea” for a seminar on “Advantages of using ERP fertiliser for plantation crop sector” organised by the Lanka Phosphate Limited (LPL), held at the Divisional Secretariat's Auditorium, Akuressa, on 25th August.

Dr A.K.N.Zoysa attended the 13th International Scientific Conference organised by the International Federation of Organic Agriculture Movements' (IFOAM), held in Basel, Switzerland, during 30th August to 3rd September, where he presented a paper entitled "Effect of incorporation of organic materials on nitrogen release pattern in an acid tea soil in Sri Lanka".

Dr L.S.K.Hettiarachchi, Mr G.P.Gunaratne and Mrs S.Ananthacumaraswamy attended the 12th PGIA Annual Congress, held at the PGRC Auditorium, Peradeniya, on 16th and 17th November, where Mr G.P.Gunaratne presented a paper entitled "Effects of intensive cropping on potassium status of soils in Tea growing areas of Sri Lanka".

Dr A.K.N.Zoysa attended the RSC VII (Galle) meeting, held at the Sun Shine Hotel, Unawatuna, on 17th November.

Dr L.S.K.Hettiarachchi addressed the members of the 06th E & E (Sinhala) meeting on the New Fertiliser Policy, held at TRI Auditorium, Talawakelle, on 11th February.

Drs L.S.K.Hettiarachchi and A.K.N.Zoysa, joined the Director, TRI, at a meeting where the members of the Planters' Association discussed the new Fertiliser Policy, held at the TRI Auditorium, Talawakelle, on 11th December.

Training programmes and workshops

Dr L.S.K. Hettiarachchi attended the International Training Programme on Computer Simulation for Crop Growth and Resource Management, jointly conducted by the International Fertiliser Development Centre in U.S.A and Tamil Nadu Agricultural University (TANU) in South India, held in Coimbatore during 21st February to 3rd March.

Dr L.S.K. Hettiarachchi attended a symposium on the management of compost conducted by the Community Environmental Initiatives Facility, implemented by the Ministry of Forestry and Environment, held at the Sausiripaya Auditorium, Colombo, on 6th April.

Dr L.S.K.Hettiarachchi, in collaboration with the National Fertilizer Secretariat, conducted a workshop on the Regulation of Fertiliser Act No 88 of 1988 and its Implementation in the Quality Control Programme for TRI Advisory and Extension officers, at the TRI Auditorium, Talawakelle, on 18th August.

Mr C.S.KA. Ratnayake commenced a 10-month training programme in Agricultural Engineering at the Larenstein International Agricultural College in the Netherlands in August.

Dr L.S.K. Hettiarachchi attended a workshop in Regional Capacity Building, on Global Changes Issues in South Asia conducted by the Sri Lankan National Committee of the International Biosphere-Biosphere Programme, held in Mt. Lavinia Hotel, Colombo, on 23rd September.

Trainees

Mr D.M.S.Duminda, and Ms B.C.Walpola, N.S.Wijesekara and T.M.Sagarika, final year students from the Agriculture Faculty of the University of Ruhuna, Matara, successfully completed their research projects in the Division during the latter part of the year.

Two and three Trainee Assistant Superintendents from Agalawatte Plantations Ltd. and Kotagala Plantations Ltd respectively, visited the Division in order to familiarize themselves on soil fertility and plant nutrition aspects on 19th June and 28th November respectively.

Visitors

A group of students from the Faculty of Agriculture, University of Peradeniya, visited the Division in order to familiarize themselves on soil, plant and fertilizer tea related aspects on 9th June.

Mr N. Wickremasinghe, Deputy General Manager, Uda Pussellawa Plantations Ltd. visited the Division, in order to discuss some aspects on soil fertility and tea plant nutrition on 06th November.

A 25.2 - Modifications to the trough with a view to reduce the cost of electrical energy

Preliminary trials/tests indicated that the modification envisaged to the trough would lead to more recycling of spent air. As such, it would not be feasible, that is, it would be less attractive compared to the existing system. Hence, the project was terminated.

M T Ziyad Mohamed, G L C Galahitiyawa

A 26.1 - Developing and evaluating solar energy techniques for tea drying

The solar field to pre-heat the air used for tea drying has been commissioned and the performance is being monitored. Preliminary results indicate a saving of about 25 - 34% saving on fuel used for tea drying. However, during the year under review, much data could not be collected due to frequent breakdown of the heat exchanger coupled to this system. The cone section of the heat exchanger has to be replaced. The performance of the system will be monitored for another 6 months before any firm recommendation is made to the industry.

M T Ziyad Mohamed, S Koneswaramoorthy,
G L C Galahitiyawa, W M U A B Marapane

A 27.1 - Evaluating new type of paper sacks

The aim of this project is to recommend packing materials with good moisture barrier properties and without any foreign odour. These trials are ongoing. Based on results obtained, new paper sacks (i.e. from different manufacturers) are recommended to the industry from time to time. The cost of multi-wall paper sacks had dropped from Rs. 95/- in 1995 to about Rs. 70/- in 2000. Following recommendations from TRI with new type of sacks, more suppliers have emerged, thereby contributing to a lowering of prices.

During the period under review, new packing materials from two different manufactures were received for testing. The trials will commence during early part of 2001.

M T Ziyad Mohamed, W S Botheju, S H Priyanthi, L Jayasinghe

A 28.1 - Optimum condition for best grade mix in Hatton district

A 28.2 - Optimum condition for best grade mix in Uva

An Environmentally Controlled Miniature (ECM) manufacturing unit was procured from Teacraft (UK) Ltd. Although these projects were to commence in the year 2002 as per Corporate Plan of the Institute, these trials would now commence in 2001. To familiarise with the instrument, a few trials have been carried out.

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 43 - Development of direct firing heaters for drying tea

As decided by the Consultative Committee on Research of the Tea Research Board, this project was abandoned because the teas could get contaminated with this type of firing/drying.

M T Ziyad Mohamed

B 45 - Quality of made tea - Orthodox *vis-a-vis* Orthodox - Rotorvane

Since the effect of type of manufacture on quality of made tea would be more pronounced during the quality season, that is, December-February in Dimbula, arrangements have been made to replace the existing roll breaker trays with trays having No 5 and 6 meshes. The trials will commence in January 2001 at St. Coombs Factory.

M T Ziyad Mohamed, K Raveendran

B 46 - Increasing the efficiency of FBD-3 drier

On summarizing the data collected over time, indications were that the best performance was achieved when the weir height in all three sections were kept at 4", which is similar to a flat bed FBD. The project has been terminated.

W S Botheju, S H Priyanthi, L Jayasinghe

B 47 - Designing a Tea Bulking Machine

A prototype bulking machine was designed, developed and tested. Based on the performance, a commercial scale unit was fabricated and the performance of the unit was monitored at St. Coombs Factory. The results indicate that the bulking of tea is satisfactory. However, as the capacity of the machine is low, the quantity which could be bulked is not adequate to pack enough number of chests to make an invoice. Modifications to the bins are accordingly being carried out to facilitate adequate bulking on discharge from the bins. This is in progress.

M T Ziyad Mohamed, K Raveendran

B 48 - Designing a Dust Collector

When Fluid Bed Driers are used for drying tea, dust particles are blown out from the drier due to high velocity of air employed. As a result, it is difficult to go close to the drier and make the necessary adjustments for the drier to perform to its potential. This could also cause health hazards to the officers and workers. As such, it is important to have dust collectors fixed to these driers. A collaborative project with University of Moratuwa to design and fabricate a closed-type dust collector for FBD driers used in tea factories is under way. The documentation is being finalized.

Although a closed type system would be ideal as far as dust extraction is concerned, it could be very expensive. Hence, it was decided to fabricate a cyclone separator of high-gas-rate type only to remove the fine particles from the drier. According to the particle size analysis conducted on blowout samples at St. Coombs Factory, the size of particles were found to be about 50 μm . The dust collector was designed and fabricated and some preliminary trials were carried out. The results were encouraging. This work is in progress.

M T Ziyad Mohamed, K Raveendran, S Koneswaramoorthy

Designing a Sand Separator

As reported last year (AR 1999), a Sand Separator was designed, fabricated and tested in collaboration with Department of Agricultural Engineering, University of Peradeniya. The performance of the sand/grit separator could be briefly summarized as follows:

- i. The throughput of the machine is about 35 – 75 kg/hour, depending on the grade cleaned, amount of sand/grit present in the sample etc
- ii. The unit developed has about 8 channels for cleaning. Increasing the number of channels could increase the output in a new unit.
- iii. The cleaning is satisfactory. Some data are given below for easy reference:

TABLE 2

	Feed Sample	Cleaned Sample	ISO 3720* requirement
Dry matter (%)	93.19	89.42	–
Total ash (%)	42.14	5.78	4 – 8
Water soluble ash (%)	4.84	62.96	45 (Minimum)
Acid Insoluble ash (%)	35.52	0.28	1 (Maximum)

* Minimum requirement

From the above, it is evident that the cleaning is satisfactory.

The machine is installed at St Joachim Factory for demonstration purposes. There have been several inquiries from the end users and tea machinery manufacturers about the performance of the machine. Some of them also visited the factory to inspect the machine.

M T Ziyad Mohamed, G Galahitiyawa, W M U A B Marapona

3. Divisional Projects

D 31 - Automation of Factory/Computer Aided Tea Manufacture

The external consultant involved in this project designed and fabricated the sensors to measure the relative humidity of the air supplied to the trough, a moisture meter to determine the moisture content in the withered leaf and a motor to regulate the hot air damper in the trough. These units were tested at St. Coombs Factory but their performance was not satisfactory. Further improvements are being carried out, based on observations made during the trials.

M T Ziyad Mohamed, K Raveendran

Testing new moisture meters

A new type of digital moisture meter (Gibetani - Eurotherm Electronic Moisture Analyzer) was tested at the Division. This moisture meter has the features to vary the temperature and time as and when required and can also be operated on "auto" mode. This "auto" mode can be pre-defined according to the user requirements. While it is used in "auto" mode, the heating element gets switched off automatically when the correct moisture is read (i.e. moisture readings become constant). After carrying out several tests, a suitable sample weight and the stable weight conditions for the "auto" mode were determined. Thereafter, the meter was programmed to those conditions and compared the readings with the standard oven readings. The meter was tested for fired dhool and some graded tea samples. The results are as follows:

TABLE 3

<i>Sample weight (5g)</i>	<i>Moisture content by Standard oven method</i>	<i>Moisture Meter Reading</i>	
		<i>Temperature °C</i>	<i>MC%</i>
BOP	1.45	115	1.46
	4.10	120	4.27
	4.55	120	4.56
	4.75	125	4.82
	13.30	120	12.38
DUST	1.90	115	1.92
	3.45	120	3.41
	4.20	115	4.32
	6.30	120	6.35
F/Dhool	1.45	120	1.40
	4.05	115	4.07
	5.05	110	5.03
	6.05	120	6.10
Witherd leaf	49.80	120	49.60
	63.60	130	63.11
Green leaf	76.84	130	75.99
	77.04	120	75.93
	77.81	120	77.20

The results indicate that the meter could be used to determine the moisture content in fired dhool and graded tea samples. The quantity used for determining moisture in green leaf (GL) and withered leaf (WL) is not found to be adequate for better accuracy.

For better results, it is necessary to test two or more samples from a particular grade. While using the above meter for better accuracy it is necessary to:

- warm up the instrument with some tea before testing
- spread the made tea sample evenly on a clean, cool pan
- break the shoots to reasonable size in order to achieve even spreading on the pan for GL and WL samples, since the pan can hold only a small amount

M T Ziyad Mohamed, D L D H Dahanayaka

Net Outturn - Made tea to Green leaf

Trials were carried out to determine the net outturn—ratio of made tea to green leaf—achievable at Kurugama Tea Factory, Muruthalawa, in the mid-country. The results indicated a negative exponential relationship with net outturn and

moisture content in green leaf (Annual Report 1999). Results also indicated that the nett outturn does not depend on green leaf standard, as found in the low-country. However, the results reported in the AR 1999 were critically reviewed at an internal workshop held at TRI and it was felt that it would be desirable to carry out more replicates with samples having higher moisture content in order to confirm the findings. Results are presented below:

Mid-country results (Kurugama Estate, Muruthalawa)

TABLE 4

Date	GL MC%	LS %	GOT %	NOT %	RT %
10.03.00	80.96	72	21.35	20.08	2.19
18.12.00	79.31	56	21.39	-	6.97

Up-country results (St. Coombs Estate)

Experiments are also being carried out in the up-country to check whether similar relationship that was found in the low-country or mid-country exists. The trials were carried out at St Coombs Factory. Results from some of the replicates are presented below:

TABLE 5

Date	GLM%	LS %	GOT %	NOT %	RT %
05.10.00	79.15	41	21.82	19.24	6.92
17.10.00	79.89	44	19.52	17.58	4.97
10.11.00	78.60	31	21.50	19.06	9.25
23.11.00	80.24	40	19.00	17.64	5.23

GL MC - Green Leaf Moisture Content

LS - Leaf Standard

GOT - Gross Outturn

NOT - Net Outturn

RT - Refuse Tea

This study is in progress.

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 Experiment

Commercial scale experiments were carried out to check the effect of shear plucking against conventional hand plucking on the quality of made tea. The leaf standard, grade percentage etc. were recorded. Made tea samples were graded and sent to professional tasters for evaluation. They were asked to comment on

dry leaf appearance, tip content, stalk and fibre content etc. The preliminary results indicate that prices realized by teas manufactured from shear plucked leaf are not significantly different to those of manually harvested leaf.

TABLE 6

Sample size - 500 g

	<i>Hand plucked</i>		<i>Shear plucked</i>	
	Nos.	Wt.(g)	Nos.	Wt.(g)
Banji	139	165.45	135	173.4
Cut pieces	218	150.74	240	121.43
Coarse leaves	4	1.96	12	4.28
Active				
Bud + 1	8	9.52	2	1.60
Bud + 2	33	32.53	50	35.8
Bud + 3	59	86.52	58	77.16
Bud + 4	11	17.83	25	42.68
Oven dry weight of 100g plucked leaves		24.86 g		23.58 g

TABLE 7 *Shear plucking vis-a-vis Hand plucking - Goomera Estate*

<i>Grade</i>	<i>Hand plucking</i>		<i>Shear plucking</i>	
	<i>weight(kg)</i>	<i>weight%</i>	<i>weight(kg)</i>	<i>weight%</i>
OPA	11.6	16.6	9.3	12.0
OP	4.1	5.9	3.9	5.0
OP1	2.0	2.9	1.6	2.0
BOP1	2.6	3.7	4.3	5.6
FBOP	2.2	3.1	2.2	2.8
FBOPF	0.3	0.4	0.2	0.2
FBOPF1	3.0	4.3	1.7	2.2
FOP	7.7	11.0	5.8	7.5
FP	6.1	8.7	9.9	12.8
Pekoe	2.6	3.7	3.1	4.0
BOP	2.9	4.1	3.4	4.4
BOPF	0.6	0.8	0.6	0.8
BOPIA	5.6	8.0	5.8	7.5
BM	9.6	13.7	11.1	14.3
FNGS	4.9	7.0	7.0	9.0
Dust	4.1	5.9	7.4	9.6
Total	69.9		77.3	
RT	2.9	4.0	3.9	4.8

Withering using microwave technique

The feasibility of using microwave energy for withering was studied, using a domestic model microwave oven. Results indicated that the moisture content could be easily reduced to the desired level. However, the enzyme polyphenol oxidase seems to get deactivated due to the high temperature developed in the leaf as a result of exposure to microwave irradiation and as such the quality of made tea suffered. If the temperature could be controlled, it could be attractive. With the domestic model oven used, it is extremely difficult to control the temperature of the leaf on exposure to microwave irradiation. The project has been terminated.

M T Ziyad Mohamed, K Raveendran, S H Priyanthi, L Jayasinghe
UD Alagiyawadu, A M M V Abeykoon

Microbial contamination of made tea

This is a collaborative project with the Plant Pathology Division. Its objective is to monitor over time the moisture build up and the associated microbial contamination. It was observed that moisture content of tea has increased to 7.89% after approximately one year from 4.68% at the time of packing. Samples have been analysed for identification of microbes.

M T Ziyad Mohamed, K Raveendran, A Balasooriya*,
K Jayasundara* * - Pathology Division

Computer model for drawing a rolling programme

A proper rolling programme in black tea processing is essential for optimizing the quality of the end produce, improving the efficiency of machinery use and enhancing the productivity of workers. At present, drawing such a programme involves tedious mathematical calculations and it is invariably finalized after testing over a period of time. 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, under Windows 98 environment. All the mathematical calculations have been fed into work sheets as equations. In order to get the rolling programme, other data such as the available machinery, capacity of each machine, the amount of leaf one would like to feed, the dhool percentages anticipated etc. should be filled according to instructions on the computer screen.

The computer was programmed to display the charging interval, once the drier output, degree of wither and the charge to initial rollers are entered in the cells provided. There are provisions to work out the charge (i.e. the quantity of withered leaf to be charged to the initial rollers) for different charging intervals, and a

convenient charging interval could be selected. Thereafter, the calculations are done by the computer and the rolling programmes for three batches will be displayed by pressing the button "Next" provided on screen.

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 leaf coming to St. Coombs Factory was monitored twice a week. Leaf was 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 leaf on the trough separately. The respective samples were bulked and 250g samples taken to monitor the leaf standard. The leaf was divided as standard and sub-standard leaf.

Standard leaf

Bud itself
Bud + one leaf
Bud + two leaves
Bud + three leaves (if 3rd is tender)
Tender single leaf
Tender banji

Sub standard leaf

Bud + three or more leaves
and leaf with hard stem
Coarse banji
Coarse single leaves
Any damaged leaves

TABLE 8 Average standard of leaf brought to St. Coombs Factory

Month	Count (%)	Weight (%)	Count (%)	Weight (%)
January	51	46	47	41
February	56	52	52	48
March	56	50	57	54
April	50	47	49	42
May	56	49	54	47
June	49	44	46	42
July	57	51	52	50
August	54	46	50	43
September	67	50	48	40
October	55	49	48	42
November	44	43	53	49
December	42	40	51	32

The acceptable standard of leaf should be about 65% good leaf (minimum) for good manufacture. The standard of leaf received from St. Coombs and Lamiliere Divisions of the estate was seen to be poor throughout the year.

M T Ziyad Mohamed, S H Priyanthi, L Jayasinghe,
A M M V Abeykoon, U D Alagiyawadu

ISO 9000

The Consultant attached to M/S Technoconsultants (Pvt.) Ltd. continued to work on ISO 9002 certification for St. Coombs Tea Factory.

Implementation of the Quality Assurance Procedures of the system commenced during the last quarter of the year. Application for certification to Sri Lanka Standard Institution was also sent during the same period.

M T Ziyad Mohamed, K Raveendran, W S Botheju, St. Coombs Staff

ISO 11286 : Tea - Classification of grades by particle size analysis

The International Organization for Standardization (ISO) has established a method to classify the grades according to particle size for Broken grades of tea produced either by CTC or Orthodox - Rotorvane type of manufacture. However, the classification included in ISO 11286 could not be applied for leafy grades, because the perforation of sieves used were small compared to particle sizes of leafy grades. Preliminary data collected on this topic was discussed at the ISO/TC 34/SC 8 meeting held in Calcutta in November 1999. Based on a resolution passed at this meeting, further work was done using sieve analysis. The progress could be summarized as follows:

1. The sieve analysis of leafy grade samples was carried out for 10 minutes in an Endecott Sieve Shaker, keeping the amplitude at 5. The results obtained by keeping the amplitude at 5 were not encouraging, that is, the separation was poor.
2. Graded samples collected from St. Joachim Factory were tested in triplicate by changing the amplitude from 5 to 10. Results were encouraging. An example is given below for FBOPF grade tea.

TABLE 9

Amplitude 10

<i>Sieve (mm)</i>	<i>Rep. 2 (g)</i>	<i>Aver (g)</i>	<i>age (%)</i>	<i>Under Size</i>	<i>Fineness Modulus</i>	<i>Probit</i>
2.80	0.00	0.01	0.01	100.00	14.00	
2.36	0.00	0.01	0.01	99.99	13.00	8.719
2.00	0.00	0.01	0.01	99.98	12.00	8.5401
1.70	0.11	0.11	0.10	99.97	11.00	8.4316
1.40	1.00	1.15	1.15	99.87	10.00	8.0115
1.20	15.95	18.18	18.15	98.72	9.00	7.2322
1.00	47.20	46.42	46.34	80.57	8.00	5.8626
0.85	20.07	19.52	19.48	34.23	7.00	4.5938
0.71	10.52	10.69	10.67	14.75	6.00	3.9528
0.60	3.77	3.33	3.32	4.08	5.00	3.2608
Pan	1.02	0.76	0.76	0.76	-	2.5911
Total	99.64	100.17	100.00			

3. Larger grades such as OPA, Pekoe and FOP were analyzed using sieves with larger perforations procured from UK. Results were satisfactory.
4. True to type OP 1 and BOP 1, samples were tested in triplicate by keeping the amplitude at 10 and changing the duration from 10 to 15 (10,11,12,13,14 & 15) minutes, to test for breakage. After analyzing the results, it was **decided to keep the duration to 10 minutes.**
5. Positions of the sieves were changed to check whether there would be an improvement in separation for certain grades. The impact was not significant.
6. All the grades produced at St Joachim were analyzed and maximum likelihood solution for each grade was worked out. The results are presented in Table 10.

Methodology:

By sieve analysis, the amount retained in each mesh is calculated, as a percentage and thereafter the cumulative under size percentage on each mesh is worked out. The corresponding probit values are read from the tables, and a graph probit (Y) Vs Fineness Modulus (Z) is plotted. If the graph obtained is a straight line, it could then be concluded that the particles in that particular grade is log-normally distributed.

Probit equation will be in the form of $Y = bZ + c$

where, Y – probit, Z – fineness modulus, b and c are constants

Maximum Likelihood Solutions:

From the equation obtained, maximum likelihood solutions could be worked out by recalculating the probit values for different fineness moduli, replacing the new gradient (b) and intercepting (c). By substituting the corrected values, a new equation would be obtained and this process is repeated until constant values

for "b" and "c" are obtained. The number of cycles that has to be repeated to arrive at the maximum likelihood solutions is given in columns 3 & 4 and the **maximum likelihood equations** are given in column 5 of Table 10.

Maximum likelihood equations are also worked out using Chi-square test.

Note:

- i. For each grade, 10 sieves with descending order of aperture sizes were used as shown in Table 1
- ii. The grades analyzed were FBOP, BOP1, OP, OP1, OPA, FBOP1, FOP, Pekoe, FBOPE, BOP, BM, BOP1A and Fannings.
- iii. For any particular grade, the equation would differ from factory to factory, depending on the type of manufacture carried out.

TABLE 10 *Summary of service analysis*

Sieves used Aperture size (mm)	Grade	Sieve used (mm)	No of cycles for const.		Equation
			b only	b and c	
6.70 5.60 4.76 4.00 3.35 2.80 2.40 2.00 1.68 1.40 1.20 1.00 0.85 0.71 0.60 0.50 0.42 0.35 0.30 0.25	FBOP	3.35-0.71	4	6	Y=0.670 Z - 2.11 Y=0.670 Z - 2.121
	BOP 1	4.00 -0.85	3	4	Y=0.764 Z - 2.85 Y=0.764 Z - 2.853
	BOP 1	4.00 - 0.85	4		Y=0.709 Z - 3.17 Y=0.709 Z - 3.197
	OPA	6.70 - 1.70	4 & B		Y=0.797813 Z - 6.68771
	OP	6.70 - 1.40		4	Y=0.779125 Z - 5.63823
	OP	6.70 - 1.40	4		Y=0.558 Z - 2.57 Y+0.558 Z - 2.574
	OP 1	3.35 - 0.71	3	4	Y=0.741 Z - 3.4 Y=0.74189 Z - 3.473
	FBOP 1	4.00 - 0.85	3	4	Y=0.725 Z - 2.20 Y=0.725 Z - 2.202
	FOP	6.70 - 1.40	4 & 7	8	Y=0.696 Z - 4.70 Y=0.696585 Z - 4.69782
	PEKOE	6.70 - 1.40	3	4 & 6	Y=0.842 Z - 6.83 Y=0.842504 Z - 6.83083
	FBOP	3.35 - 0.71		4	Y=0.63317 Z - 1.570
	FBOP 1	4.00 - 0.85	3	4	Y=0.725 Z - 2.20 Y=0.725223 Z - 2.20214
	FF	2.80 - 0.60	3	4	Y=0.695 Z - 0.41 Y=0.695 Z - 0.416
	FNGS	1.68 - 0.36	6	7	Y=0.486 Z + 2.20 Y=0.486809 Z + 2.20088
	BOP	1.68 - 0.36	2 & 7	7 & 10	Y=0.479 Z + 1.29 Y=0.479238 Z + 1.295208
	BOP 1A	3.35 - 0.71	4		Y=0.514 Z - 0.274
	BOP 1A	3.35 - 0.71	3	4	Y=0.410 Z + 0.29 Y=0.410 Z + 0.289
	BM	2.80 - 0.60	2		Y=0.4158 Z + 1.252

4. 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 Evaluation Committee appointed by Chairman, Sri Lanka Tea Board, to advise on credit scheme to install orthodox machinery in CTC factories
- A member of the panel of the Professional 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 Institution
- A member of the Academic Committee of NIPM
- The Convenor/Secretary of the Consultative 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

Mr. D L D H Dahanayaka attended the following workshops:

- 1) "Scientific writing" at the University of Peradeniya from 15th - 17th September
- 2) "Physics and Mathematics in National Development" at the NSF on 29th September

M/s. D L D H Dahanayaka, U M U A B Marapane and A M M V Abeykoon attended the training program on "Statistical Survey, Sampling and Analysis" conducted at TRI, from 24th to 26th July.

4.2 Meetings

Dr Ziyad Mohamed attended the following meetings:

January

- 14th – Consultative Committee on Research Meeting
- 28th – Experiments and Extension Forum at TRI
- 29th – Seminar for Bank Managers, Ratnapura, organized by Tea Development Project (TDP)

February

- 3rd – Technical Evaluation Committee Meeting at TDP Office

- 14th & 15th – Training programme for factory officers at TRI Station Deniyaya
- 23rd -25th – Training programme for Trainees attached to Plantation Monitoring Division, MPI, at TRI
- 28th – Technical Evaluation Committee Meeting at TDP Office

March

- 06th – Consultative Committee on Estates and Advisory Services meeting
- 09th -10th – Training programme for factory officers at TRI Station Deniyaya
- 12th – Seminar for Bank Managers, organized by TDP in Galle
- 24th – Meeting with PA officials
- 25th – Seminar for Bank Managers, organized by TDP at Kotmale
- 27th – Technical Evaluation Committee Meeting at TDP Office

April

- 03rd – Advisory Officers Forum at Passara
- 11th – ISO 11286 meeting in Colombo
- 28th – RSC Seminar in Kandy

May

- 04th – Annual General Meeting of the Private Tea Factory Owners' Association (PTFOA) at BMICH Colombo
- 09th – ISO 11286 Meeting in Colombo
- 30th – Technical Evaluation Committee Meeting at SLTB, Colombo

June

- 05th – Consultative Committee on Research Meeting
- 12th – ISO 11286 meeting in Colombo
- 13th – Seminar on Baseline Survey of Tea Small Holdings of Private Estates, organized by TDP
- 27th – RSC Seminar in Uva

July

- 03rd – Advisory Officers' Forum at Galle
- 04th - 05th – Factory Officer training program in Galle
- 06th – ISO 11286 meeting
- 28th – E & E meeting at TRI, Talawakelle

August

- 03rd – Consultative Committee on Estates and Advisory Services meeting
- 11th – Meeting with subcommittee of the PA to discuss projects with private sector funding
- Tea Sector Review meeting

September

- 04th – ISO 11286 meeting in Colombo
- 05th – Consultative Committee on Research Meeting at TRI

- 16th – Seminar for Bank Managers organized by TDP at Maharagama
- 18th - 20th – Training program for Tea Commissioner's Division officials at TRI, Talawakelle
- 22nd – Delivered the key note address at the convention "Small improvements – Higher productivity" organized by the Tea Commissioner's Division of the Sri Lanka Tea Board and held at BMICH, Colombo
- 25th – Advisory Officers' Forum at Ratnapura
- 29th – Seminar organized by Tea Commissioners Division at Matara for Factory Officers/ Owners
- October*
- 23rd – Seminar organized by Tea Commissioner's Division, at Kandy
- 27th – Technical Committee on Tea Meeting at SLSI
- November*
- 16th – Consultative Committee on Estates and Advisory Services meeting
- 17th – RSC meeting at Galle
- 20th – TRI - TSHDA Interaction Meeting at TRI, Talawakelle
- 23rd – Seminar to discuss the report on Factory Capacity Utilization in Colombo, organized by TDP
- December*
- 12th – Consultative Committee on Research Meeting at Ratnapura
- 14th -16th – Training program for Tea Commissioner's Division Officials at TRI

4.3 Training programs / Paper presentation

S H Priyanthi and L Jayasinghe: "Advance Course in Tea Testing and Quality Control" at Kothari Agricultural Management Center, Coonoor, India, 08th May to 22nd August.

W S Botheju: Training Program on "Agriculture Machinery" in China, 25th August – 25th September.

U D Alagiyawadu: Diploma in "Laboratory Technology" at the Open University of Sri Lanka, commencing 07th December.

K Raveendran: Indian Convention of Food Scientists and Technologists 2000 in Bangalore, India, 22nd to 24th November.

4.4 Publications

M T Ziyad Mohamed (2000) "Some notes on ECP and FBD drying" -TRI Update, Vol 5

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, 43 advisory visits to the following factories were made by the members of the Technology Division. These include factories in Mid-country and Up-country but exclude the seminars and the Factory Officer training programs conducted and coordinated by NIPM.

Date	Factory	Purpose of visit
03.01.2000	Lidesdale	Drier Test
06.01.2000	Maha Uva	Drier Test
25.01.2000	Hauteville	Drier Test
01.02.2000	Dambetanne	Manufacture Test
07.02.2000	New Peacock	Advisory
15.02.2000	Madulkelle	
21.02.2000	Crage	Advisory - Manufacture
08.03.2000	Brook Side/Park	Drier Test
10.03.2000	Concodia	Drier Test
15.03.2000	Delmar/Gorden	Drier Test
30.03.2000	Gartmore/Strathspey	Drier Test
06.04.2000	Tea Shakthi	Drier Test
07.04.2000	Stony Cliff	Out turn Test
10.04.2000	Stony Cliff	Out turn Test
25.04.2000	Hellbode	Manufacture Test
26.04.2000	Courtledge	Drier Test
27.04.2000	Kataboola	Drier Test
04.05.2000	Pitarathmalie	Manufacture Test
09.05.2000	Laxapana	Drier Test
11.05.2000	Idalagashinne	Drier Test
22.05.2000	Welimada,Down Side	Drier Test
30.05.2000	Warwick	Drier Test
01.06.2000	Maussakelle	Drier Test
05.06.2000	Troup	Manufacture Test
20.06.2000	Kataboola	Advisory - Manufacture
20.06.2000	St.James	Drier Test
01.07.2000	El Tab	Drier Test
26.07.2000	Tillyrie	Drier Test
27.07.2000	Koslanda	Drier Test
31.07.2000	Moray	Manufacture Test
03.08.2000	Henfold	Smoke Test
07.08.2000	Kirkoswald	Drier Test
10.08.2000	Laxapana	Drier Test
22.09.2000	Glentil	Advisory visit
25.09.2000	Montecristo	Drier Test
19.10.2000	Ingestry	Deier Test
24.10.2000	Roeberry	Drier Test
01.12.2000	Mahanilu	Drier Test
09.12.2000	Greenwood	Drier Test
16.12.2000	Hope	Drier Test
21.12.2000	Tillyrie	Drier Test

AGRICULTURAL ECONOMICS UNIT

Officer-in-Charge - J.A.A.M. Jayakody

Thrust A 31 - Identification of appropriate labour use pattern to improve profitability in plantations

Thrust A 31.1 Evaluating and determining ways and means of reversing the factors that influence migration of workers in the low-country estates for outside work

A survey was carried out in the Southern Province estate sector. Data analysis and the first draft of the report had been completed.

J.C.K.Rajasinghe, J.A.A.M Jayakody, H.W.Shyamale, J.A.S.K.V.Jayasinghe

Project B 1.1 Development of a Tea Area Overview Map in GIS

The collaborative project with the CARP-GTZ research management project was continued. The methodology for development of the Tea Area overview map was completed. Estate data entering was continued at the project office.

J.A.A.M. Jayakody

Project B. 5 Estimation of cost of tea cultivation

The draft relating to Part I – Nursery Management – is being edited as per the comments received from external reviewers and the final version will shortly be available for publication. Data collection for the part II – Maintenance of Mature Tea Fields – has been completed. This is being analysed for purpose of preparing the first draft.

J.A.A.M. Jayakody, H.W. Shyamalie

Project B. 8 Work studies (ergonomics) for efficient labour use in tea lands

This project is proposed to be conducted in collaboration with scientists of the Tea Research Institute and the University of Peradeniya, with partial funding by the Programme Support Group (PSG). The ergonomics of tea harvesting is being done to identify the physical condition and fitness of the pluckers and also to improve their earning capacity.

H.W. Shyamalie

D 35. Tea Sector Studies

D 35.1 Break-Even Analysis

The application of break-even concept for tea cultivation was tested in order to assess the economic viability of an individual tea estate or a tea field. A technical paper on this subject has been accepted for publication in the Journal of the National Institute of the Plantation Management.

J.A.A.M. Jayakody

D 35.2 Tea Information

Computation of national and international tea data continued.

J.A.A.M. Jayakody, W.M.J.C. Bandara

D 35.3 Other

35.3.1 Socio-Economists and Policy Analysts Group Meeting of CARP

Ms. H.W. Shyamalie continued to participate for the above meetings held at the CARP every two months.

Seminar, Meetings and Training programmes

1. Mrs. J.A.A.M. Jayakody attended for a training programme on "Resource Economics" conducted and sponsored by the South Asia Co-operation for Economy and Environment, at the University of the Philippines – Los Banos from 3rd April to 29th April 2000.
2. Ms. H.W. Shyamalie and Mr. J.C. Bandara attended the workshop organised by the SLAAS on Application of Geographic Information System for Development & Planning Activities.

Staff Changes

Mrs. J.A.A.M. Jayakody was released on secondment basis in June, for a one year contract assignment as Consultant, Management and Labour Relations to the National Institute of Plantation Management, Athurugiriya.

Overseas Training

Mr. G. Ganewatte, returned to the Institute for the local research component of his PhD research programme in March. He went back to the University of La Trobe in July after completing research data collection.

Mr. D.P.B. Herath was granted extension of six months leave in October, to complete his PhD programme at the University of Guelph, Canada.

ADVISORY & EXTENSION SERVICES DIVISION

Acting Head – S.Wimaladharm

General

Mr. BAD Samansiri, Advisory Officer/Acting OIC, Advisory & Extension Division, TRI, Talawakelle, underwent a short-term training programme on technology transfer in the work plan for 2000-2001 under the MOA between ICAR & CARP in New Delhi, India, from 4th December to 24th December.

Mr.JCK Rajasinghe, Acting OIC Uva Centre, Passara, was temporarily transferred to the Advisory & Extension Division with effect from 16th October.

Mr.RADS Ranatunga, Extension Officer, resigned from service with effect from 30th April.

Mr.KG Rajika Niroshan assumed duty as Photographer with effect from 15th August.

Mr.T Ramilan, Extension Officer, resigned from TRI service with effect from 31st May.

Mr MKSLD Amaratunga was granted the additional responsibilities of Officer-in-Charge, Deniyaya, as Mr JASKV Jayasinghe, Advisory Officer proceeded on study leave to follow the MSc programme at the Post Graduate Institute of Agriculture, University of Peradeniya, with effect from 1st October.

Mr Lalantha Kodikkara, Guest House Keeper, was transferred to the TRI Head Office with effect from 1st January.

Mr RW Suwaris, Field Officer, was transferred to Uva Advisory & Extension Center, Passara, effect from 25th February.

Mr AG Chandrapala, Extension Officer, resigned from the TRI service on 30th April.

Land Use Information of Regional Stations

TYPE OF LAND USE	PASSARA	KOTTAWA	DENIYAYA
Seedling tea (ha)	-	-	-
VP tea -mature (ha)	3.85	9.5	6.41
VP tea -Young (ha)	0.33	1.3	0.38
Mother Bushes (ha)	1.15	1.0	-
Nursery (tea)	0.12	0.7	0.463
Seed Garden (tea)	-	1.0	-
Under grasses (ha)	1.50	1.6	0.237
Fruit trees (ha or Nos.)	-	1.4	-
Coconut (ha or Nos)	-	-	0.13
Forestry (ha)	6.85	9.3	1.92
Marshy land (ha)	-	-	0.50
Buildings, gardens, Roads	0.50	9.8	1.44
Pepper (ha)	-	-	0.05
Encroachment (ha)	-	-	1.12
Uncultivated area (ha)	-	-	0.57
Total Extent (Ha)	14.30	35.6	13.22

Mr S. Wimaladharma, Acting Head/Advisory & Extension Services, continued to serve in the following committees and attended the meetings held during the year.

- Tea Sector Review meeting
- Steering committee meeting of the Tea Development Project
- Training needs meeting of the Tea Development Project
- Plantation Reform Project Committee on AV materials preparation
- Estate Affairs meeting of TRI

Mr.S.Wimaladharma served as a resource person to the NIPM and conducted training programs for Superintendents, Assistant Superintendents, Field Officers, Assistant Field Officers and workers of Udupussellawa Plantations Ltd., Maturata Plantations Ltd., Kahawatte Plantations Ltd., Agalawatte Plantations Ltd. and Hapugastenna Plantations Ltd. during the year.

Mr.S.Wimaladharma was also associated with the following activities:

- Preparation of three-video programmes on plucking and nursery management with funding from the Plantation Reform Project.
- Addressed a series of seminars conducted by the Tea Commissioners Division to green leaf suppliers on the advantages of good quality leaf and leaf handling.

- Addressed the Regional Scientific Committee seminar, Nuwara- Eliya on replanting and productivity of tea in the Nuwara-Eliya region.
- Addressed the Regional Scientific Committee seminar, Kandy on nursery management.
- Attended a fertilizer quality control meeting conducted by National Fertilizer Secretariat.
- Co-ordinated the clonal mother bush program of the ADB to establish 80ha of clonal mother bushes in 6 TRI stations and 16 TSHDA sites.

Project 1: Adaptive Research and Demonstration –

Adaptive fertilizer trials under the TRI Corporate Plan were conducted in 16 sites in the tea growing districts by the staff in collaboration with SPND Division and TSHDA.

Project 2 : Information Desks

Arrangements were made to equip the Information Desks with the following;

- Preparation of wall charts and display boxes in all Extension Centers.
- Preparation of a Computer Data Base

Project 3 : Upgrading of mother bush areas

Preliminary arrangements for upgrading Museum and “AV” saloons are in progress.

Project 4:- Establishment of mother bush areas

- ADB clonal mother bush project under the Corporate Plan is in progress.

Project 5: Monitoring of agricultural performance of tea plantations and smallholdings

- Several regular visits and field observations were made, besides 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 first volume of the newsletter “Tea thathu” was published for distribution of technical information to the tea smallholders. The production and updating of advisory leaflets are in progress.

Infrastructure Development of Regional Stations

Passara Centre

- Expansion work of the office building which commenced during later part of the year is in progress.
- The old security light system was replaced with mercury fittings and two additional sodium lamps were installed to enhance the security of the station.
- Fixing of iron grills to the windows of Circuit Bungalow, OIC's Bungalow and "C" type bungalow was completed.
- Replacement work of old water supply commenced during December.
- Internet/e-mail facility was provided to the station from August.
- Rehabilitation work of the ADB mother bush area of Field No.04 (2001 Block) is in progress.
- Uprooting work of Field No.1B – ADB (2002 Block) commenced in December. Uprooting and land preparation were done using an earth-moving machine.
- Nursery with a capacity of 7000 plants (TRI 3000 & 4000) series was started to raise plants for ADB mother bush block; planting is scheduled for October/November 2001.

Kottawa Centre

- Construction of a retaining wall for D1 & D2 bungalows was completed.
- Roof repairs of the seminar hall was completed.
- Construction of 02 nos. vehicle garages for CI & CII bungalows was completed.
- Fixing of 02 nos Air Conditioner units for the seminar hall was completed.
- Construction of a Watchers' shed at the office entrance was completed.
- Erection of a new barbed wire fence and Main Gate around the office was completed.
- Construction of 02 nos. twin worker's cottages was commenced.

Advisory & Extension Activities

	Talawakelle	Ratnapura	Hantana	Passara	Kottawa	Deniyaya
Advisory correspondences	645	525	256	214	187	93
Advisory visits	85	70	114	54	61	31
Extension visits		112				17
Visitors to the division						
-Estate management & smallholders	712	426	323 (small holders)	170	656	329
-University /Diploma students & others	3408	150	155			
Advisory & Extension programmes (Total)	29	176	09	04	90	57
Skill training for nursery management						01
Seminars	09			03	13	20
Field days	09	12	03		77	01
Educational programmes	04	07				
Awareness programmes		25				
Training programmes	01		04			03
Familiarization programmes for planter trainees	03					
NIPM programmes	02	35				09
Informal discussion		85				22
Video Shows		20				
Exhibitions		01				01
RSC seminars	01	02	02	01		
Meetings attended	45	112				09
Commercial nursery inspection		13				
Advisory publications distributed	1947	1000				
Planting material distributed				54300	65200	43120
Soil samples tested for pH		137	464	1020	261	270
Soil samples tested for carbon				596		
Exhibitions		1				1

Advisory & Extension Division – Talawakelle

Acting OIC - B.A.D.Samansiri

RSC Seminars

1. The Advisory staff organised and co-ordinated a RSC seminar for the members of the Regional Scientific Committee of the Nuwara Eliya region on the following subjects;
 - i Feasibility of non-conventional pest control methods in tea lands in Sri Lanka
 - ii Natural suppressiveness of plant parasitic nematodes in tea

More than 100 Superintendents and Asst. Superintendents participated.

Training Programmes

Three familiarisation programmes for the trainee Assist. Superintendents of Watawala Plantations Ltd. and Maskeliya Plantations Ltd, two special lectures to visitors from the Netherlands and a one-day training programme for the officers of the Plantation Monitoring Management Division were undertaken by the staff of Advisory and Extension Division.

Preparation of Extension and Teaching Material

- (a) The Tea Newsletter- 'Te Thatu' prepared for tea growers was brought out on 8th December. (*Edited by B.A.D.Samansiri, Shantha Jayasinghe and S.Wimaladharm*)
- (b) The preparation of a poster on "Major insects tea pests in Sri Lanka" is in progress. (*B.A.D.Samansiri*)
- (c) Revision of the leaflet "ඔළු වගාමාලා" is in progress. (*All Staff*)
- (d) A tea field demonstration in Field No 11 of St Coombs Estate Upper Division has been commenced and is in progress. (*V.S.Sithakaran, B.A.D.Samansiri*)
- (e) Two models of "Tea growing areas in Sri Lanka" are nearing completion. (*V.S.Sithakaran, B.A.D.Samansiri*)

Radio Programmes

16 Radio programmes were prepared and broadcasted through "Lakhanda" radio and Ruhunu services. (*J.C.K.Rajasinghe, B.A.D.Samansiri, S.Wimaladharm, S.T.Yatawatta, V.S.Sithakaran, Lalith Amaratunga and Research Staff*)

Additional Activities

- Mr. V.S. Sidhakaran, Advisory Officer, co-ordinated the activities relating to the revision of Advisory Circulars.
- Mr B.A.D Samansiri, Acting OIC, served on the following committees/meeting during the year:
 - Convenor/Secretary of Grade I to V staff meeting
 - Member of the Committee on Revision of Advisory Circulars
 - Member of the Committees appointed to prepare guidelines for the “crisis management of tea” and a cautionary note on “dying of high yielding clones”.

Advisory & Extension Division at Ratnapura

Acting Head - S.Wimaladharm

• Commercial Nursery Inspection Visits

13 Commercial nurseries were inspected. Only two of them fulfilled the requirements specified in the commercial nursery agreement. The others were disqualified because of the production of inferior or poor quality plants. The conditional report was submitted to the TRI-TSHDA Linkage Forum and a committee appointed to formulate a nursery index and seek legislative powers for the inspection of commercial nurseries in future.

Advisory & Extension programmes conducted

- 176 advisory and extension programmes were conducted by the advisory staff in collaboration with research staff. Some of the special programmes are noted below:
 - a. **200th E & E**
 - Mr. S.L.D. Amarathunga and Dr. M.A. Wijeratna presented a paper on “Some of the ecological factors affecting sustainable production of clonal tea” at the 200th E & E forum held at TRI, Talawakelle.
 - b. **RSC –VI Activities-Ratnapura Region**
 - The RSC Committee VI for Ratnapura Region 2000, with the TRI representative, continued to co-ordinate all the scientific and estate sector affairs pertaining to tea plantations in the low-country. The following two seminars were successfully organised for the tea planting community in estate sector in Ratnapura region in collaboration with the Advisory and Extension Services, Low Country Station. These events were presided over by Mr. Tony Perera / RSC VI Chairman and co-ordinated by Mr. S. L. D. Amarathunga RSC VI - TRI co-ordinator.
- 1. The first RSC Seminar – 2000 was held for the Superintendents and Assistant Superintendents of Ratnapura region at the Silver-Ray Hotel, Lellopitiya, on

23rd March. At this function, more than 70 planters from the various plantation companies in the region participated. Three technical presentations were made on the following themes and a panel discussion was held thereafter.

Theme	Presenters
<i>Some of the ecological factors affecting sustainable productivity of clonal tea in low-country</i>	<i>Mr. M K S L D Amarathunga</i> <i>Dr. M A Wijeratne</i>
<i>Planting material for sustained productivity and quality</i>	<i>Dr I D Singh</i> <i>Mr. V. Shanmugarajah</i>
TRI Fertilizer policy	<i>Dr. Kapila Zoysa</i>

2. The second RSC Seminar – 2000 for Ratnapura region was held on the 20th September, at TRI-Low Country Station, Ratnapura. More than 50 planters from the various plantation companies of the region, participated. In the technical session, three presentations were made on the following themes.

Theme	Presenters
<i>Mechanical pruning of tea</i>	<i>Dr. M. A. Wijeratna</i>
<i>Introduction to irrigation in tea land</i>	<i>Mr. N. P. S. N. Bandara</i>
<i>Identification of new TRI clones and estate clones for the low grown tea lands</i>	<i>Mr. M. Ratnayake</i>

c. Method demonstrations and Field days

- Twelve demonstrations and field days were conducted by the Advisory and Extension division at the TRI-Low Country for leaf suppliers, smallholders, diploma students and field officers on various aspects such as nursery management, pruning, plucking, pests and diseases control and weed management. TRI Advisory and Scientific staff participated as resource personnel. Most of these programmes ended with a practical session on shear harvesting.

d. Educational programme

- Advisory and Extension staff conducted six educational programmes for the Advance level and Ordinary level students.
- A nursery programme for Diploma students of the Agricultural School, Karapincha, was conducted on 26th April.

e. Awareness programmes

- Acting Head/Advisory and Extension Service participated for 3 seminars organised by Assistant Tea Commissioner and 1 seminar organised by the Superintendent of Didenipotha Estate.
- Four awareness programmes were conducted by TRI Advisory and Extension Division for bought leaf suppliers of St. Joachim Estate, Raigama Estate, Bogawantalawa Plantation Ltd. and Kandalanda Tea Factory.

- Fifteen seminars were conducted to empower smallholders and field staff of proprietary and company estates.
- A Seminar and Field demonstration was held on 25th October for a group of smallholders from Pelawattha area.
- The Advisory staff participated as resource personnel at a seminar organised by THSDA on 06th May at Gamini Vidyalaya, Ingiriya.

f. Training programmes in collaboration with NIPM

The Advisory staff participated as resource personnel for the following training programmes conducted by NIPM:

- Mr S Wimaladharma, Head/ Advisory and Extension Service, conducted 32 NIPM training programmes for Superintendents, Assistant Superintendents, and Field staff on nursery practices, plucking and other cultural practices.
- Mr S L D Amarathunga, Extension Officer, conducted two NIPM training programmes for Assistant Superintendents and Field staff of Kahawatte Plantation Ltd. on weeds, pest and disease management and labour motivation.
- Head/ Advisory and Extension Services conducted a training programme for officers of the Plantation Monitoring and Management Division.

g. Informal discussion with individuals or groups

- Approximately 85 informal discussions with individuals or groups (management and field staff of company or proprietary estates, smallholders and students) were held at TRI Low Country Station and at the respective properties on Development programme, Pruning programme, Manuring, Nursery failures, Plucking, Control of canker, Woodrot. Termite and Shot-hole borer, Water logging, Drought mitigation etc.

h. Video Programme

- More than 20 video programmes relating to land selection, nursery, plucking etc were displayed for proprietary planters and their field staff and smallholders during their visit to the TRI-station or while the training programmes were conducted on their properties.
- Head/Advisory & Extension Service and other advisory staff assisted in the production of video programmes on nursery, plucking and other field practices that are being undertaken by the video team of the Open University under the Plantation Reform Project.

i. Exhibition

- Assistance was provided to students to establish an exhibition stall on tea cultivation by giving them specimens, wall charts on tea information other exhibits etc. at the school exhibition held in October at the Maha Vidyalaya, Kuruwita.

Meetings attended by the Advisory Staff

- One hundred and twelve meeting related to the research and advisory, circulars, clonal materials, computer issue, CADMAR, District Agricultural Development Committee meeting, Administration and Finance matters etc. organised by TRI and other organisations (Tea Sector Committee, MPI, TSHDA etc.) were attended by the Head/Advisory and Extension Service and Extension Officers.

Adaptive Demonstration Trial

- *Adaptive research trials on fertilizer*:- Five trials in Kalawana, Horana, Palawatte, Daraniyagala and Balangoda were continued. However, the Balangoda trial had to be terminated. One pruning cycle was successfully completed in all the trials at the 5 locations and these will be continued until the next pruning. Besides the assessment of the fertilizer performance, these trials served as centers for dissemination of various agricultural skills/practices to adjoining small holders.
- *Method demonstration*:- A trial was conducted to demonstrate the effect of normal pruning *vis-a-vis* sanitary pruning under smallholding condition (at Durekkanda Estate) where bush debilitation is high. This field was planted with TRI 2026 and is about 12 years old. The trial was established with 4 treatments as given below in 3 replicates. All the plots were rested for 2 months prior to pruning.

Treatment	Time					
	After 4 wk	After 10wk	After 13wk		After 16 wk	
	No of bud braked/ Plant	No. of Shoots/ Plant	No. of Shoots/ Plant	No. of Leaves Plant	Total Shoot length/plant (cm)	Tipping wt./plang (g)
T1	74	41	95	438	111.5	705
T2	30	30	65	264	76.5	460
T3	41	33	58	272	58.4	443
T4	20	22	27	224	53.6	443

T1 - Normal Pruning & height - at 25"

T3 - Normal Pruning & height - at 20"

T2 - Sanitary Pruning & height - at 20"

T4 - Sanitary Pruning & height - at 16"

- *Growth measurements are given in mean value*

The above growth measurements at initial stages were taken. The preliminary results show that recovery ability at the initial stage was high in the normal pruning done in plots T1 at the height of 25". However, T2 (Sanitary Pruning & height at 20") shows promising results. It was also observed that new shoots are growing up from the lower section of secondary branches of tea bushes in T2, T3 and T4 plots while new shoots are coming up from the

upper section of secondary branches (just below the pruning cuts) of tea bushes in T1 plots. The experiment is continuing.

- *Nursery index*:- Initial arrangements have been made to formulate a nursery index for the 3000/4000 clones recommended for the low-country.

Information Desk

Arrangements have been made to equip the Information Desk with the following:

- Wall Charts containing regional profile, tea statistics and regional specific information
- Hotline telephone service (045-32348) to enable smallholders, planters and other interested persons to have direct access to the Advisory & Extension Services for obtaining the required information/advice
- Estate data such as weather, yield and other field information that are being computerized for the low grown region
- Ready reckoner

Leaflets, Booklet and Newsletters

- Arrangements have been made for bring out the booklet on "Tea & Rubber inter-cropping system"
- The booklet on "Control of Stem and Branch canker in low country and Uva region" is due for publication shortly.
- Tea Information - A Leaflet on the various tea related statistics is under publication.
- The Leaflet on "New TRI recommendation for fertilizer" special reference to the smallholders (Sinhala medium leaflet) has been revised and arrangements have been made to publish it.
- A leaflet on "Weed management" for the smallholders has been revised .
- A booklet on "Weed identification" has been submitted to final editing.
- The Advisory & Extension staff contributed an article on "Control of wood-rot in low-grown tea land" in the first volume of Tea thathu
- A research article on "Some factors associated with the death of tea plants in low-lying lands" has been accepted for publication in the 'Jubilee Volume of Tea Bulletin'

Photographs on tea related information

Arrangements have been made to collect photographs on tea related information. These are proposed to be used as extension material for upgrading the Museum.

Research papers

Based on an agro-ecological survey, a research paper on the “Variation of the productivity of tea lands in the different agro-ecological regions in Sri Lanka” was presented by Mr. M.K.S.L.D. Amarathunga at the Annual Session of the SLAAS at the University of Peradeniya on 29th November.

Survey on smallholder lands

a. *Stem and branch canker disease*

With a significantly higher incidence of Stem and Branch canker disease specially in the smallholding tea lands of the low country, a survey was conducted in 118 such units with the assistance of a Diploma student of Aquinas College, Colombo. This survey identified the causal factors and highlighted the remedial measures to be taken to mitigate the casualties due to the canker in the tea smallholding lands in the Nivitigala AGA Division.

Some of outcomes of the survey are:

- More than 90% of the small holding in the region have been infested with low country Stem and Branch canker disease.
- Planting of clone TRI 2023, TRI 2026 in marginal lands (gravelly land, rocky land) is one of the main factors responsible for the high incidence of canker.
- Deviation from recommended cultural practices such as direct planting without rehabilitation, non-selection of resistance clones, use of inferior planting material, absence of soil and moisture conservation practices, poor management policies for weed and shade, continuous adaptation of hard plucking and lack of adaptation of sanitary pruning etc were found to have contributed to this condition.

b. *Other Extension Surveys*

The following extension surveys in tea smallholding lands were carried out with the assistance of Diploma holders from the School of Agriculture, Karapincha.

- Fertilizer usage in Daraniyagala region
- Dolomite usage and maintenance soil acidity in Daraniyagala region
- Labour cost and other expenditure for different types of nursery method

Field survey on the above studies have been completed and the tabulation and analysis of data is in progress.

Advisory and Extension Division, Mid Country Station, Kandy

Advisory Officer- S.T.Yatawatta

Advisory and Extension programmes

R.S.C. Seminars

Two Seminars were conducted for the Superintendents and Assistant Superintendents of the Mid-country region during the year. These were well attended and the following subjects were discussed.

Seminar 1 New fertiliser policy
 Tea manufacture

Seminar 2 V.P. tea nursery work
 Harvesting practices

Field Days/Demonstrations

3 Field days were arranged for estate Managers and Smallholders on the correct use of T.R.I. shear.

4 Field demonstrations/training programmes were held for Smallholders on V.P. Nursery practices.

3 Adaptive trials on fertilizer use and 1 trial on collar pruning and other development work on seedling tea were conducted with the collaboration of S.P.N.D. and Agronomy Divisions respectively.

The Advisory Officer attended the R.S.C. seminars held at Galle, Ratnapura, Bandarawela and the meetings held for the revision of Advisory circulars.

The Advisory Officer was associated with the recording of radio programmes which were broadcasted on Lakhanda Radio.

The Advisory Officer served as the Convenor Secretary of the following forums during the year.

1. Advisory Officers forum
2. E & E for Smallholder sector

Research and Development

The Advisory Officer was associated with the filming of harvesting practices video film and attended to the preparation of the book on tea cultivation practices.

Advisory And Extension Centre, Passara

Acting OIC - J.C.K.Rajasinghe

Field Trials

- Clonal observation trials, UVP 7 and UVP 8, are in progress at the Centre. These are carried out and monitored by the Plant Breeding and Propagation Division.
- Demonstration trials on the use of tea fertilizer 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. These are carried out by the Soils and Plant Nutrition Division in collaboration with TSHDA. The 2nd cycle of these trails commenced in January 2000.
- The second phase clonal observation trial 2/VP37/UVA was commenced at the Centre by the Plant Breeding and Propagation Division. Planting under the trial was completed in December 1998. Monitoring of this trial is in progress.
- A field trial was laid down in the station by the Plant Propagation and Breeding Division in January 2000 to develop seed varieties.
- A field trail to evaluate the drip irrigation system for mature tea was laid down on Dammeria Estate, Passara, with the assistance of Brown & Company Ltd. Advisory staff of Passara station is monitoring it under the supervision of Agronomy Division, Talawakelle.

Special Problems of Uva

- Sulphur deficiency symptoms in mature tea were recorded in a few smallholder properties in the area.
- Symptoms similar to those of the High Forest problem were recorded in a few fields on Dambetenna Estate, Haputale.
- Die back of young tea plants in new clearings of some estates has been on the increase. Stress caused by early centering of plants followed by fertilizer applications and less rainfall were the main contributory factors for the casualties observed.

JCK Rajasinghe, Advisory Officer-in-Charge, performed the following tasks in addition to his normal duties:

- co-ordinated the first radio programme produced about TRI and its activities, which was broadcast over Lakhanda and Ruhunu service
- conducted a sample survey on labour migration in low-country tea growing districts

Advisory and Extension Centre, Kottawa, Talgampola

OIC - K.D.Dhahanayake

Field Days and other Training Programmes

Objective: Advice on aspects including demonstrations relating to nursery work, plucking, pruning, fertilizer, weed management, pests & diseases as applicable to the low-country

Experiments & Observations

- effect of different mulches on the microbial activity of tea lands
- effect of burying of prunings
- shear plucking observation block
- hedge planting observation block
- 4000 series observation block
- calliandra plants block
- 200 plants cinnamon in boundaries (intercropping)
- growth performance of gravellia – reported by Talawakelle & Ratnapura
- Growth performance of young tea - reported by Ratnapura
- lopping high shade - Albizzia
- Clonal Mother Bush Project - 3000 & 4000 clones
- adaptive research trials (U-709 and T-1130) at Akuressa and Alpitiya

Advisory and Extension Centre, Deniyaya

Acting OIC - S.L.D.Amaratunga

On-going Experiments

- LVP 74 phase II – This trial which commenced in August 1997 is in progress. It is being conducted in collaboration with the Plant Propagation and Breeding Division. The Physiology and Pathology Divisions also commenced experiments on the evaluation of growth performances and resistance to the regional specific diseases, in accordance with the project proposed under the Corporate Plan.
- Evaluation of Aislaby and Hugoland Seedling Trial in collaboration with Plant Propagation and Breeding Division at Deniyaya is in progress.
- Evaluation of plucking-in *vis-a-vis* Tipping trial was commenced in collaboration with Plant Physiology Division, using a clonal block of TRI 2027
- 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.

On-going experiments conducted outside the station by different research disciplines

- Me Br 06 – To test alternatives for eradication of Nematodes in tea fields - Handford 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 to reduce shot-hole borer damage- (E-284) - Kiruwanaganga Estate (Agronomy Division)
- Labour migration survey in collaboration with Agricultural Economics Unit conducted at Deniyaya, Enasalwatta, Hulandawa, Indola and Hayes Estates
- Evaluation of Grevillea provenance in Deniyaya Estate
- Trials on the development of an economical viable system to eliminate/reduce the soil rehabilitation period prior to replanting tea in the low country - Handford Estate (Agronomy Division)

Advisory and Extension Programmes

- *Skill Training programme for nursery management*:- One programme was held for the management and field staff of Deniyaya and Hanford Estates on 15th December
- *Field days*:- One programme was held for the smallholders organised by *Southern Development Authority* at the Divisional Secretarial Office, Pitabaddara. on 2nd December, to create awareness of land selection, soil conservation, planting, infilling and after care.
- *Seminars*:-The following seminars were conducted during the year:
 - 4 on “Quality leaf for better price” conducted for leaf suppliers and collectors in collaboration with Tea Commissioner’s Division, Matara
 - 1 on plucking the management and field staff of Deniyaya
 - 1 on infilling for smallholders
 - 11 on pruning plucking, weeding, pests and diseases control for smallholders
 - 2 on tea cultivation in low- country for students of Sabaragamuwa University
 - 1 on general practices in tea cultivation for the students of Central College, Deniyaya
- *Training Programmes*:-Three Training Programmes were conducted at the Deniyaya Agro-met station on the collection of weather data for the students of Central College, Deniyaya, Rajapaksha Vidyalaya and Godakumbara Vidyalaya

- *NIPM Programmes:-* The Officer-in-Charge participated as a resource person at 9 training programmes conducted by NIPM for field staff of Maturata Plantations Ltd. in Deniyaya region.
- *Informal discussions:-* These discussions involved the following:
 - 7 Sessions were held with proprietary and company estate management personals to provide advice on nursery management, pests and diseases control, pruning and development programmes
 - 15 discussions took place with smallholders to provide advice on nursery management, pests and diseases control, pruning and development programmes
- *Exhibition:-* The Centre participated in an Exhibition held at Rajapaksha Vidyalaya, Deniyaya, from 10th to 13th September 2000, on dissemination of technical information to tea growers

Meetings attended by the Officer- in-Charge/Advisory and Extension Officers

- *Advisory Officers' Forum:-* The meetings held at Talawakelle, Kottawa and Ratnapura were attended by the Officer in-Charge and Extension Officer.
- *Experiments and Extension forum-* Four meetings held at Talawakelle were attended by the Officer -in-Charge and Extension Officer.
- *Regional Scientific Committee Seminars:* The Officer in-Charge attended the RSC-seminars held at Kandy and Galle.

Special problems encountered in Deniyaya

The sudden death and decline in yield of clone TRI 2026 at the tea fields in Deniyaya, Enselwatte and Hanford Estates and a few proprietary and smallholding lands was 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. The investigation is in progress.

**MID-COUNTRY RESEARCH, ADVISORY AND
EXTENSION CENTRE, KANDY**

Officer-in-Charge - P. B. Ekanayake

1. General

Miss. R. M. S. S. Rajapakase, Experimental Officer, Agronomy Division, returned in December after completing her postgraduate studies at the Asian Institute of Technology, Bangkok.

Mr. K. Palathantrige, Works Supervisor, was transferred to Talawakelle in April. Mr. P. Marapona, Stenographer, was temporarily transferred to the Mid-Country Station from Head Office in August.

2. Research, Advisory and Extension activities

The details are reported under the respective Divisions.

3. Hectarage as at 31st December 2000

<i>Type of land use</i>	<i>ha</i>
Seedling tea	2.60
VP tea (mature)	4.80
VP (young)	2.00
Mother bush	3.00
Nursery (tea)	0.20
Under mana grass	2.00
Fruit trees	0.40
Coconut	0.81
Forestry	1.21
Marshy land	0.62
Buildings, gardens, paths & roads	5.77
Total	23.00

4. Crop

Month	Crop harvested (kg)	Crop sold (kg)	Rate paid (Rs./kg)	Total (Rs.)
January	3658	3651	15.52	56,663.52
February	3677	3669	16.09	59,034.21
March	5513	5493	16.39	90,030.27
April	3214	3213	16.67	53,560.71
May	5023	4870	16.67	81,182.29
June	2678	2677	13.86	37,103.22
July	2888	2879	10.14	29,193.06
August	2716	2683	13.26	35,576.58
September	3372	3350	13.26	44,421.00
October	2112	2112	16.38	34,594.56
November	3748	3727	18.25	08,011.75
December	2972	2939	18.25	53,367.75
Total/Average	41,571	40,363	15.92	642,744.92

5. Income

No: of cuttings sold	741,300
Income from sale of cuttings	Rs. 186,758.75
No. of VP plants sold	23,000
Income from sale of plants	Rs. 115,100.00
Total crop harvested (kg)	42,217
Income from sale of green leaf	Rs. 642,744.92
Guest House occupation charges	Rs. 18,225.00
Soil testing (pH) charges	Rs. 13,620.00
Sale of TRI publications	Rs. 5,800.00
Miscellaneous (Sale of pepper)	Rs. 10,000.00
Total Income	Rs. 992,248.67

6. Special Visitors

1. Dr. K. P. Premaratna, University of Peradeniya, in January
2. Dr. V. S. Pandit, Zeneca Agrochemicals, India, in June.
3. Dr. N. Krishnan, UPL world, Mumbai, India, in July
4. Mrs. P. Ailapperuma, PMU, ADB, in July
5. Ms. Loli Ai Tee, ADB, Manila, Philippines, in July
6. Mr. D. C. Weragala, Rubber Development Department, in August
7. Mr. W. D. L. Gunaratna, Dept. of Export Agriculture, in august
8. Dr. G. Hitinayake, Faculty of Agriculture, in September
9. Dr. P. S. Waidyanatha, Coconut Research Board, in October
10. Mrs. N. K. Ekanayake, School of Agriculture, Kundasale, in November
11. Mr. Y. Ratnayake, Horana Plantations Ltd., in December
12. Mr. Sumedha de Silva, Tea Development Project, in December

**LOW COUNTRY RESEARCH, ADVISORY AND
EXTENSION CENTRE, RATNAPURA**

Officer-in-Charge - Sushlla I Vitarana

General

Construction work of a new laboratory and library was completed in July. The Entomology staff moved into the laboratory on 17th October. The library was furnished by the end of the year. Construction of the Nursery Record Room for the Plant Breeding Division and a new security post was also completed by the end of the year.

Appointments, transfers, retirements and resignations

Transfers - Mr. C.B. Koswatte, Accounting Assistant, was transferred from the Head Office with effect from 1st January. Mr. H.I. Mettananda, Driver, was transferred to the station from TRI Advisory and Extension Centre, Kottawa, with effect from 25th January.

Retirements - Mr. T.S. Lokuhetty, Clerk Typist, retired with effect from 31st January, and Mr. D.J. Wilson, driver, retired on 2nd April, after serving 39 and 34 years respectively at the Institute.

Resignation - Mr. T. Ramilan, Extension Officer, resigned from the Institute's service with effect from 1st May.

Local training

Mr. S.L.D. Amarathunga, Extension Officer, completed his practical project in part fulfilment of requirements for MSc degree based on an agro-ecological survey to study the impact of the variation of weather parameters on crop environment and productivity of tea lands in Sri Lanka.

Ms. S.M. Samarasinghe, Experimental Officer, completed her research work on allomones (keiromones and allelomones) of tea with reference to Low-country Live Wood Termites of tea, in part fulfilment of the requirements for M Phil degree.

Overseas training/conferences

Mrs. S.I. Vitarana presented a paper entitled "Prospects of Using Neem Products and Pheromones as Pest Control Tools and the target organisms in Tea in Sri Lanka" at the Workshop on "Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones" held in Lahnau, Germany, from 13th to 15th March.

Mr.A.K.M Jayasena, Experimental Officer, Plant Breeding Division and Mr.D.W.Vithana, Experimental Officer, Agronomy Division, participated at a three-month residential Basic Certificate Course in Plantation Management, at Kothari Agricultural Management Centre, Coonoor, India from September.

External trainees

Five apprentices underwent on-the-job training at this station, organised by the National Apprentice and Industrial Training Authority; three of them were trained in scientific and Advisory & Extension divisions for the National Diploma in Technology (Agriculture) and two in the administration section in English Stenography. Mrs. S.I.Vitarana, Entomologist, supervised one undergraduate project conducted by Ms. K.M.A.Malkanathi of the Faculty of Agriculture, University of Peradeniya.

Maintenance of roads, buildings, water supply and services

Repairing of roof and ceiling, fixing of gutters and colour washing of the TRILCS Sports Club were completed. Colour washing of 10 residential quarters on the 7-year programme was completed. Drilling of an additional tube well was completed and commissioned in July. Barbed wire fencing of the station premises was replaced.

Electrical maintenance

XLPE 185 mm 4 core cable was substituted for the old main cable to meet the current and immediate future increases in the demand for power. The overhead line of the laboratory was replaced with Arial Bundle Cable. Action was initiated to replace the old cables of the lab complex, water filtration plant and the residential quarters with XLPE 120 mm x 70 mm cables. Thirtyfour street lights were replaced with Mercury Cobra light fittings and additional street light posts were erected. Rewiring of the office and the lab complex was completed.

Telephone

Four additional direct lines were installed at the station. The numbers are: 045-31928, 32350, 32351 and 32352.

Transport

The fleet of vehicles at the station was increased following the acquisition of a new bus and a motor cycle.

Staff Cadre

A proposal to increase the staff cadre at the station in the Administration Section, Scientific Divisions and the Advisory and Extension Division has been submitted.

LIBRARY

Librarian - Wasantha Illangantilake

The collection and dissemination of information on tea and allied areas were carried out during the year.

Acquisition

The library acquired 98 new books, of which 74 were purchased while the rest were received on exchange, free and as donations. Subscribed 67 journals. About 20 journals were also received on a gift/exchange basis.

Services

The library provided reference, lending inter-library loan services (ILL) and selective dissemination content pages services (SDCP) regularly to the staff. In addition, reference services were made available to postgraduate and undergraduate trainees and visitors accepted by the Institute. The library continued its normal work such as classification, cataloguing, indexing, reference, lending material and also maintained a news clipping collection.

Inter-library loan activities continued satisfactorily. On request, 41 articles were sent to various agricultural libraries while 37 articles were received for our users.

Nine literature surveys were done using CD-ROM databases and Internet facilities available at the CARP.

A "Literature Survey on Tea" was carried out bi-monthly using CCOD Agri. Bio. & Env. Science which was distributed among the staff.

The library continued to be an active member of the AGRINET (Agricultural Information Network) with a view to sharing of resources. We received 111 journal content pages according to our user requirements and we forwarded 363 journal content pages to AGRINET libraries on SDGP services. We received 43 articles from other libraries and sent 23 articles to them through AGRINET.

Other activities

Provided computerized data to the CARP for:

1. National Agricultural Bibliography
2. Bibliography on Organic Farming
3. National Bibliography on Plant Protection

Library Automation

The following database was made and updated using CDS/ISIS package:

Lending record of library books

Periodical records

Meetings

The Librarian attended two meetings of the AGRINET Advisory Committee (held on 5.4.2000 & 8.8.2000) & AGRINET Librarian's meeting (held on 5.4.2000) at the CARP Office.

ST. COOMBS / LAMILIERE ESTATE

Superintendent - S.G.Ekanayake

1. General

Mr.D.H.Wickramasooriya, Visiting Agent, visited the estate on 8th May.

2. Weather and Rainfall

A rainfall of 1,887.6 mm was recorded over 184 wet days as against 2,032.0 mm over 190 days in 1999.

3. Hectarage as on 31st December 2000

	Total	St. Coombs	Lamiliere
Old Seedling Tea in Bearing	20.4	18.4	2.0
V.P.Tea in Bearing	121.1	76.6	44.5
V.P.Tea Immature	7.5	5.5	2.0
Uprooted Area Under Grass	4.6	4.1	0.5
Nurseries	1.3	1.2	0.1
Total under 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

	2000		1999	
	Crop (kg)	Yield (kg/ha)	Crop (kg)	Yield (kg/ha)
St. Coombs	189,406	1,994	178,072	1,825
Lamiliere	98,652	2,122	87,929	1,871
Total	288,058	2,036	266,001	1,840
Bought Leaf	-	-	13,872	-
Grand Total	288,058	2,036	279,873	1,840

The yield of 2,036 kg/ha was the highest recorded in the history of St. Coombs Estate.

5. Tea Prices

Apart from topping the Western market on several occasions, St. Coombs Estate recorded an all-time high price of Rs.3,500 per kg for Silver Tips and Rs. 230 per kg for Dust I.

6. Working Results

The profit for the year was Rs.9,431,018.92. (see Table 1)

7. Nursery

32,750 plants of clone TRI 3000 and 4000 series were raised in the estate nursery for the ADB Project.

8. Cultural Operations (see Tables 3-7)

9. Labour/ Labour Accommodation

The health condition of the work force was satisfactory and there were no major industrial disputes.

Workers' Quarters

Re-roofing was completed in Line No. 1 St.Coombs Lower Division and Line Nos. 12, 13 & 14 in the Lamiliere Division.

10. Factory and Manufacture

Roller Table Cone, Racers were replaced during the year.

Rotovane, Vanes, Resistors Worm Wheels were also replaced.

11. Replanting

Block No. 8, 2nd year upkeep Field No. 12 St.Coombs

Block No. 9, 2nd year upkeep Field No. 5 Lamiliere

Following regular upkeep done during the year, these fields will be brought under revenue in 2001.

Block No. 10, 1st year upkeep Field No. 12 & 10

Block No. 11, 1st year upkeep Field No. 5 Lamiliere

The routine work was undertaken done after re-supplying was done during the year.

12. Supporting Staff

Mr.D.H.Jayathilake continued as Acting Chief Clerk.

Mr.E.M.Dayaratne continued as Acting Factory Officer.

Mr.L.B.Nimal De Silva continued as Acting Field Officer.

Mr.S.Fernando, Estate Medical Assistant, was interdicted with effect from 27th May.

Mr.P.A.Piyadasa, Driver, was interdicted with effect from 1st June.

Mr.G.N.Thambiah, Senior Assistant Factory Officer, retired from service on 25th October.

TABLE 1: Working results of St.Coombs / Lamiliere Estate for year 2000 compared to previous years

Year	Estate Crop kg (MT)	Bought Leaf kg (MT)	Yield (kg MT/ha)	Net Sale Average (Rs/kg) Actual	Cost of Production (Rs/kg)		Gross Profit + Loss - Rs. Cts.
					Estimated	Actual	
1995	292,530	107,765	2,001	93.52	83.03	82.56	+2,965,830.76
1996	262,162	113,432	1,783	106.52	83.09	82.69	+5,194,465.00
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

TABLE 2 *Monthly Yield (kg/ha), Rainfall and Average 'N' applied from 1996-2000 St. Coombs Estate - St. Coombs Division*

Month	1996	1997	1998	1999	2000
January	148	161	176	190	165
February	102	86	118	168	179
March	74	58	66	173	182
April	93	69	48	193	201
May	424	403	95	118	244
June	105	140	156	73	144
July	150	203	60	130	98
August	140	115	135	168	183
September	93	109	112	120	133
October	164	190	83	166	101
November	198	196	168	127	192
December	186	193	196	199	172
Total	1,877	1,923	1,413	1,825	1,994
Rainfall (mm)	2,199.2	2,395.9	2,292.0	2,032.0	1,887.6
No. of wet days	210	199	170	190	184
Average N kg (ha ⁻¹ yr ⁻¹)	258	226	220	170	225

TABLE 3: Monthly yield (kg/ha) of fields with amount of "N" (kg) applied St. Coombs Division

Field	Extent	Total	Mixture N	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	6.5	200	U360,U235,U709	26	77	168	158	265	151	143	234	154	130	221	193	1920
1A	0.6	200	U360,U235,U709	28	119	226	145	147	382	96	289	98	95	93	114	1832
1B	0.6	140	U360,U235	27	75	100	177	146	157	78	P	0	0	0	0	760
2	2.6	250	U709	211	122	191	155	228	137	95	150	139	162	102	99	1791
3A	7.0	270	U709	276	332	270	256	433	250	123	240	228	175	278	308	3169
3B	6.7	270	U709	267	334	207	394	379	277	139	355	205	18	253	291	3119
4	9.1	180	U360,U709	144	178	166	116	11P	3	13	14	20	41	162	161	1029
5	7.4	270	U709	212	214	286	328	356	142	94	249	206	96	240	241	2664
6A	3.0	270	U235,U709	215	244	204	210	352	198	107	212	165	121	253	208	2489
6B	2.9	270	U235,U709	114	98	141	155	223	114	106	183	67	56	166	96	1519
7	4.7	250	U360,U709	153	137	110	P	6	0	0	20	85	61	157	137	866
8	5.2	250	U360,U709	223	196	163	246	294	143	111	194	206	123	299	206	2404
9A	3.0	170	U360,U709	174	126	229	236	255	202	142	171	65	18	27	158	1803
9B	4.8	120	U360,U709	154	173	173	139	298	93	95	150	3	0	0	0	1278
10NC	2.0	225	U360,U709	88	125	55	181	207	142	82	239	136	70	192	138	1655
11A	2.0	260	U709	187	264	159	177	394	100	185	194	213	110	348	215	254
11B	4.0	200	U709	177	118	128	146	191	137	37	142	103	104	170	110	1563
12A	1.2	225	U360,U709	152	162	117	177	125	124	107	160	118	207	216	214	1879
12B	1.0	180	U360,U709	0	74	105	121	123	73	53	151	154	150	194	118	1316
13	9.0	245	U709	191	120	149	189	217	133	124	202	164	90	167	144	1890
13A	1.4	245	U709	204	141	93	159	107	109	162	97	83	103	140	98	1496
13NC	2.0	240	T 250	183	147	106	177	180	155	121	65	65	29	0	0	1228
14	7.3	240	U360,U709	48	158	221	218	269	203	112	236	124	145	277	182	2193
4NC	1.0	240	T 250	55	185	238	279	231	250	102	201	137	37	0	0	1715

TABLE 4: Cultural Operation - St. Coombs Estate - St. Coombs Division

Field No.	Seedling Tea (Ha)	V.P. Tea (Ha)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 1999	Yield (kg/ha) 2000	Shade	Experiments
1	-	6.5	T.R.I.2016,2023,2025 & DN	Sep. 1999	1953 - 1959	1526	1920	Dadaps, Grevillea	Nil
1A	0.6	-	-	Aug. 2000	Before 1935	365	1832	Grevillea	Nil
1B	-	0.6	T.R.I.777	Sep. 1999	1993	1469	760	Dadaps	ADB Mother Bush Area
2	-	2.6	T.R.I.2043,2142 2025, DT 1 & DT 95	Aug. 1996	1964	2102	1791	Dadaps, Grevillea	Plant Breeding & Agronomy
3A	-	7.0	T.R.I.2027,2043 2025	June 1998	1965-1968	3083	3169	Dadaps, Grevillea & Calliandra	Agronomy & SPND
3B	0.4	6.3	WT 26	June 1998	1965-1968	2530	3119	Dadaps, Grevillea & Calliandra	Agronomy & SPND
4	-	9.1	T.R.I.62/9, 2025, 3016 DN, N2 & CY 9	May 2000	1978-1981	2090	1029	Dadaps, Grevillea & Calliandra	Agronomy, SPND Plant Physiolog
4NC	1.0	-	3000 & 4000 Series	-	1997	-	1715	Nil	ADB Mother Bush Area
5	-	7.4	T.R.I. 2142,2025 2023,TC9,DT95 & N2	May 1996	1970	2986	2664	Dadaps, Grevillea & Calliandra	Agronomy, SPND & Plant Breeding
6A	-	3.0	T.R.I.2025, DN	June 1997	1985-1986	2164	2489	Dadaps & Grevillea	Agronomy & SPND
6B	-	2.9	N2 & T.R.I.4061	June 1997	1985-1986	1709	1519	Dadaps & Grevillea	Plant Breeding
7	-	4.7	T.R.I.2024,2025,62/9 DT 1,DT 95 & TRI 3019	Apr 2000	1962-1964	2080	86	Dadaps & Grevillea	Nil

TABLE 4 Contd.

Field No.	Seedling Tea (Ha)	V.P. Tea (Ha)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 1999	Yield (kg/ha) 2000	Shade	Experiments
8	-	5.2	TRI 2024,2025,4052, 4072 & DT 1	June 1999	1962 - 1964	692	2404	Dadaps, Grevillea & Calliandra	Agronomy
9A	-	3.0	TRI 2043 & 3000 Series	Dec. 1995	1986	2334	1803	Dadaps, Grevillea & Calliandra	Agronomy
9B	4.8	-	-	Sep. 2000	1935	1750	1278	Dadaps & Grevillea	Nil
10NC	-	2.0	SALT Area	March 1999	1993	525	1655	Dadaps, Grevillea & Calliandra	Agronomy
11A	-	2.0	T.R.I.2025,62/9	June 1998	1988	2049	2546	Grevillea & Calliandra	Nil
11B	4.0	-	-	June 1998	1935	1504	1563	Dadaps, Grevillea & Calliandra	Plant Breeding
12A	-	1.2	T.R.I.2025, KO 145	June 1999	1985	1124	1879	Dadaps & Grevillea	Plant Breeding & Pathology
12B	1.0	-	-	June 1999	1935	222	1316	Grevillea	Nil
13	9.0	-	-	July 1997	1935	1669	1890	Dadaps, Grevillea & Calliandra	SPND
13A	-	1.4	T.R.I.2025,2043 DT 1	July 1997	1986	1166	1496	GrevilleaCalliandra	Nil
13NC	-	2.0	T.R.I.3000 Series TRI 2025,DT 1	Nov.2000	1996	1329	1228	Grevillea & Calliandra	Entomology
14	-	7.3	T.R.I.777,2023 2024,3000 Series & N2	Oct. 1999	1961	1216	2193	Dadaps, Grevillea & Calliandra	Plant Breeding & Pathology

TABLE 5 *Monthly Yield (kg/ha), Rainfall and Average 'N' applied from 1996-2000 St. Coombs Estate - Lamiliere Division*

Month	1996	1997	1998	1999	2000
January	120	149	197	176	175
February	98	76	170	178	174
March	163	58	65	196	203
April	153	76	75	174	200
May	287	311	185	139	261
June	113	186	189	84	125
July	118	196	122	126	93
August	123	111	117	134	193
September	82	142	114	131	133
October	133	191	95	172	127
November	176	209	153	134	218
December	158	193	225	227	220
Total	1624	1898	1707	1871	2122
Average N (kg ha ⁻¹ yr ⁻¹)	215	213	219	169	220

TABLE 6 : Monthly Yield (kg/ha) of fields and amount of "N" (kg) applied - Lamiliere Division (2000)

Field	Extent	Total N	Mixture	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4A	5.1	265	U 235, U 709	142	232	287	262	455	160	130	309	245	159	326	223	2930
4B	1.9	270	U 235, U 709	305	207	293	286	507	137	141	194	177	239	211	198	2895
5	0.5	180	U 235, U 709	80	164	216	176	158	128	178	300	182	276	288	302	2448
6A	1.5	180	U 235, U 709	65	73	85	90	152	107	57	132	118	127	119	173	1298
6B	3	200	U 235, U 709	198	119	131	151	166	151	86	296	94	134	234	230	1990
7	4.5	260	U 235, U 709	107	211	208	136	236	206	154	252	118	161	266	201	2256
8A	5	120	U 235, U 709	262	235	249	273	194	P	6	7	27	29	98	158	1538
8B	4	255	U 235, U 709	126	189	217	280	359	150	82	300	184	157	234	277	2555
9A	4	260	U 235, U 709	284	127	223	268	314	153	119	236	161	164	245	256	2550
9B	4	255	U 235, U 709	168	174	178	184	399	136	116	226	202	103	224	232	2342
10	6.6	225	U 235, U 709	135	163	202	163	267	204	148	209	141	162	257	226	2277
11	6.4	180	U 235, U 709	169	128	124	121	P	P	P	29	40	44	138	210	1003

TABLE 7: Cultural Operation - St.Coombs Estate - Lamiliere Division

Field No.	Seedling Tea (Ha)	V.P. Tea (Ha)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 1999	Yield (kg/ha) 2000	Shade
4A	-	5.1	T.R.I.2025	June 1996	1984	1899	2930	Dadaps & Grevillea
4B	-	1.9	T.R.I.2025	Aug. 1998	1986	2158	2895	Dadaps & Grevillea
5	0.5	-	-	Sep. 1999	Before 1935	572	2448	Dadaps
6A	1.5	-	-	Sep. 1999	Before 1935	374	1298	Dadaps & Grevillea
6B	-	3.0	DT 1, WT 26 & T.R.I.2025	Aug. 1997	1990 - 1991	1158	1990	Dadaps & Grevillea
7	-	4.5	T.R.I.2025	July 1998	1983	1763	2256	Dadaps & Grevillea
8A	-	5.0	T.R.I.2025 & CY 9	June 2000	1979	2602	1538	Dadaps & Grevillea
8B	-	4.0	T.R.I.2025, DN N2, WT 26 & CY9	June 1996	1989 - 1990	2079	2555	Dadaps, Grevillea & Calliendra
9A	-	4.0	T.R.I.2025	Aug. 1996	1979	2450	2550	Dadaps & Grevillea
9B	-	4.0	T.R.I.2025, DN & CY9	August 1997	1980	2343	2342	Dadaps & Grevillea
10	-	6.6	DN & T.R.I. 2025	June 1999	1967 - 1969	1110	2277	Dadaps&Grevillea
11	-	6.4	DN & T.R.I.2025	May 2000	1970 - 1971	2169	1003	Dadaps&Grevillea

ST. JOACHIM ESTATE
Acting Superintendent - H.S.Ratwatte

1. General

Mr.H.S.Ratwatte continued to function as Acting Superintendent of St.Joachim Estate.

Mr.D.H.Wickramasooriya continued as Visiting Agent of St.Joachim Estate. He visited the estate on 24th April.

Messrs De Silva Abeywardena & Peiris, Forbes & Walker and Bartleet Co. Ltd continued as brokers.

Mr.W.M.W.L.Perera, Acting Chief Clerk, has been recommended for promotion to the post of Chief Clerk.

The factory continued to be without a Head Factory Officer. Meanwhile, Mr.P.G.H.Bandara functioned as the Acting Head Factory Officer.

Mr.S.P.Warnasooriya, Field Officer, who was on a contractual appointment, had to discontinue working following an illness in August.

2. Hectarage as at 31st December 2000

	<u>Ha</u>	
Mature V.P. tea	54.07	
Immature V.P. tea	2.02	
Land under rehabilitation	24.92	
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	<u>7.28</u>	118.14
Other Lands		
Acquisition by Government		
Buildings/roads/ravines jungle		<u>23.84</u>
Total		<u><u>141.98</u></u>

3. Crop (made tea kg)

Production in St. Joachim Estate in 2000 compared to that of the previous year was as follows:

Year	Estate Crop (kg)	Bought Crop (kg)
1999	78197	746768
2000	75336	711325

Production on the estate registered a decrease of 2861 kg or 0.04% in comparison to the previous year.

3.1 Bought Leaf

The bought leaf manufactured at St. Joachim factory showed a decrease of 35,443 kgs or 4.75% in comparison to previous year. This was mainly due to the severe competition with private factories in Ratnapura District.

Periodic seminars were conducted during the year for bought leaf suppliers. These were sponsored by Bank of Ceylon and A Baur & Co. Ltd. and the response from the suppliers was satisfactory.

4. Prices

All teas produced at St. Joachim factory were sold at the Colombo Auctions in the Main Low Grown catalogue. M/s Bartleet & Co. Ltd, Forbes & Walker and De Silva Abeywardena and Peiris sold the teas in equal proportion.

The net sale average of Rs.137/84 per kg showed an increase of Rs.17/62 per kg over the previous year. As a result, the average price paid for bought leaf suppliers increased by Rs. 2/41 per kg green leaf compared to 1999.

The working of St. Joachim Estate resulted in a profit of Rs.9,041,690.

5. Nursery

The supply of planting material to smallholders in the district continued this year as well. Sale of planting material compared to the previous year was as follows:

Year	Shoots supplied	Income (Rs.)	Plants supplied	Income (Rs.)
1999	-	-	24,541	405,685
2000	-	-	17,787	271,095

TABLE 1

**Working Accounts of St. Joachim Estate for 2000
in comparison with previous years**

Year	Total crop sold/Made Tea-kg	Yield Made Tea kg/ha	Net Sale Average Rs/kg	Estimated COP Rs/kg	Actual COP Rs/kg	+Profit - Loss Rs.
1994	*865,691 57,487	1045	69/49	66/13.84	69/53.08	- 35,914/-
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	137/84	118/58	133/42 (end Nov)	+8,141,633/- (end Nov)
					135/01** (Dec. Appro)	+9,041,690** (Dec. Appro)

* Bought Crop

2000 Production – 123,875 kgs of made tea remained unsold as at 10/01/2001

** Estimate

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 1999	1059 kg/ha
Yield 2000	1986 kg/ha
Shade	<i>Albizia and Gliricidia</i>
Experiments	Machine plucking, irrigation system and weedicide experiments were carried out by TRI Low Country Station

Regular upkeep of tea was done during the year.

Field No. 1 A

V.P. tea	1.20 ha
Clones	TRI 2025,2027,S/106 KEN
Last pruned	May 1998
Yield 1999	2488 kg/ha
Yield 2000	2825 kg/ha
Shade	<i>Albizia and Gliricidia</i>
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 1999	267 kg/ha
Yield 2000	318 kg/ha
Shade	<i>Albizia and Gliricidia</i>

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 1999	3807 kg/ha
Yield 2000	3225 kg/ha
Shade	<i>Albizia and Gliricidia</i>

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 1999	691 kg/ha
Yield 2000	1131 kg/ha
Shade	<i>Albizia and Gliricidia</i>

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 1999	1462 kg/ha
Yield 2000	800 kg/ha
Shade	<i>Albizia and Gliricidia</i>
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.50/1 & S/106
Last pruned	June 1998
Yield 1999	1397 kg/ha
Yield 2000	1591 kg/ha
Shade	<i>Albizia and Gliricidia</i>
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	8.20 ha
Clones	TRI 2023,2025,2027, H.50/1
Last pruned	May 1998
Yield 1999	1157 kg/ha
Yield 2000	1250 kg/ha
Shade	<i>Albizia and Gliricidia</i>
Experiments	Weedicide and cover crop experiments were carried out

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 1999	3192 kg/ha
Yield 2000	5040 kg/ha
Shade	<i>Albizia and Gliricidia</i>
Experiments	Nil

Regular maintenance was undertaken during the year in tea area as well as in the area under mana grass.

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. Regular maintenance was carried out during the year.

Field No.10 - Rubber Area (Part)

Regular maintenance was undertaken. Tapping was done and the latex sold to M/s Rubber Manufacturing and Exporting Corporation of Sri Lanka Ltd., Kuruwita.

Field No. 6C - 4.08 Intercropping Tea and Rubber (Planting 1998)

Tea

Replanting was undertaken in the field using TRI clones 2027,S/106, H.58/1, 3000 and 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 4th 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 - Intercropping Tea/Rubber-3rd 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 manna, 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.

Field No. 8B - 2.02 ha - 3 rd year upkeep

Weeding, manuring and routine upkeep were undertaken.

7. Factory

Overhaul repairs to the 6' CCC drier was undertaken by M/s C.C.C., Ratnapura and this unit is now in operation. The 4' ECP drier too was repaired by M/s C.C.C., Ratnapura.

No.1 leaf elevator - Overhaul repairs were carried out by M/s C.C.C., Ratnapura.
Factory troughs were painted.

8. Buildings

All buildings on the estate were well maintained during the year.

9. Labour

The health condition of the population was satisfactory. There were no strikes or major disputes.

The monthly yield of St.Joachim Estate for 2000 in comparison with that obtained from 1995 to 1999 is given in Table 2. The monthly yield of each field is given in Table 3.

TABLE 2

Monthly Yield (kg/ha), Rainfall and Average N applied from 1995 to 2000

St. Joachim Estate						
Month	1995	1996	1997	1998	1999	2000
January	94	82	112	146	122	117
February	68	86	42	99	94	105
March	77	83	61	81	132	139
April	96	90	118	131	133	141
May	97	96	111	104	108	143
June	99	75	147	123	113	118
July	102	119	113	103	102	95
August	101	112	95	98	101	100
September	101	108	99	120	135	101
October	89	125	90	127	121	100
November	104	126	122	107	138	110
December	69	146	126	120	147	124
Total	1097	1248	1236	1359	1446	1393
Total Rainfall (mm)	4216.2	3655.0	4552.3	4579.9	4526.4	3740.6
No. of Wet Days	208	188	199	220	224	211
Average N (kg-1 ha ⁻¹ yr ⁻¹)	165	119	143	158	164	162

TABLE 3: Monthly yield (kg/ha⁻¹) of fields with fertilizer mixture used and amount of N applied - St. Joachim Estate

Field No.	Extent ha	Total N	Ferti. Mix	MONTHS												Total
				Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1	5.85	180		101	104	191	179	200	172	117	212	169	172	154	215	1986
1A	1.20	160		141	122	232	162	307	196	169	227	437	183	317	332	2825
2	4.12	TRI		08	14	34	22	28	16	18	60	24	30	26	38	318
		Exp. Block														
2A	0.93	180		201	270	254	414	278	401	365	455	513	316	424	434	4325
2F	6.78	180		103	70	80	79	87	104	105	86	97	106	96	118	1131
3	8.40	160		109	98	110	107	122	93	89	17	-	-	11	44	800
4	5.85	140		128	126	129	143	169	141	134	141	92	107	143	138	1591
5	6.80	140		100	63	110	100	107	99	93	95	162	116	96	109	1250
5J	1.40	140		19	83	138	141	98	86	73	108	66	38	85	64	999
6	1.50	300		381	379	525	619	559	333	261	399	420	407	401	356	5040
8A	6.00	300		181	163	191	176	159	133	13	03	13	62	93	92	1279
8C	1.90	300		197	151	186	212	114	-	-	04	27	180	179	278	1528
3A	3.34	160		63	66	91	103	106	86	79	86	56	79	91	23	929
Total	54.07			117	105	139	141	143	118	93	101	100	100	110	124	1291

METEOROLOGICAL OBSERVATION
ADVISORY & EXTENSION CENTRE, DENIYAYA
(Elevation 250 m amsl)

Month	Mean Temperature		Soil at 30 cm		Rainfall (mm)	Wind Travelled (Km)	Sunshine Hours	Wet Days
	Min. °C	Max. °C	8.30 h	5.30 h				
January	17.8	30.97	27.4	27.3	77.8	716	193.6	9
February	18.1	31.1	27.5	27.6	327.8	661	178.3	16
March	20.7	30.7	27.6	27.3	370.0	703	157.7	22
April	21.4	30.7	27.5	27.4	184.6	1413	167.0	8
May	21.3	30.9	27.3	27.6	145.4	1968	150.3	10
June	22.0	28.8	27.4	27.6	444.8	2707	101.7	19
July	18.5	29.2	27.7	27.5	100.7	3488	139.9	8
August	16.5	28.6	27.3	27.3	308.3	2483	122.7	21
September	16.4	29.8	27.0	27.3	262.8	1507	103.4	12
October	16.5	30.3	27.2	27.9	371.8	1571	171.2	16
November	15.9	31.1	27.5	27.6	299.7	774	163.9	15
December	15.6	30.3	27.7	27.8	334.0	722	121.5	21
Total					3227.7	18763	1771.2	177
Mean	18.39	30.2	27.42	27.51	268.9	1563.5	147.6	14.75

METEOROLOGICAL OBSERVATION

MID-COUNTRY, RESEARCH, ADVISORY AND EXTENSION STATION, KANDY

(Elevation 762 m amsl)

Month	Mean temperature (°C)		Relative Humidity (%)		Mean Sunshine (h. day ⁻¹)	Rainfall (mm)	Wet Days	Cum. Evaporation (mm)
	Min	Max.	08.30 h	15.30 h				
January	19.06	26.54	92.39	92.22	4.38	69.7	13	76.45
February	19.21	27.66	90.33	90.56	5.35	95.0	13	79.10
March	19.61	29.56	94.70	94.22	6.61	94.3	8	87.69
April	21.20	28.14	94.09	93.44	6.95	220.5	11	88.60
May	20.50	29.50	91.00	91.20	8.70	129.0	5	114.10
June	20.50	26.30	92.30	91.20	4.80	119.4	16	70.20
July	20.17	28.01	91.59	91.08	7.92	51.0	8	166.57
August	19.96	26.50	95.45	87.29	4.10	256.0	21	71.90
September	20.63	27.39	97.57	97.48	8.15	256.0	21	71.57
October	19.94	27.40	89.08	85.30	5.20	215.4	14	80.00
November	19.20	26.27	92.19	92.68	2.40	274.5	16	73.20
December	19.87	25.54	94.23	93.18	4.26	192.2	14	71.18

METEOROLOGICAL OBSERVATION

UVA ADVISORY AND EXTENSION CENTRE, PASSARA

(Lat.6°.56N : Long 18° 07'E,1120 m amsl)

Month	Mean Temperature °C		Mean Relative Humidity %		Mean Sunshine (h. day ⁻¹)	Total Wind (km)	Total Rainfall (mm)	Total Evaporation (mm)
	Min Dry	Max Dry	08.30h	15.30h				
January	16.3	23.3	84	79	3.7	1239	192.7	59.40
February	17.3	24.1	86	87	4.1	522	255.2	48.16
March	17.7	25.2	78	62	5.5	603	144.8	82.30
April	19.0	26.7	79	82	5.4	135	142.0	78.21
May	19.3	27.1	76	79	5.5	212	115.0	82.69
June	17.6	25.2	83	66	4.2	1123	196.4	87.66
July	18.6	26.4	70	72	5.9	1377	61.4	103.47
August	18.4	25.7	75	71	4.0	893	238.7	75.35
September	18.0	25.5	76	83	4.1	219	275.9	59.34
October	17.8	25.7	74	83	5.1	617	49.7	73.96
November	18.1	25.8	82	88	3.5	1130	472.7	36.52
December	16.9	22.9	86	87	3.1	2403	172.9	48.85
Total						10473	2317.4	835.91
Mean	17.9	25.3	79	78	4.5	872	193.1	69.6

METEOROLOGICAL OBSERVATION

LOW COUNTRY RESEARCH, ADVISORY & EXTENSION CENTRE, RATNAPURA

(LAT 6°41N, LONG 80° E-40°E, 29 m amsl)

Month	Temperate °C		Relative Humidity %		Mean Sunshine (h. day ⁻¹)	Rainfall (mm)	Difference from 30 years	Wet Days	Difference from 30 years	Pan Evaporation (mm)
	Min Dry	Max. Dry	9.00 hrs	16.00 hrs						
January	22.11	33.09	88	67	3.50	207.6	+96.5	13	+ 4	3.61
February	22.47	33.60	89	67	3.19	484.8	+347.8	20	+ 11	3.81
March	22.71	34.32	88	60	2.46	196.1	- 16.1	14	—	4.29
April	23.95	33.77	87	73	3.38	250.3	- 88.6	14	- 6	4.61
May	24.15	33.05	85	71	3.55	476.1	+ 0.2	19	- 1	3.49
June	23.77	31.27	87	76	3.78	324.3	- 87.9	25	+ 4	3.19
July	23.64	32.56	82	64	5.96	144.5	- 148.3	11	- 9	4.84
August	23.37	31.41	87	61	3.58	501.3	+ 197.2	25	+ 5	2.07
Sept	22.91	32.90	87	69	3.98	438.5	+ 17.1	23	+3	3.16
Oct	22.95	31.97	85	71	4.71	334.0	- 102.8	16	- 5	3.65
Nov	23.08	33.01	86	78	4.59	207.0	- 164.4	16	- 2	2.40
Dec	22.26	32.15	86	71	4.09	147.5	- 87.8	11	- 3	2.74
Total	—	—	—	—	—	3712.00	—	—	—	—
Mean	23.11	32.75	86	69	3.89	—	—	—	—	3.48

METEOROLOGICAL OBSERVATION

ADVISORY & EXTENSION CENTRE, KOTTAWA, TALGAMPOLA
(Elevation 30 m amsl)

Month	Mean Temperature (°C)		Relative Humidity (%)		Mean Sunshine (h. day ⁻¹)	Rainfall (mm)	Rainfall difference from 20 years	Wet Days
	Max	Min	09.00h	16.00h				
January	30.3	21.8	87	76	5.9	373.0	+ 273.4	9
February	30.8	22.2	88	78	6.5	149.5	+ 66.4	12
March	31.2	22.3	89	78	6.0	182.8	+ 66.8	14
April	31.5	23.4	92	83	6.9	250.1	- 30.9	8
May	30.7	24.1	90	79	7.1	305.0	- 64.2	16
June	29.6	23.5	90	82	4.8	259.6	- 18.5	23
July	*	*	89	75	7.2	66.4	- 134.9	10
August	*	*	90	80	4.7	262.1	- 49.1	20
September	29.4	22.9	90	82	4.8	600.7	+ 314.8	23
October	29.9	23.0	90	85	5.8	158.7	- 217.5	15
November	30.8	22.4	90	83	6.4	310.8	+ 13.1	14
December	30.1	22.2	92	82	4.4	282.4	+ 112.0	16
Total						3201.1		180
Mean			90	80	5.9			

* Meter was out of order

METEOROLOGICAL OBSERVATION

TRI - ST. COOMBS, TALAWAKELLE
(LAT.6" 54768'N, LONG.80" 4239'E, 1382m amsl)

Month	Mean Temperature(C)		Soil at 20 cm under grass		RH (%)		Wind Travelled (miles)	Mean Sunshine (h day ⁻¹)	Rainfall (mm)	Wet Days	Total Evaporation (mm)
	min	max	09.00hrs	16.00hrs	09.00hrs	16.00hrs					
January	12.4	24.3	22.1	20.5	91.0	89.3	2136.47	4.7	85.1	13	83.80
February	12.8	24.8	20.9	22.4	93.1	92.0	1348.66	5.8	104.3	13	74.13
March	12.1	26.2	21.4	23.0	92.9	87.9	1534.23	6.9	68.8	9	88.77
April	13.2	25.9	21.9	21.9	94.4	93.5	1269.83	6.8	136.2	10	79.98
May	15.6	25.6	22.9	24.0	95.8	93.3	1499.98	6.7	127.1	8	81.19
June	15.6	21.7	20.8	21.2	97.4	96.2	2624.70	2.8	346.4	23	45.57
July	13.9	22.5	20.1	20.8	96.1	93.9	2474.94	5.1	198.2	15	64.75
August	14.1	21.6	20.1	20.7	97.5	95.6	2811.90	2.0	294.4	23	48.30
September	13.6	24.1	21.2	22.0	95.3	95.0	1364.46	5.3	104.6	13	66.30
October	12.9	23.8	20.9	21.4	94.7	94.2	1835.82	4.2	168.4	13	72.25
November	14.3	24.9	21.2	22.1	93.2	94.8	1655.06	5.0	101.2	11	66.77
December	13.4	24.1	20.6	21.7	95.2	95.6	1803.84	4.0	88.5	11	67.74
Summary	13.7	24.1	21.2	21.8	94.7	93.4	1863.3	4.9			
Total									1823.2	162	839.55