ANNUAL REPORT – 2002

TEA RESEARCH INSTITUTE OF SRI LANKA

CONTENTS

REPORT OF THE CHAIRMAN
TEA RESEARCH BOARD

The Tea Research Board (TRB) was reconstituted following the change in government towards the end of last year and eight Board meetings were held during the year, commencing May 2002, including one special Board meeting. Immediately afterwards the TRB reconstituted its three consultative committees on research, estates and advisory services, and audit and management. In addition the grievance committee was also reconstituted. In reconstituting these committees, a departure from tradition was followed, by enlarging their membership, particularly in the committee on research, to enable representation by the diverse stakeholder groups within the tea industry.

Midway in the year a change in the management of the Tea Research Institute (TRI) took effect with the ending of the contractual period of service of its director and the subsequent appointment of a successor in early August. Within a month from his appointment the new director in his report to the TRB highlighted the various deficiencies that had bedevilled the TRI, chief among which being the communication gap that had existed between the TRI management and its staff in the various divisions including research, finance and administration. He also alluded to the low morale of the staff resulting from issues related to increments, promotions and filling of vacancies. Inability to fill the vacant position of senior accountant was deemed to have affected the smooth functioning of the TRI. Other areas that he considered of importance were the rolling over of the corporate plan of the TRI to accommodate a revised research agenda to meet the emerging challenges of the tea plantation and smallholder sectors; the need to broaden the genetic base of our tea cultivars through accession and incorporation of diverse tea germplasm in their development; development of drip irrigation and fertigation technology to mitigate the effects of drought which occur in increasing frequency and intensity due to climate change resulting from global warming; conducting research on energy saving in tea processing on a prioritized basis; minimizing the delays in issuing publications and advisory leaflets; having a TRI website; strengthening and upgrading TRI's advisory and extension services; strengthening of participatory/partnership research with the tea plantation and smallholder sectors; and developing a strong administrative and financial management support base.

During the course of the year the major issues that engaged the attention of TRB were: development of a draft policy on tea cultivation and processing for submission to the Ministry of Plantation Industries; developing proposals for restructuring of TRI under the ADB funded Tea Development Project; improved worker welfare through consideration of profit share bonus payments; obtaining permanency for lent workers from the TRI estates and payment of wages based on the collective agreement between the employers federation and plantation trade unions; review of TRI's new fertilizer recommendations and participatory research with tea plantations and smallholders; upgradation of TRI's corporate plan following interaction with representatives of the tea plantation and smallholder sectors; and participation of TRI scientists as resource personnel in local universities.

Other noteworthy activities include the participation of TRI in the Government's 100 day programme wherein the six projects planned were successfully completed. The projects were:

- Training of estate executives, field supervisors and field workers on the use of the innovated tea plucking and conveyance system for green leaf.

- Adoption of software for computer-based rolling programme developed by TRI in local tea factories.

- Publication of a book on Tea and Health.

- Production and distribution of 4 extension pamphlets for tea smallholders in Sinhala.

- Organizing in Sri Lanka the International Conference on Phasing-out of Methyl Bromide in Tea Plantations.

- Writing a manual on Cost of Tea Cultivation - from Nursery to the Field.

During the year under review TRI scientists were engaged in a number of donor funded projects as detailed below:

- Assessment of the Impacts and Adaptation to Climate Change (AIACC) with special reference to tea and coconut funded by UNDP through the Sri Lanka Association for the Advancement of Science.

- Phase-out of Methyl Bromide for Eradication of Tea Nematodes in Sri Lanka funded by UNDP.

- Biochemical Pest Control funded by SIDA/SAREC.

- Use of DNA markers for molecular characterization of tea funded by SAREC.

As in previous years human resources development received due attention. TRI staff participated in conferences, workshops and training programmes as detailed below:

Conferences:

- International conference on phase-out of methyl bromide in tea plantations held in Sri Lanka.
- International conference in GIS-Map 2002 in Thailand on GIS, remote sensing, GPS and photogrammatry.
- 14th IFOAM World Congress, Victoria, Canada.
- International conference on Asian Research Network for Organic Agriculture, Suwon, South Korea.

Workshops:

- Climate change vulnerability and adaptation in Trieste, Italy organized by the project on AIACC in multiple regions and sectors.
- Econometrics and environment, Dhaka, Bangladesh.
- Regional workshop on use of methyl bromide alternatives at Thailand.

Training programmes/courses:

- In Library Science at Indian Agricultural Research Institute.
- Biotechnology, plant breeding and soil technology at the International Agricultural Centre, Netherlands.

- Biological control of plant parasitic nematodes, at Government Science Centre, Queensland, Australia.
- Post-graduate diploma in chemistry and chemical engineering at Tokyo Institute of Technology funded by UNESCO and Government of Japan.
- Agricultural research for development at International Centre for development oriented research in Agriculture, Wageningen, Netherlands.
- Induced mutation breeding at the National Botanical Research Institute, Lucknow, India.
- Full-time residential course in tea plantation management, tea tasting and quality assurance at Kothari Agricultural Management Centre, India.
- 2nd FAO/IAEA Interregional training course on mutant germplasm characterization using molecular markers, Seibersdorf, Austria.

Dr S D I E Gunawardena
Chairman
Tea Research Board

REVIEW OF THE DIRECTOR
TEA RESEARCH INSTITUTE

Corporate Plan and Cess Allocation

Scientists and extensionists continued to work in a transdisciplinary mind-set. The thrusts and projects listed under the Corporate Plan were revised to suit the allocation of funds and also the staff strength. In the meantime, the scientists had discussion with the stakeholders to obtain their views on new areas of research.

There had been an increase of the TRI's share of the cess from 25 to 30 per cent for the year under review. In spite of receiving about Rs 225 million, funds were not adequate for capital purchases. However, that the momentum, which was built up in our activities since we commenced operating our Corporate Plan (1999-2003) in July 1999, was maintained in 2002.

Achievements and Highlights

Major achievements in 2002 are given here in summary form. (The project notation used in the TRI Corporate Plan, 1999-2003, is given in parenthesis.)

Progress on activities identified under "Hundred days - Revolutionary Program"

Six activities were identified under the "Hundred days - Revolutionary Program" proposed by the new Government for implementation during the first 100 days of the year and were successfully completed. The progress on this activity could be summarized as follows:

- Popularizing innovated plucking and leaf conveyance system. The Institute staff trained about 900 staff members and 3000 workers on the use of new system.
- Introduction of the computer software developed to draw/select rolling programs in tea factories. This computer software was installed in about 150 tea factories. In factories, where there were no computers, based on information received appropriate rolling programs were drawn and posted.
- Publication of a book titled "Tea & Health"
- Publication of a manual titled "Cost of tea cultivation - from nursery to the field"
- Publication of extension pamphlets on topics such as nursery, harvesting, pruning and the TRI Selective Tea Harvester, in Sinhala for the benefit of the smallholders

- Organized an International Conference on phasing out of Methyl Bromide in tea plantations in April 2002.

Research Highlights:

Research highlights during the period under review could be summarized as follows:

- A simple device was fabricated to fill the nursery bags with soil.
- A power driven mechanical hand pruner capable of pruning 750-1000 bushes per day was innovated, tested and patented.
- A light weight folding plucking basket was designed and patented.
- Potential new shade tree species have been identified.
- Physiological studies using air enriched with CO_2 (550 ppm) had shown a yield improvement of 15% compared to control (360 ppm).
- Results from fertigation experiments have recorded a yield increase of higher than 100%, in Up country due to fertigation. Substantial yield increases were also recorded from other elevations due to fertigation.
- Construction of a tea genomic library to screen for Simple Sequence Repeat Polymorphism (SSRP) was completed. SSRP's are reliable molecular markers, which will help to characterize diverse tea cultivars and the characters thus identified could be used in plant breeding program.
- Many clones from TRI 3000 and 4000 series and seedling materials were selected for their resistance/tolerance to different pests and diseases.
- 1029 accessions were evaluated to identify potential cultivars and 92 accessions were found to be promising (based mainly on yield levels) in stage II trials.
- Metham sodium, soil solarization and soil substitutes were recommended as alternative to Methyl Bromide.
- Chemical control methods for nematode infested young-tea were recommended.
- *In vitro* screening of recommended fungicides against major root diseases and leaf disease (Blister Blight) was completed.
- Under the Second Small Holder Tea Development Project 57 ha had been planted, as Mother Bush areas.
- Based on experiments carried out variable speed drives for withering fans were recommended. Installation of such fans was proved to result in a saving of about 40% on electrical energy used in withering.
- A method was developed to classify leafy grades of tea.

- Experiments to study the effect of shear plucking on yield and quality of tea produced had shown no significant differences in yield in shear harvested field compared to manual harvested field. Quality of tea produced under both systems is comparable.

Awards and recognition:

- Project on "Conservation of Electrical Energy in Trough Withering" received the "Best energy related study for year 2002", awarded by Sri Lanka Energy Managers Association.
- Hand pruner designed was patented.
- St Coombs Factory managed by the Institute received ISO 9002 certification for tea processing.
- Contribution made by TRI towards organic tea production was acknowledged at the 15th World Organic Tea Celebrations.

Advisory and extension services:

- Staff carried out about 478 advisory visits to plantations and factories to advise on various aspects of tea cultivation and processing.
- Thousands of soil, root, leaf and fertilizer samples were tested for pH, carbon content, nutrient composition, starch content nematode infestation etc.
- 263 made tea samples were tested for moisture contents.
- 11 moisture meters from estates were calibrated.
- Videos on "Selective Tea Harvesting", "Weed Management" and "Shade Management" were prepared.
- Several skill development training programmes were conducted by the staff, for estate personnel, smallholders and factory staff.

Publications:

- A manual on "Cost of Tea Cultivation" was published.
- A book on "Tea and Health" was published
- Extension pamphlets on "Nursery Management". "Pruning", "Plucking" and "Selective Tea Harvester" in Sinhala for the benefit of the smallholders were published.
- A leaflet on "The Tea Leaf to the Cup" describing the unit operations in black tea processing was published.
- Altogether there were 57 papers published during the period under review.
- Two issues of TRI Update (Newsletter in English) and one issue of "Te Thathu" (Newsletter in Sinhala) were published.
- Six Advisory Circulars on following topics were published:
  - Guideline on land suitability classification

- Protection of tea from blister blight
- Protection of tea from red root disease
- Control of nematodes in young tea
- White grubs on tea lands and their control
- The suitability of tea clones for the different regions

Other activities:

- Several meetings with senior executives of Regional Plantation Companies and one meeting with Tea Small Holding Development Authority were held with a view to assess the research needs of the stakeholders and to seek their opinion on ways and means of improving the contribution of the TRI towards achieving the stakeholder expectations
- Two draft concept papers with a view to preparing policy documents on tea cultivation and tea processing were prepared.
- A brain storming session on quality of tea produced was organized.

Dr S S B D G Jayawardene
Director

REPORT OF THE ADMINISTRATION DIVISION

1.1 Introduction

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

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

1.2 Functions of the Tea Research Board

The specific functions of the Tea Research Board are:

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

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

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

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

1.3 Tea Research Institute Head Office at Talawakelle

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

1.4 Members of the Tea Research Board as at 31st December, 2002

1.	Dr. S D I E Gunawardena	-	Chairman, TRB.
2.	Dr. S S B D G Jayawardena	-	Director, TRI.
3.	Mr. Y G Wijeratne	-	Member
4.	Mr. Clifford Ratwatte	-	Member
5.	Prof. H P M Gunasena	-	Member
6.	Mr. M. Malin Goonetilleke	-	Member
7.	Dr. (Ms) Damitha de Zoysa	-	Member
8.	Mr. M L M Aboosally	-	Member
9.	Mr. K M Opananda	-	Member
10.	Mr. Roonie Weerakoon	-	Member
11.	Mr. K P Govindaraj	-	Member
12.	Mr. M Sunderalingam	-	Member

Mr. C C Mawilmada served as convenor Secretary up to October 2002.

1.5 Senior Management Staff as at 31st December, 2002

1. Director - Dr. S S B D G Jayawardena

2. Deputy Director Research (Technology) - Dr. M T Z Mohamed

3. Deputy Director (Administration) - Mr. C C Mawilmada

1.6 Executive Staff (Grade I & II) as at 31st December, 2002.

Administration Division

Mr. C C Mawilmada	-	Deputy Director (Administration)
Ms. S Anusha	-	Administrative Officer
Mr. K G Piyasena	-	Public Relations Officer

Finance Division

Mr. M F Y Arafath	-	Accountant/Acting Senior Accountant

Internal Audit Division

Mr. R Kariyawasam	-	Internal Auditor

Engineering Division

Ms. D W Manawadu	-	Resident Engineer

Library

Ms. R W M W K Illanganthillake	-	Librarian

Publication Unit

Vacant	-	Publication/Publicity Officer

Advisory & Extension Services Division

Mr. S Wimaladharma	-	Head, Advisory & Extension Service (on contract)
Mr. B A D Sanmansiri	-	Acting Officer-in-Charge/Advisory Officer
Mr. V S Sidhakaran	-	Advisory Officer

Agronomy Division

Ms. M S D L de Silva	-	Research Officer (On overseas study leave)

Agricultural Economics Unit

Ms. J A A M Jayakody	-	Senior Research Officer/Officer-in-Charge
Mr. D P B Herath	-	Research Assistant (On overseas study leave)
Mr. G Ganewatte	-	Research Assistant (On overseas study leave)

Bio-Chemistry Division

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

Entomology/Nematology Division

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

Plant Physiology Division

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

Plant Pathology Division

Dr. A Balasooriya	- Actg. Head/Senior Research Officer
Ms. N H L Pradeepa	- Research Assistant(on overseas study study leave)
Ms. B A P Cooray	- Research Assistant

Plant Propagation & Breeding Division

Mr. V Shanmugarajah	- Actg. Officer-in-Charge/Senior Research Officer
Dr.(Ms.) M T K Amarakoon	- Senior Research Officer
Mr. M Ratnayake	- Research Officer
Mr. M A B Ranatunga	- Research Assistant

Soils & Plant Nutrition Division

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

Technology Division

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

TRI Sub-Station Deniyaya

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

TRI Low Country Station, Ratnapura

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

TRI Sub-Station, Hantane

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

TRI Sub-Station, Kottawa

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

TRI Sub-Station, Passara

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

1.5 Other Administrative, Scientific, Research & Advisory Staff - Grades III-V as at 31st December 2002

Administration Division

Ms. S Jayasingham	-	Secretary to the Director
Ms. S Shanmuganathan	-	Stenographer/Typist (English)
Mr. B Tilakeratne	-	Purchasing Officer
Ms. Devika Ratnayake	-	Stenographer/Typist (English)
Ms. D H Kalikotuwa	-	Stenographer/Typist (English)
Ms. A P V Kalyani	-	Stenographer/Typist (English)
Ms. C S K Kiribathgoda	-	Stenographer/Typist (English)
Mr. M L H Perera	-	Transport Officer
Mr. P D S L De Silva	-	Clerk/Typist
Mr. R Nadarajah	-	Clerk/Typist
Mr. K R M Priyantha	-	Clerk/Typist
Ms. R Jayasinghe	-	Clerk/Typist
Ms. R Wanasinghe	-	Clerk/Typist
Ms. Chandrika Jeyaram	-	Clerk/Typist
Mr. S H Chandrasena	-	Clerk/Typist
Mr. P T Perera	-	Clerk/Typist
Mr. G G E H Gamage	-	Chief Motor Mechanic
Mr. U A Wickramasinghe	-	Electrical Foreman
Mr. J M R K Bandara	-	Electrician
Mr. R W Rengasamy	-	Electrician
Mr. K M Seneviratne Banda	-	Telephone Operator
Ms. P K N Damayanthi	-	Telephone Operator
Mr. S Karuppiah	-	Telephone Linesman
Mr. D V D Vithanage	-	Clerk of Works
Mr. W P A N Jayasinghe	-	General Clerk
Mr. V Shanmuganathan	-	Clerk/typist (on 'No Pay' overseas leave)
Mr. C J B Abeykoon	-	Works Supervisor

Mr. W C K Fernando	-	Chief Plumber Mechanic
Mr. J G Gamage	-	Filter Plant Assistant
Mr. S N W M Premaratne	-	Tinker/Welder

Finance Division

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

Internal Audit Divisonit

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

Library

Mrs. R W M S K Amunugama	-	Library Assistant

Advisory & Extension Services Division

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

Agronomy Division

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

Agricultural Economics Unit

Ms. H W Shyamalie	-	Experimental Officer
Mr. W M J C Bandara	-	Technical Assistant

Biochemistry Division

Mr. M D L P Gunatilaka	-	Experimental Officer (On overseas study leave)
Mr. K M Mewan	-	Experimental Officer (Study leave)
Mr. G A A R Perera	-	Experimental Officer
Ms. J M D Abeysinghe	-	Technical assistant
Ms. A D M Damayanthi	-	Technical Assistant
Ms. R W T Dharshaini	-	Technical Assistant
Mr. P K P Muthukumarana	-	Technical Assistant
Mr. M W Silva	-	Skilled Mechanic

Entomology/Nematology Division

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

Plant Physiology Division

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

Plant Pathology Division

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

Plant Propagation & Plant Breeding Division

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

Soils & Plant Nutrition Division

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

Technology Division

Ms. S H P Waduge	-	Experimental Officer
Mr. D L D H Dahanayake	-	Experimental Officer
Mr. L Jayasinghe	-	Technical Assistant
Mr. A M M V Abeykoon	-	Technical Assistant
Mr. U D Alagiyawadu	-	Technical Assistant

Mechanical Workshop

Mr. A Nandasiri	-	Workshop Mechanic

TRI Sub-Station, Deniyaya

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

TRI Low-Country Station, Ratnapura

Mr. H S N Peiris	-	Experimental Officer
Mr. E R Perera	-	Experimental Officer
Mr. P D Upali	-	Experimental Officer
Mr. W M U A B Marapana	-	Experimental Officer
Mr. D S E Weerasooriya	-	Chief Clerk
Mr. A K Prematunga	-	Experimental Officer
Mr. D W Vithana	-	Experimental Officer
Mr. A G Gamage	-	Experimental Officer
Mr. K G J P Mahindapala	-	Extension Officer
Mr. D G N Mahinda	-	Extension Officer
Mr. A K M Jayasena	-	Technical Assistant
Mr. K A D Mervin	-	Accounting Assistant
Ms. P V G Karunanayake	-	Stenographer/Typist (English)
Mr. K A S Kumarapperuma	-	Clerk/Typist
Mr. H K Seetha	-	Accounts Clerk
Mr. J S K de Silva	-	Electrician
Ms. B S N Vithana	-	Experimental Officer
Mr. K Gunawardena	-	Work Supervisor
Mr. J H N Piyasundera	-	Experimental officer
Ms. E W D P Prematunga	-	Experimental Officer
Mrs. P I Jayawardena	-	Telephone Operator/Receptionist
Mr. M A B De Silva	-	General Mechanic
Mr. M A Chamindra	-	Technical Assistant
Mr. M M Jayatillake	-	Technical Assistant

TRI Mid-Country Station, Hantana

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

Ms. W R P de Silva	-	Clerk/Typist
Mr. K Palathantirige	-	Works Supervisor
Mr. C.S.K. Ratnayake	-	Experimental Officer
Ms. P Marapana	-	Stenographer/Typist (English)

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
Mr. R Nandasena	-	Station Assistant

Walahanduwa Laboratory Complex

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

Estate

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

1.8 Retirements during the year

(a) Mr. S Wimaladharma, Head, Advisory & Extension Services, retired after 36 years of service on 15/01/2002.

(b) Mr. M Bowatte, Accountant, retired after 33 years of service on 09/04/2002.

(c) Mr. P B Chandradasa, Technical Assistant, retired after 37 years of service on 17/05/2002.

(d) Mr. D A Sirisena, Carpenter, retired after 22 years of service on 21/08/2002.

(e) Dr. W W D Modder, Director, contractual period expired on 10/06/2002.

(f) Mr. S N A Devadas, Carpenter, retired after 21 years on 05/10/2002

1.9 Resignations during the year

(a) Mr. D H Jayatillake, Clerk/Typist, resigned on 14/10/1999.

(b) Mr. C B Herath, Technical Assistant resigned on 10/05/2001.

1.10 Staff Recruitments

The following staff were recruited during the year

(a) Director	-	01 (Contractual basis)
(b) Head Advisory & Extension Services	-	01 (Contractual basis)

1.11 Officers who have sent on Vacation of Post

(a) Mr. R Rajendrakumar, Clerk/Typist vacated from post w.e.f 25/06/2002.

(b) Ms. R M S S Rajapakse, Experimental officer, vacated from post on 12/08/2002

1.12 Overseas Training/Seminars/Conferences etc.

a. Mr V Siddhakaran, Advisory Officer, Advisory & Extension Division, followed a professional training course in inter disciplinary team research in agriculture from 14-01-2002 to 25-07-2002 at International Centre for Development, Wageningen, Netherland.

b. Mr G P Udumulla, Experimental Officer, Entomology Division, followed a training on Intergrated Pest Management Techniques applicable at managing nematode problems in cultivated crop from 06-02-2002 to 06-03-2002 at the Institute de Nematologia, Bari, Italy, under the Methyl Bromide Project.

c. Dr A Anandacumaraswamy, Senior Research Officer, Agronomy Division, attended the meeting on "Assesment of Impact and Adaptation to Climate Change Project implementation" from 11-02-2002 to 15-02-2002 at the United Nations Environment Program Headquarters in Nairobi, Kenya.

d. Mr T M Sarathchandra, Experimental Officer, Plant Breeding Division, followed a fellowship on training of Techniques of Polyploidy induction Mutation from 15-04-2002 to 15-07-2002 at the National Botanical Research Institute, Lucknow, India.

e. Dr (Ms.) M T K Gunasekara, Senior Research Officer, Plant Breeding Division followed a fellowship on Biotechnology, Plant Breeding and Seed Technology, from 229-04-2002 to 05-07-2002 at the International Agricultural Centre, the Netherlands under the Netherlands Fellowship Programme.

f. Dr M A Wijeratne, Senior Research Officer, Agronomy Division and Mrs J. A. A. M. Jayakody, Senior Research Officer, Agricultural Economics Unit participated at the Climate Change Vulnarability & Adaptation workshop from 03-06-2002 to 14-06-2002 at A.I.C.C.C. In Trieste, Italy.

g. Ms. W Illangantilake, Librarian, followed a short term training in Library Science from 03-06-2002 to 15-06-2002 at the Indian Agricultural Research Institute, New Delhi, India, under the M.O.A, between ICAR & CARP.

h. Mr N Navaratne, Experimental Officer, Nematology Division, followed a training in the field of Biological control of Plant Parasitic nematodes from 17-06-2002 to 14-07-2002 at the Queensland Government Science Centre, Qureensland, Australia.

i. Mr P A N Punyasiri, Research Officer, Bio-chemistry Division, followed a training on Chemical and Biochemical techniques in flavonoid research from 01-07-2002 to 30-11-2002 at the Technical University, Munich, Germany, as a part of his PhD programme.

j. Mr M D L P Gunathilaka, Experimental Officer, Bio-chemistry Division, followed a short term training in Gas Chromatograph - Mass spectrophotometer which was acquired under SAREC/SIDA Bio-chemical Pest Control Project from 21-07-2002 to 27-07-2002, in Singapore.

k. Mr D L D H Dahanayake, Experimental Officer, Technology Division, left the country on No-pay study leave for a period of three years commencing from 01-08-2002 to follow a PhD course at the University of Oklahoma, U.S.A.

l. Ms. R M S S Rajapakse, Experimental Officer, Agricultural Economics Unit, participated at the MAP Asea 2002 International conference from 07-08-2002 to 09-08-2002 in Bangkok, to present a research paper as a speaker delegate.

m. Dr A K N Zoysa, Senior Research Officer, Soils and Plant Nutrition Division participated at the 14th IFOAM Organic World Conference held from 15-08-2002 to 31-08-2002 in Victoria,. Canada.

n. Mr P D Upali, Experimental Officer, Plant Propagation and Plant Breeding Division followed the full time residential course in tea plantation management from 17-09-2002 to 30-11-2002 at Kothari Agricultural Management Centre, Coonoor, South India.

o. Mr A M M V Abeykoon, Technical Assistant, Technology Division, followed the full time residential course in Tea Tasting and quality assurance from 17-09-2002 to 31-12-2002 at Kothari Agricultural Management Centre, Coonoor, South India.

p. Ms S I Vitarana, Entomologist, attended the work shop on the use of Methyl Bromide Alternatives from 25-09-2002 to 27-09-2002 at Pattaya, Thailand under UNDP Multilateral Project.

q. Mr M D L P Gunathilaka, Experimental Officer, Bio-chemistry Division, left the country to follow a Post graduate Diploma for Advanced Research in chemistry and chemical Engineering, from 07-10-2002 to 07-10-2003 at the Tokyo Institute of Technology, Tokyo, Japan.

r. Dr (Ms) A C Liyanage, Senior Research Officer, Bio-chemistry Division, participated at the 02nd FAO/IAEA Inter-regional training course on Mutant Germplasm characterisation using molecular markers from 04-11-2002 to 29-11-2002, at the International Atomic Energy Authority, Austria.

s. Ms J A A M Jayakody, Senior Research Officer, Agricultural Economics Unit, attended a training workshop in Econometrics and environment from 09-12-2002 to 14-12-2002 at the BRAC Centre for Development Management in Rajendrapur, Dhaka, Bangladesh.

1.1 Maintenance Divisions

Engineerng

General

The Chief Plumber Mechanic Mr.W.C.K. Fernando assumed duties back in the Division on July 2002, after two years "No Pay" leave.

1. **Maintenance of Buildings**

The annual program for Internal color washing of TRI quarters was completed during the year.

In addition all repair work in TRI buildings and full color washing including roof painting at the Director's bungalow was carried out by the Engineering Division staff.

The details of the maintenance work are as follows:

The work carried out under **C/ENGW/4.02** -MB	- 342
The work carried out under various **divisional votes**	- 105
The total number of completed work	**- 415**

In addition to the above maintenance work the Engineering Division was successfully completed the following repairs and maintenance work under " **100 days accelerated program from the 1st of January 2002".**

i. Repairs and maintenance of staff quarters D Type - No 01 to 31
ii. Repairs and maintenance of staff quarters D Type - No 32 to 59 and E Type - No 01 to 12.
iii. Repairs and maintenance 0f staff quarters C Type - No 24 to 34
iv. Improvements to the Internal Roads Phase I - 8.71 Km.
v. Improvements to the Internal Roads Phase II - 0.71 Km.
vi. Renovation work of the Glass House at Plant Breeding Division/TRI, Talawakelle.

The above works were carried out under**C/ENGW/4.02/2002** and **C/ENGW/5.03c/2002** Votes.

Construction work at TRI Talawakelle and Extension Centers

Preparation of plans, Bill of quantities, Tendering etc, for the following construction works carried out during the year.

i. Construction of Rubble Retaining wall - Stage I - Completed
ii. Construction of Toilet Block at The Deputy Director's Office - Completed
iii. Construction of an Extension to the S.P.N. Division - Partially - Completed

Kottawa.

Renovation of 14 Nos. line Houses
Renovation of staff quarters is in progress.

Deniyaya.

New Road Construction work (access road to the village). Stage I - 240m length - completed

Improvements to the Internal Roads - work in progress

Soils & Plant Nutrition Laboratory – Walahanduwa.

Renovation work at the Laboratory, Hostel and the Staff quarters was completed.

2. **Water Supply**

Rains were experienced during the first four months during the dry period. As a result, it was possible to maintain a continuous supply of water through out the year. The Renovation work at the filter plant was partially completed during the year. As per the request made by the Engineering Division together with the filter plant assistant the National Water Supply and Drainage Board replaced the filter media again and the filtering process is properly functioning now. The chemical treatment is functioning properly.

Maintenance work

274 water supply maintenance jobs were completed during the year including the following major repairs and new work.

i. Installation of 10 Nos. water geezers to TRI bungalows and hostel rooms.
ii. Installation of Plastic shell water tanks to 'B', 'C', 'D' type staff quarters.
iii. Replacing the G.I pipes to P.V.C was completed from main pipe line to senior staff storage sump.
iv. Repairing and cleaning the laboratory water tank with internal painting
v. Four major pump repair work was successfully carried out by the maintenance team after obtaining the proper training from the "Jinasena Co.Ltd ".
vi. Repairs and cleaning work were completed in all storage tanks and total over head tanks at the bungalows.

Capital work

i. Installation of pipe lines at Bio Chemistry Division was completed
ii. Installation of Booster pump pipe line at the Pathology Division was completed.
iii. Installation of New water tank at Pathology Division was completed.
iv. Installation of Cartridge water filters at the Pilot plant & Bio Chemistry Division was completed.
v. Installation of New Pump for St.Coombs Estate was completed by the water supply maintenance group.

Tools and Equipment

02 Nos. Centric PM/200/3 pumps and essential pump spares were purchased. One installed at the main pump house/TRI and other is reserved to install at the new pump house near 'C' type sump, under the capital vote 2002.

02 Nos. Box Spanner set and other tools were purchased for maintenance work during the year.

01 No. Wood working machine for carpentry work shop were purchased.

13 Nos. Gas cookers were purchased for replacements.

Electrical

The Electrical Division completed the following work during the year:

- Completed 372 jobs at laboratories and bungalows

i.	Maintenance of TRI Bungalows -	221
ii.	Maintenance of Laboratory, Office buildings etc.-	107
iii.	Maintenance of Sub-station -	06
iv.	Maintenance of street lights, security lights etc. -	38

- Completed the following at TRI, Talawakelle.

i Re-wiring of D-28, D-56, D-15, C-54 Bungalows.
ii Installed and completed wiring water pump house
iii Installed and completed wiring water pump house at St. Coombs Estate, Lower Division.

iv Installed and wiring completed at the Creche, St. Coombs Estate.
v. Installed electrical equipment and completed wiring etc. at the Pathology Division.

- Completed the following at TRI Sub-stations

i Completed wiring, repair work - Street lights and over head line at Deniyaya Sub-station.

ii Re-construction work completed with 3 phase over head line and to fix the air conditioners to the office building at Kottawa Sub-station.

iii. Re-wiring of ARP C1 Quarters and wiring and installation of Plant Breeding Unit at Hantane, sub-station.

iv Re-wiring completed at Soils Plant Nutrition Stores at Walahanduwa Laboratory

TEA RESEARCH BOARD

BALANCE SHEET AS AT 31ST DECEMBER - 2002

2001 Rs.			Tea Research Institute 2002 Rs. cts.	St.Coombs Estate 2002 Rs. cts.	St.Joachim Estate 2002 Rs. cts.	Total 2002 Rs. cts.
	FIXED ASSETS					
464,598,859	Property, Plant, Equipment etc.	(Anx. I)	509,642,721.20			509,642,721.20
(242,663,672)	Less: Accumulated Depreciation	(Anx. I)	(278,491,592.37)			(278,491,592.37)
221,935,187			231,151,128.83			231,151,128.83
24,826,995	Capital Work in Progress	(Anx. II)	54,534,102.27	741,647.80		55,275,750.07
246,762,182			285,685,231.10	741,647.80	-	286,426,878.90
15,550	Other Assets-Patents		15,550.00			15,550.00
246,777,732			285,700,781.10			286,442,428.90
	CURRENT ASSETS					
10,189,976	Stocks	(Anx. III)	8,474,384.64	1,249,390.22	1,937,840.98	11,661,615.84
198,401,053	Debtors and Other Debit Balances	(Anx. IV)	75,252,056.93	6,301,832.69	1,774,354.11	83,328,243.73
36,633,703	Deposits,Pre-Payments & Purchase Advances	(Anx. V)	30,488,464.22	454,425.43	1,025,062.77	31,967,952.42
23,449,094	Loans and Advances to Staff & employees	(Anx. VI)	22,431,730.66	3,502,891.41	1,203,862.52	27,138,484.59
62,994,016	Short Term Investments-7 day Call Deposits	(Anx. VII)	116,000,000.00			116,000,000.00
5,231,745	Cash and Bank Balances	(Anx. VIII)	40,404,903.00	233,035.24	24,050.19	40,661,988.43
336,899,586			293,051,539.45	11,741,574.99	5,965,170.57	310,758,285.01
500,558	Identified Losses	(Anx. IX)	500,557.67	-	-	500,557.67
281,889	Excess & Shortages	(Anx. X)	300,511.28	-	-	300,511.28
337,682,034			293,852,608.60	11,741,574.99	5,965,170.57	311,559,354.16
	CURRENT LIABILITIES					
(36,783,240)	Creditors and Provisions	(Anx. XI)	(27,474,891.92)	(6,725,525.55)	(11,603,388.60)	(45,803,806.07)
300,898,793	Net Current Assets		266,377,716.68	5,016,049.44	(5,638,218.03)	265,755,548.09
547,676,525	**TOTAL ASSETS LESS CURRENT LIABILITIES**		552,078,497.78	5,757,697.24	(5,638,218.03)	552,197,976.99
	REPRESENTED BY					
59,683,060	Grants and Reserves	(Anx. XII)	89,984,590.53	-	-	89,984,590.53
452,705,232	Tea Research Fund		427,125,233.05			427,125,233.05
-	A/C Current St.Coombe Estate		6,855,084.39	(6,855,084.39)		-
-	A/C Current St.Joachim Estate		10,626,687.31		(10,626,687.31)	-
754,670	Long Term Liabilities-Land Reform Commission					-
34,521,763	Provision for Gratuity	(Anx. XIII)	17,473,672.50	12,612,781.63	4,986,469.28	35,074,903.41
11,800	Petrol Deposit Refundable	(Anx. XIV)	13,250.00			13,250.00
547,676,525			552,078,497.78	5,757,697.24	(5,638,218.03)	552,197,976.99

Accountant-T.R.I

Director-T.R.I

Chairman-T.R.B

TRE RESEARCH BOARD

OPERATING ACCOUNT FOR THE PERIOD 1ST JANUARY TO 31ST DECEMBER, 2002

2001 Rs. Cts		INCOME		2002 Rs. Cts
256,799,008	1	Cess	(Note 1)	230,242,023.75
5,790,694	2	Income from Other Commercial Activities	(Annx. XV)	5,093,316.64
8,179,867	3	Interest on Investments		5,802,045.46
3,403,609	4	Miscellaneous	(Annx. XV)	4,085,266.59
				245,222,652.44
(970,581)	5	Estate Profits/(Loss) - St.Coombs Estate	(Annx. XVIII)	(4,362,172.05)
(1,096,536)		- St.Joachim Estate	(Annx. XIX)	(3,200,384.90)
272,106,061		Total Income		237,660,095.49

Total		EXPENDITURE		Administration Finance and Common Service	Advisory, Extensions & Publicity	Research	Total
65,314,507	01	Personnel Emoluments		23,811,483.68	12,494,994.45	27,147,615.75	63,454,093.88
4,680,844	02	Travelling		1,507,728.71	1,223,688.90	1,752,322.42	4,483,740.03
14,730,245	03	Supplies and Requisites		4,467,869.82	4,892,677.48	12,171,911.26	21,532,458.56
18,257,805	04	Repairs and Maintenance of Capital Assets		16,006,484.54	7,536,661.98	2,224,249.74	25,767,396.26
31,802,170	04	Depreciation of Fixed Assets		8,203,941.67	4,455,390.27	18,571,751.02	31,231,082.96
	05	Transportation,Communication,Utility					
33,894,020		and Other Service		23,633,413.76	13,464,257.78	526,442.12	37,624,113.66
2,383,021	07	Contributions,Grants and Subsidies		2,125,299.36	202,548.38	203,039.30	2,530,887.04
6,724,656	08	Pensions and Retirement Benefits		2,069,384.10	1,129,217.76	2,753,028.06	5,951,629.92
2,753,396	08	Gratuity Provision		1,972,306.00			1,972,306.00
768,273	10	Media,Advertising,Publicity and Gifts		209,759.74	841,232.54	13,435.00	1,064,427.28
5,398,878	11	Cultivation and Field Trials		-	4,726,816.57	3,790,004.92	8,516,821.49
5,638,168	12	Miscellaneous	(Annx. XVI)	1,050,523.31	175,396.58	4,507,246.77	5,733,166.66
192,345,983		Total Expenditure		85,058,194.69	51,142,882.69	73,661,046.36	209,862,123.74
79,760,078		Operating Surplus for the year 2002					27,797,971.75
-		Less:- Tax Payments					(931,066.55)
79,760,078		Surplus after the Tax Payments					26,866,905.20
-		Less:- Prior years Adjustments	(Annx. XVII)				(52,446,903.96)
79,760,078		Operating Surplus/(Deficit) transferred to Tea Research Fund					(25,579,998.76)

Note: 1. Tea Cess receivable as at 31st December 2002 - Rs. 28,368,882.89

TEA RESEARCH BOARD
CASH FLOW STATEMENT 2002

The following statement show the cash flow of the board during the year under review and in the previous year.

Year ended 31st December

	2002		2001	
Cash flows from	**Rs.**	**Rs.**	**Rs.**	**Rs.**
Operating Activities				
Surplus/(Deficit) for the year excluding interest on investments		**21,064,860**		**71,580,210**
Adjustment for items not involving movement of cash:				
Depreciation	35,828,900		35,689,452	
Provision for Gratuity	553,140		2,678,217	
	36,382,040		38,367,669	
Less: Income from sale of fixed assets	(19,274)	36,362,766	(161,600)	38,206,069
		57,427,626		109,786,279
Adjustment for items not involving movement of cash:				
Less: Prior period items- Cess Adjustment		(52,446,904)		-
Operating surplus before changes in items of working capital		**4,980,722**		**109,786,279**
Changes in items of working capital				
Stocks - (Increase)/Decrease	(1,471,640)		276,410	
Debtors and other balances - (increase)/Decrease	115,533,083		(72,986,479)	
Deposits, Prepayments and purchase advances-(Increase)/Decrease	4,665,751		3,301,212	
Loans and advances to Staff & employees -(increase)/Decrease	(3,689,392)		(3,188,326)	
Other Current Assets-(Increase)/Decrease	-		(5,250)	
Excesses and shortages -(Increase)/Decrease	(18,622)		(229,552)	
Creditors and provisions -(Decrease)/Increase	8,267,346	123,286,526	(3,272,782)	(76,104,767)
Cash generated from operating activities		**128,267,248**		**33,681,512**

Contd...(2)

Cash generated from operating activities C/F		**128,267,248**		**33,681,512**
Cash Flows from Investing Activities				
Interest on investments	5,341,771		7,219,283	
Purchase of fixed assets	(45,044,846)		(47,922,165)	
Proceeds from sale of fixed assets	19,278		161,600	
(Increase)/Decrease in capital work-in-progress	(30,448,755)		(11,229,121)	
Cash used in investing activities		**(70,132,552)**		**(51,770,403)**
Cash Flows from Financing Activities				
Grants received from :	-			
NRC	348,784		279,731	
ADB	29,623,469		6,066,961	
Uppsala University	329,278		273,180	
Cash generated from financing activities		**30,301,531**		**6,619,872**
Net Increase/(Decrease) in cash and cash equivalents		**88,436,227**		**(11,469,019)**
Cash and cash equivalents at beginning of the year		68,225,761		79,694,780
Cash and cash equivalents at end of the year (Note)		**156,661,988**		**68,225,761**
Note:-Head Office				
Short Term Investments - 7 Day Call Deposits		116,000,000		62,994,016
Bank of Ceylon Corporate Branch		35,266,176		2,186,044
Bank of Ceylon - Talawakelle		1,614,347		2,270,709
Bank of Ceylon - Talawakelle ADB		2,267,985		1,250
Bank of Ceylon - Deniyaya		5,642		5,960
Petty Cash Imprest		1,241,793		657,426
Stamp Imprest		8,960		26,561
St.Joachim Estate				
Cash In Hand		6,911		11,098
Cash at Bank		17,013		69,599
Stamps		126		10
St.Coombs Estate				
Cash In Hand		28,663		1,456
Cash at Bank		204,216		1,532
Stamps		156		100
		156,661,988		**68,225,761**

AGRONOMY DIVISION

A Anandacumaraswamy – Actg Head of Division

Research activities

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

1.1 Project A9.1: Evaluating soil rehabilitation techniques

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

The objective of this study is compare the effect of soil reconditioning before replanting in very high altitude (>1800m AMSL) where soil fertility is not limiting the establishment of tea. Five clones (PK2, TRI 2024, DT1, NAY3, TRI 2025) are used in this study. This experiment is in the first year of the second cycle. The yield for the period September 2001 to August 2002 is presented in Table 1.

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

Treatments	Yield		
Clone	Reconditioning	Direct Planting	Mean
TRI 2025	2056	2174	2115
TRI 2024	2267	2246	2257
NAY3	2798	2673	2735
DT1	2507	2549	2528
PK 2	3119	3068	3094
Mean	2550	2542	
LSD(P=0.05) for reconditioning		NS	
LSD(P=0.05) for Clones		220	
SE for reconditioning		72.3	
SE for Clone		76.3	
SE for reconditioning x Clone		120.1	
CV(%)		8.5	

Benefits of soil reconditioning was not evident during the second year of the second cycle.

U.P.Abeysekera

1.2. Edinburgh Estate (2002)

The objective of this study is to assess different techniques of soil reconditioning in a seedling tea field. In this study two years of soil reconditioning with grass is compared with insitu soil reconditioning for two years with grass before up-rooting the old seedling tea. Mana grass was inter-planted between the seedling tea. In addition, rejuvanation pruning of existing bushes with subsequent infilling after soil reconditioning is also tested.

U.P.Abeysekara and A.Anandacoomaraswamy

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

Project 10.1: Evaluating soil rehabilitation techniques

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

a.New Peacock Estate (1991) --TRI 3013

The objective of this experiment is to test the available alternate methods with traditional methods to reduce the soil reconditioning period of two years. Compost, coir dust with and without T200 (young tea mixture) were incorporated at the time of planing (July 1997). Further *Flemingia congesta* was used as another treatment for *in-situ* soil reconditioning after planting tea. The control for this comparison was two years of soil reconditioning with Mana. This experiment is in the first year of second cycle. The yield from September 2001 to August 2002 is given in Table 2

TABLE 2. Yield (kg Made Tea ha^{-1})

Treatments	
T1 -Tea Planted in Soil reconditioned with Mana	2841
T2 - Direct Planting with compost (3kg per hole)	1152
T3 - Direct Planting with Compost (1.5 kg at the bottom of the hole + T200 20g per hole)	1205
T4 - Direct planting with coir dust 1.5 kg at the bottom of the hole and compost 1.5 kg on the top	1496
T5 –Direct planting with coir dust (3 kg per hole and T200 –20g per hole)	1310
T6 –Direct planting with coir dust (3 kg per hole)	1383
T7 –Direct plsnting of tea with interplanting *Flemingia congesta* as a cover crop in the inter rows after planting tea	1173
T8 – Direct planting without any soil amendments + T200 20g per hole	1105
SE	159.6
LSD(P=0.05)	
CV(%)	19.0

A.R.Amerasekera

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

The objective of this experiment is to investigate available alternative methods compared to traditional methods to reduce soil reconditioning period. The first year yield is presented in Table 3:

TABLE 3. Tipping weight and yield (kg ha^{-1})

Treatments		
T1 - Control (Direct Planting)		240
T2 - Rehabilitation with Mana for 2 years	468	
T3 - Rehabilitation with Mana for 2 years + Cowpea in between tea rows		545
T4 - Compost + Trochoderma 3kg per hole		364
T5 - Coir dust 2 kg per hole		564
T6 - Coir dust 4 kg per hole		579
T7 - Refuse tea 2 kg per hole		496
T8 - Refuse tea 4 kg per hole		361
T9 - Coir dust 2 kg per hole + Refuse tea 4 kg per hole		387
T10 - Mana *insitu* every row		185
T11 - Maize *insitu* every row		395
T12 - 'Turdhal' *insitu* every row	141	
LSD (P=0.05)		262
CV(%)		37

The beneficial effect of soil recondition was not visible in this trial. Planting an economic crop like Cowpea with tea in the rehabilitated soil also gave the similar results. Out of the soil amendments, coir dust (4kg) and refuse tea(2kg) was better than the other treatments.

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

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

Project 11.1: Evaluating soil rehabilitation techniques

1. Balangoda estate

This study was started in 1999. Planting of tea (TRI2026) was done in September, 1999. Plants were brought into bearing in 2002.

TABLE 4 Yield Girth and Number of Primary branches

Treatments		Yield (kg ha-1)	Girth (cm)	Primary Branches
Planting after Rehabilitation		743	3.46	5.06
Direct planting (planting hole)	596	3.15	3.91	
Planting with Compost (planting hole)	613	3.08	4.16	
Planting with Compost (trenches)		651	2.92	4.36
LSD (p=0.05)		NS	0.36	0.90
CV%			6.1	10.9

Due to dry weather prevailed in the Balangoda region, plucking was restricted to few months only. Although rehabilitation has given a higher yield compared to other treatments, results were

not significantly different ($p>0.05$). Growth assessments showed that number of primary branches and girth of tea planted after rehabilitation were superior to all other treatments.

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

b. St.Joachim Estate (2000)

Second cut was given at a height of 45 cm in May 2002 and the tea plants were brought into bearing in October 2002. Weight of cut branches and girth of tea plants were measured. Results showed that the growth of tea plants of rehabilitated block (mana) was significantly better than those of control and other treatments. Of the alternative measures to rehabilitation tested, application of compost has given better results (growth) than interplanting with mana, 'Tuor dhall' and sweet corn.

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

Project 11.2: Minimum period required for soil rehabilitation

1). 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. Half of the blocks were uprooted and planted with tea and the grasses in the balance area were maintained.

TABLE 5: Soil organic carbon content, Number of tillers per bush and maximum length of the root system (± SE)

Grass spp.	Soil OC %	No. Tillers	Max. Root length (cm)
Citronella	1.95 ± 0.14	69 ± 6.70	42.8 ± 3.4
Mana	2.10 ± 0.07	92 ± 15.7	48.8 ± 3.9

There were no significant differences in soil organic carbon level between the tested two species of grasses. However, growth assessments show that length of root system and number of tillers of Mana grass are marginally higher than those of Citronella.

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

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

c Handford Estate – Deniyaya

The objective of this experiment is to investigate available alternate methods compared to traditional methods to reduce the soil reconditioning period. Compost with tricodama, refuse tea, coir dust with and without refuse tea were incorporated at the time of planting (August 2000). Further, mana, maize and turdhal was used as other treatments of in situ soil reconditioning after planting tea. Other treatments are rehabilitation with Mana grass for 2 years and planting tea with and without cowpea. The control for these comparisons was direct planting of tea after uprooting old seedling tea. The casualties counts were taken June 2002 and vaccancies were infilled. The were no casualitities in the reconditioned plots while 25- 50% casualities in the soil amended plots. The plants were allowed to

grow freely to have better root growth and tipped at 35-40cm in June. Tipping weight is presented Table 6

TABLE 6 – Tipping Weight

Treatments:		Tipping weight (kg ha^{-1})
T1	Rehabilitation with mana grass for two years	3577
T2	Rehabilitation with mana grass for two years + Green gram	4151
T3	Direct planting of tea with mana in between the tea rows (*Insitu* rehabilitation)	526
T4	Direct planting of tea with vettiver in between the tea rows (*Insitu* rehabilitation)	549
T5	Direct planting of tea with 'turdhal' in between the tea rows (*Insitu* rehabilitation)	291
T6	Direct planting of tea with green gram in between the tea rows (*Insitu* rehabilitation)	970
T7	Direct Planting with T200 with no forking	626
T8	Direct planting with T200 with forking up to 18"	384
T9	Direct Planting with compost (3kg per hole)	915
T10	Direct Planting with coir dust (3kg per hole)	1811
T11	Direct planting of tea with 'tricoderma'	603
T12	Direct Planting with refuse tea (3kg per hole)	1293
T13	Direct Planting with compost (1.5kg per hole) and coir dust (1.5kg per hole)	491
LSD(P=0.05)		
CV(%)		12.5

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

A.R.Amerasekara, U.P.Abeysekara

Project 11.2: Minimum period required for soil rehabilitation

a. St.Joachim Estate

Mana and Citronella grasses were planted in two large blocks of field No. 1, St.Joachim estate in August, 2001 for soil rehabilitation. Grasses were lopped three times in 2001 and the total weight of loppings are given below in Table 7:

TABLE 7 Fresh Weight of Loppings

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

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

Thrust 12 – Development of intercropping systems (with pepper and coffee) for marginal tea lands in mid country small holder sector

Project 12.1 Evaluating the most compatible crop combinations.

12.1.1 Effect of intercropping minor export crops in mid country small holder tea estate, Manikdewela (2000)

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

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

Design: Observation blocks

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

TABLE 8 – Yield of tea in made tea kg per ha during first year of the first cycle

Treatment	Yield in kg made tea ha^{-1}
Tea alone	2457
Tea x Pepper	3317
Tea x Coffee	3128
Tea x Pepper x Coffee	2778

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

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

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

Project 13.1. Evaluating the most compatible crop combinations.

13.1. Effect of intercropping minor export crops in mid country, New peacock Estate, Pussellawa (2002)

The experiment carried out at Ratwatte estate was abandoned due to high percentage of casualties of pepper and coffee. This experiment was initiated at the New Peacock estate with following treatments.

Treatments:

Coffee

C1 – Catimore
C2 -- IMY

Pepper

P1 – Paniyur
P2 – Local

Spacing

S1 – 4m X 4m
S2 – 6m X 6m

Plot size: 18m X 18m

Design: RCBD with 3 replicates

Plot marking was done during April in a mature tea field. Pepper and Coffee were planted during May/June.

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

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.

Rehabilitated tea plots were pruned in May 2002 and tipped in August 2002. The yield and tipping weights are presented in Table 9

TABLE 9. *Yield of rehabilitated tea under different spacing of rubber*

	Green leaf Yield kg/bush/yr	*Tipping Weight g/bush*
Rehabilitated tea		
Tea (monocropping)	0.485	195
Tea+Rubber (8'x40')	0.282	150
Tea+Rubber (8'x27')	0.255	122

LSD (p=0.05)	0.198	51.9
CV	25%	

The yield of rehabilitated tea under rubber was significantly lower than that of monocropped (rehabilitated) tea. Analysis of results on yield of tea planted without rehabilitation showed that 8'x40' spacing gives a higher yield than 8'x27' i.e. 0.420 and 0.282 kg/bush/yr respectively. Weight of tippings was significantly high in monocropped tea when compared with that of tea under rubber.

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 (stand of tea-100%), tea under rubber (40'x 8') (stand of tea-75%) and rubber (20'x 12') in three replicates. Rubber was planted in 1990 and tea was introduced in 1993. Second pruning was done in April 2001.

The yield of tea was significantly different ($p<0.05$) and it was 1.796 kg/bush/yr for monocropping and 1.072 kg/bush/yr for intercropping of tea under rubber. The rubber yield was recorded as 154 ml /tree/tapping for intercropping and 108 ml/tree/tapping for monocropping.

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

Field practices of the demonstration plot were continued during the year 2002.

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 and rubber were continuously harvested. Yield of tea (fresh weight basis) for the year 2002 was 2.92 kg/bush, 1.42 kg/bush and 1.25 kg/bush for monocropped tea, tea under rubber (40'x8') and tea under rubber (60'x8'x8'), respectively. The average yield of tea planted at 2'x3' and 2'x4' was 1.42 and 1.24 g/bush/yr respectively. The rubber yield was recorded to be 36, 56 and 42 ml/tree/tapping for 12'x18', 40'x8' and 60'x8'x8' spacing respectively.

M.A.Wijeratne, P.B.Ekanayake, H.S.N.Peiris, P.Premathunga

14.2. Effect of Intercropping Tea and Coconut on productivity and land utilization

14.2.1. Tea and Coconut Intercropping Experiment - Citrus Estate, Poddala (2000)

In collaboration with the CRI observation trial was initiated in 2000 with following treatments.

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

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

1). Study on drip irrigation-St. Joachim Estate, Ratnapura

A feasibility study on the use of drip irrigation on tea was commenced at St. Joachim estate, Field No. 1. The irrigation system and the technical support were given free of charge by Messrs. Agriworld Pvt.Ltd., Colombo. The system covered about one acre.

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

TABLE 10 – Yield (kg MT ha^{-1})

Treatments	Mean	Std Dev
Clones		
TRI 2023	4381	1584
TRI 3025	2646	1196
Bed Type		
Floor	3028	1568
Raised Bed	3999	1603
Irrigated	4574	1467
Control	2454	1004

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

1.2.Effect of frequency of fertigation on the yield of mature tea.

An experiment was initiated to test the effect of frequency of fertigation on the yield of mature clonal tea (TRI2025). The frequencies tested were daily, every other day and the control. The fertilizer was U709 equivalent in water soluble form.

The yield from January -December is presented in Table 11

T5 - Tea x Coconut at 12 ft x 40 ft without rehabilitation
T6 - Tea x Coconut at 12 ft x 40 ft with rehabilitation

Planting of mana grass and coconut completed. The trial is in progress

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

14.2.2 Tea and Coconut Intercropping experiment – Mawarala, "The Shakti" estate, Deniyaya (2001)

In collaboration with Coconut Research Institute and Tea SmallHolding Development Authority (Tea Shakthi Fund") the experiment was initiated during the year with following treatments.

Treatments:

T1 – Coconut alone at recommended spacing
T2 – Tea alone at recommended spacing without rehabilitation
T3 – Tea alone at recommended spacing with rehabilitation
T4 – Tea x Coconut at 20 ft x 30 ft without rehabilitation
T5 – Tea x Coconut at 20 ft x 30 ft with rehabilitation
T6 – Tea x Coconut at 20 ft x 40 ft without rehabilitation
T7 – Tea x Coconut at 20 ft x 40 ft with rehabilitation
T8 – Tea x Coconut at 20 ft x 20 ft x 60 ft without rehabilitation
T9 – Tea x Coconut at 20 ft x 20 ft x 60 ft with rehabilitation

Design: RCBD

No:of Replicates: 3

Planting coconut and mana was done during the year. The experiment is in progress

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

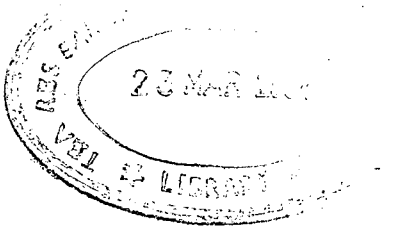

TABLE 11 – Yield (kg MT ha^{-1})

Treatments	
Control	4930
Daily	5648
Every other day	5765

N.P.S.N.Bandara

Evaluation of fertigation, Somerset Estate, Nanu Oya

In this study, previous treatments were modified to include nitrogen levels. Fertilizer was given with the irrigation water at the rate of 180, 225 and 300 kg N ha^{-1} as urea for 300 days. The annual yield is presented in Table 12. There was an additional treatment of water application only with surface broadcasting of fertilizer at the rate of 360 N kg ha^{-1} in four splits.

TABLE 12 *Yield of Tea*(kg MT ha^{-1})

Treatments	
Fertigation daily 1 hr with 180 kg N ha^{-1}	6050
Fertigation Daily 1hr with 225 kg N ha^{-1}	5730
Fertigation Daily 1hr with 300 kg N ha^{-1}	5783
Water only Daily 1hr with 360 kg N ha^{-1}as ground application 4 times in an year	3070
Control (No fertigation)	1711

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

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

Evaluation of Fertigation, Dammaria Estate, Passara

In this study, the four treatments of varying frequencies were tested in large blocks of land (0.25 ha). Fertilizer was given with the irrigation water at the rate of 180 kg N ha^{-1} as urea in combination with muriate of potash (90 kg K_2O) and triple super phosphate was given for 300 days. The plants were pruned in December 2001 was tipped in April 2002 and brought into plucking in June. The yield from June -December is presented in Table 13.

Table 13 *Yield of Tea*

		Yield (kg MT ha^{-1})
1	Fertigation daily (1hr)	1856
2	Fertigation every two days (1.5hrs)	1730
3	Fertigation once in every three days (1.5hrs)	2075
4	Control (No fertigation)	1538

This study is in progress

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

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

Project 20.2. Evaluating harvesting devices.
20.3. Modifying the harvesting intervals
20.5. Modifying the bush management

1). Raigama Estate (2000)

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

Treatments:

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

Clones: TRI 2027 and H1/58

Harvesting of tea continued until May and bushes were pruned in August after resting. Made tea yield from June 2001-May 2002 are given in Table 14 below:

TABLE 14 –Yield(kg ha^{-1})

	H1/58	**TRI 2027**
Manual harvesting	3559	3858
Mechanical harvesting (14 days)	2239	2278
Mechanical harvesting (21 days)	2149	2200
LSD (p=0.05)	494	762
CV%	11.4	16.8

Results show that the use of motorised machines has reduced tea yield in both clones irrespective of the changes in frequency of plucking.

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

3). Balangoda estate (1998)

This was commenced in 1998 under the collaborative research programme with the estates. Four systems (spacing) of planting are tested using two clones at Balangoda Estate, Balangoda. The different spacing are 0.6x1.2 m (100%), 0.6x0.9x1.5 (100%) 0.6x0.6x1.5m (114%) and 0.9x0.45'x1.5m (133%) and the two clones are TRI 2026 and DG 39. Tea plants were brought into bearing in year 2000. Results of the statistical analysis of yield and ground cover are presented in Table 15.

TABLE 15-Yield (kg ha^{-1}) and Ground Cover

	Yield	% Ground cover
Spacing (m)		
0.6 x 1.2	945	73.6
0.6 x 0.9 x 1.5	929	74.2
0.6 x 0.6 x 1.5	1125	76.4
0.9 x 0.45 x 1.5	1478	64.1
LSD (p=0.05)	**139.0**	**2.46**
CV%	**13.5**	**3.7**

Analysis of results show that double hedge rows with a spacing of 0.6 x 0.6 x 1.5m and 0.9 x 0.45 x 1.5m has given a significantly higher yield than the 0.6x1.2m spacing and 0.6x0.9x1.5m spacing. Similar results were found during the first year of harvesting after bringing into bearing. Estimated ground cover show that the hedge-row system with the highest plant density (0.9 x 0.45 x 1.5) has a poorer ground cover than the other systems of planting. Of the two clones tested, TRI 2026 has given a significantly ($p<0.05$) higher yield (1239 kg/ha/yr) than DG 39 (1000 kg/ha/yr).

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

4). Noragalla estate (2000):

Growth performance of tea plants were recorded on in relation to different spacings and results are given in Table 16.

TABLE 16- Plant Height and Collar thickness

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

± Standard Error for the mean

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

Project: **20.2: Evaluating harvesting devices.**
20.4 Modifying the fertilizer application

1). Galaboda estate

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

Treatments:
Method of harvesting: Manual harvesting
Mechanical harvesting (Kawasaki NV 60H)
Levels of K application: Normal rate (Recommended K)
Enhanced rate (1.5 x Recommended K)

Replications: 4

Clone: TRI 2027

Yield records showed no significant difference between two rates of K applied under mechanical and manual harvesting. In spite of adopting manual harvesting during dry weather on mechanically harvested plots, harvesting of tea by the motorized machine has given about 23% reduction in yield in comparison with continuous manual harvesting. The recorded made tea yield was 5050 kg/ha/yr under manual harvesting and 3928 kg/ha/yr for the motorized machine.

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

Thrust 21: Development of devices for improving pruning efficiency

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

Field testing of the new hand pruner have shown that it can prune about 750 bushes per manday. The labour requirement for pruning with this new machine is estimated to be 16 workers/ha thus registering about 68% saving of labour. Considering the cost of a portable generator, fuel, depreciation, maintenance and labour, mechanical pruning with this hand pruner reduces the cost of manual pruning by about 35%.

M.A.Wijeratne

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

Observations were made on the post pruning vigour of mechanically pruned tea bushes and it was found that there is no significant variation in recovery. However, it was observed that tea bushes needs to be manual cleaned after mechanical pruning. Death of branches can occur if cut end of branches are split due to bad blades or incorrect use of machines.

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

Thrust A-24 Development of Weed Management strategies in Tea

24.1 Screening of herbicides:

i) Deverinol (Napropamide 45% sc) a pre-emergent herbicide.

Four dosages i.e. 1, 2, 3 and 4 kg a. i. of the product was tested by spraying on to the bare soil of inter-rows of a new clearing at Joachim estate, Ratnapura in December 2001.

Mean weed fresh weight as affected by the herbicide, Deverinol is given in Table 17.

TABLE 17- WEED FRESH WEIGHT

Treatment (Rate)	**Weed fresh weight**			
	First application(Dec. '01)		Second application (June '02)	
	8 WAS	14 WAS*)	12 WAS	20 WAS
	(g 0.09 m^{-1})	(kg/plot (20 m^2)	(kg/plot (20 m^2)	
1 kg a.i ha^{-1} (4 ml/l)	9.1	2.34	2.45	2.55
2 kg a.i ha^{-1} (8 ml/l)	4.7	2.70	1.11	2.60
3 kg a.i ha^{-1} (12 ml/l)	10.4	2.41	1.50	2.76
4 kg a.i ha^{-1} (16 ml/l)	2.8	2.17	1.40	2.50
Control	25.5	6.65	2.62	1.89
sed	6.4	0.34	0.492	NS
df	16	12	12	

There was a significantly lower weed weight in all treated plots 8 WAS compared to the control. Same was significantly reduced in treated plots when compared to control 14 WA first application. However, a significantly lower weed weight was recorded only with 2,3 and 4 kg a.i /ha, 12 WA second application in June. There was no difference in weed growth between treatments 20 WA second application.

b) St Coombs estate, TRI, Talawakelle.

Mean weed fresh weight as affected by the herbicide, Deverinol is given in Table 18.

TABLE 18 – Fresh Weight

Treatment (Rate)	**Weed fresh weight (kg/8 m^2)** 10 WAA (DOS-4th Oct.)
T1) 2 kg a.i ha^{-1} (8 ml/l)	0.673
T2) 4 kg a.i ha^{-1} (16 ml/l)	0.520
T3) 6 kg a.i ha^{-1} (24 ml/l)	0.530
T4) Control	1.360
sed	0.3378
df	9

4 and 6 kg a.i /ha Deverinol significantly ($P<0.05$) reduced the weed growth when compared to 2 kg a.i/ha and control 10 WAA.

c) Hantana Estate, Kandy
Amiphosate (50% and 70%) glyphosate

Design: RCBD with 3 replicates

Treatments

T1 -- Amiphosate 0.72 kg/ha
T2 -- Amiphosate 1.43kg/ha
T3 -- Amiphosate 0.99 kg/ha
T4 -- Amiphosate 1.98kg/ha
T5 --Glyphosate 1.8 l /ha
T6 --Glyphosate 2.75 l/ha

Treatments applied on 26.12.02
Experiment is in progress

K.G.Prematialake S.N.Wijesekara

ii) Amiphosate - Granular form (glyphosate 50% and 70%)

a) At St. Joachim estate.

Weed dry weight and recovery of weed growth as affected by new formulations are given in Table 19.

TABLE 19 – Weed Dry Weight and Recovery Rate

Treatment	**Dosage a.i** @ kg/ha		**Weed dry weight** (3 WAA) (g/plot 2 m^2)	avg	**Recovery rate** (12 WAA) (%)	avg
Glyphosate (70% a.e)	0.49	1.3 g/l	8.05		18	
Glyphosate (70% a.e)	0.99	2.6 g/l	10.22	(9.18)	23	21
Glyphosate (50% a.e)	0.49	1.8 g/l	10.94		6	
Glyphosate (50% a.e)	0.99	3.6 g/l	7.07	(9.05)	34	20
Glyphosate (36% a.e)	0.49	2.5 ml/l	10.03		60	
Glyphosate (36% a.e)	0.99	5.0 ml/l	4.52	(7.28)	39	49
sed (at $p< 0.10$)			2.189			
df			10			

There was a slight increase in weed weight with 50% and 70% granular formulations compared to 36% liquid formulation. However, the recovery rate was faster with 36% glyphosate.

b) Control of cooch grass with Amiphosate (50% and 70%) at St. Coombs estate.
The fresh weight and % death are presented in Table 20

TABLE 20 – Fresh Weight and % Death

Treatment	Dosage a.i kg/ha	Dosage (g/0.09m^2)	kaolin g/l	Fresh weight of rhizome (4 WAA)	% Death (above ground) (4 WAA)
Glyphosate (70% a.e)	1.99	5.2 g/l +	4.5	70.0	99
Glyphosate (50% a.e)	1.99	7.2 g/l +	4.5	48.0	99
Glyphosate (36% a.e)	1.99	10.0 ml/l +	4.5	70.0	99
Untreated Control				87.0	0

Although the above ground foliage was properly killed underground rhizomes were not properly killed by all glyphosate formulations. Further investigations are in progress.

A 24 . 2 Management of Problem weeds:

1) Management of Passali kodi weed **at Balangoda estate:**

a) Effect of various herbicides on the control of Passali kodi weed

TABLE 21 : Fresh biomass yield of over-grown passali vines and yield of tea as affected by various herbicides/ combinations.

Treatment	Jan.-April '02* (kg/ha)	May-Dec. '02 (kg/ha)	MT yield (kg/ha/yr)
T1 Wallop @ 3.0 l ha^{-1} with CDA sprayer	1040	1682	1580
T2 Wallop @ 3.0 l ha^{-1} with CDA + hand sprayer	739	1471	2415
T3 Spark @ 4.0 l ha^{-1} with CDA sprayer	1617	1464	2145
T4 Spark @ 4.0 l ha^{-1} with CDA + hand sprayer	684	1811	2192
T5 Direx @ 1.2 l ha^{-1}+ Round up @ 3 l ha^{-1}	1178	1314	1799
T6 Goal @1.2 l ha^{-1} fb Round up @ 3 l ha^{-1}	665	953	2267
T7 Manual removal of all weeds	1752	1404	2259
T8 Control	1732	2201	2120
SED	*255.9*	*429.5*	*660.5*
df	*14*	*14*	*14*

*[*T1-T6 was treated with another application of Deverinol (45%AI) @ 10 ml/l in April'02]*

The above treatments were imposed in late November 2001. Passali shoot weight was significantly reduced with Wallop, spark with both CDA and hand sprayers, Direx + Round up and Goal.

Passali weight was significantly reduced only in Goal treated plots compared to control during May-Dec '02. Made tea yield was significantly reduced with Wallop 5.5 l/ha alone followed by Deverinol.

b) Effect of frequency of removal of Passali shoots on the growth of passali and yield of tea.

Experiment was commenced in August 2001. Overgrown Passali vines were plucked at different intervals from tea plots which were uniformly infested with Passali . In control treatment passali yams and seedlings were regularly removed from plots. Yield of tea and passali growth were assessed.

Treatments

T1 Removal of passali –Every 2 weeks
T2 Removal of passali –Every 4 weeks
T3 Removal of passali –Every 6 weeks
T4 Removal of passali –Every 8 weeks
T5 Removal of passali –Every 10 weeks
T6 Removal of passali –Every 12 weeks
T7 Control

Table 22 : Yield of tea and growth of passali (above tea canopy) as affected by the treatments.

	Made tea yield (kg/ha/yr) for 2002.	Mean Fresh weight of passali shoots (kg/ha/12 week round)
T1	2475	1225
T2	2240	1413
T3	2339	756
T4	2549	415
T5	2284	366
T6	2319	625
T7	2332	697
SED	*170.6*	*228*
Df	*18*	*18*

Made tea yield was not significantly affected ($p>0.05$) by the frequency of removal of passali. A significantly greater passali weight was recorded when passali was removed every 4 weeks when compared with that of every 6,8,10 and 12 weeks. Weight of Passali removed at 2 and 6 week intervals was also comparable. Thus, yield of tea was not affected by longer plucking rounds until 12 weeks. Passali removed at shorter intervals such as 2-4 could aggravate the passali growth.

A 24-3 : Economics of weed management.

24.3.1: Impact of various chemical weed management methods on the Growth of tea.

a) Hemingford Estate, Parakaduwa, Ratnapura (2001).

Table 23 : Mean yield of tea before and after application of various herbicides.

Treatment	Yield (kg MT $ha^{-1}yr^{-1}$)
T1 Wallop(21% ai) 3 l fb gly (36%) 3 l fb gly 1.7 l fb gly 1.7 l ha^{-1}	1990
T2 Wallop 5 l fb gly (36%) 4 l fb gly 2.8 l ha^{-1}	2443
T3 Spark (16% a.i) 3 l fb 4 l fb 3l ha^{-1}	3280
T4 Spark 5 l fb 6 l fb 5 l ha^{-1}	2680
T5 Weed Master 1.65 kg ha^{-1} alone (4 rounds)	2886
T6 Weed Master 2.75 kg ha^{-1} alone (4 rounds)	2990
T7 Blaster 2.75 l ha^{-1} alone (4 rounds)	3002
T8 Amosuper 1.65 l ha^{-1} (4 rounds)	2088
T9 Amosuper 2.75 l ha^{-1} (3 rounds)	2251
T10 Paraquat 1.1 l ha^{-1} (3 rounds)	3900
T11 Control (Manual / slash)	2353
LSD (0.05)	ns

There was no significant difference in yield between treatments. Experimental block was pruned in December.

b) Galphelle Estate, Panwila, Kandy (2000).

Table 24 : Mean yield of tea during second year after imposition of various herbicides.

Treatment*	Yield (kg MT $ha^{-1}yr^{-1}$)
T1 Wallop @ 2 l ha^{-1} with CDA fb Amosuper@ 2.8l/ha**	6506
T2 Wallop @ 4 l ha^{-1} with Knapsack fb Blaster @2.8 l/ha**	3650
T3 Spark @ 3 l ha^{-1} with CDA (twice)	3692
T4 Spark @ 5 l ha^{-1} with Knapsack (twice)	5451
T5 Weed Master @ 1.65 kg ha^{-1} with Knapsack (twice)	4123
T6 Weed Master @ 2.75 kg ha^{-1} (do)	4405
T7 Amosuper @ 1.65 l ha^{-1} (do)	4364
T8 Blaster @ 1.65 l ha^{-1} (do)	5293
T9 Round up @ 1.1.65 l ha^{-1} (do)	5955
T10 Gramoxone @ 1.1 l ha^{-1} (do)	4255
T11 Control (Manual)	5000
sed	*1464*
df	20

Herbicides were applied twice i.e in January and September,'02.
There was no significant different in made tea yield between treatments.

Project D/AGRY - *Divisional Activities*

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

Different styles of pruning (lung pruning at 20"-partial cleaning, lung pruning at 20"-full cleaning, cut across at 26" and lung + cut across pruning-alternate cycles) and two types of bringing in to plucking (plucking-in and tipping to hard green wood) were tested. Tea bushes were pruned in May 2002 and the experiment was terminated. There was no difference in yield at the last 4 months before pruning and pruning weight. However, the thickness of branches at the pruning cut was high under tipping treatment when compared with that under plucking-in i.e. 1.6cm and 1.4cm, respectively.

M.A.Wijeratne, D.W.Vithana

2). Assessment of plucking baskets introduced to the tea sector.

A study was conducted at Hantana estate, Kandy in collaboration with the University of Peradeniya, to assess suitability of PVC plucking baskets (TRI innovated basket and a basket produced by a private company) in comparison with cane basket and poly sack. Findings of the study have shown that two innovated baskets contribute to significant improvements in the working condition of the pluckers when compared with the cane basket. In comparison with poly sacks commonly used, the new baskets reduced leaf damage significantly. Innovated baskets have also improved plucker productivity. Hence, worker productivity and quality of harvested shoots can be improved by the use of these innovated plucking baskets in place of poly sacks and they are also better substitutes to cane basket.

M.A.Wijeratne, S.T.Yatawatte K.G.Wanigasekara,
W.A.D.P. Wanigasundera, (Faculty of Agriculture, University of Peradeniya)

3). Screening clones for drought tolerance, St. Joachim estate, Ratnapura.

This study was done in collaboration with the Faculty of Agriculture, University of Ruhuna and Plant Breeding Division, TRI. Water relation characteristics of 28 TRI 4000 series clones were investigated and their drought tolerance capability were compared with well-known drought tolerant clone TRI 2025 and drought susceptible clone TRI 2023. Water relation characteristics such as stomatal density, leaf thickness, relative water content, leaf water potential, transpiration and diffusive resistance were measured. Clones were first statistically compared with two control clones (TRI 2025 and TRI 2023) taking each parameter separately and they were ranked according to their level of drought tolerance giving numbers from 1 to 5 as follows.

Significantly inferior to TRI 2023 -	5
Equal (not significant) to TRI 2023 -	4
Not significantly different from both TRI 2025 and TRI 2023 or significantly superior to TRI 2023 and inferior to TRI 2025 -	3
Equal (not significant) to TRI 2025 -	2
Significantly superior to TRI 2025 -	1

Thereafter the results (ranks) were pooled i.e. individual parameter was taken as a replicate and combined result was statistically analysed. Results showed that TRI 4003, TRI 4006, TRI 4020, TRI 4024 and TRI 4033, TRI 4042, TRI 4043, TRI 4044, TRI 4047, TRI 4049, TRI 4052, TRI 4053, TRI

4054, TRI 4059, TRI, 4061, TRI 4062, TRI 4067, TRI 4075, TRI 4078, TRI 4079, TRI 4083 and TRI 4085 had drought tolerant characteristics that are similar to TRI 2025 and hence rated as drought tolerant clones. Water relation characteristics of TRI 4004 and TRI 4014 were not significantly different from TRI 2023 and hence considered as drought susceptible clones. Other tested clones viz. TRI 4010, TRI 4016, TRI 4055 and TRI 4071 were inferior to TRI 2025 but superior to TRI 2023. Therefore, those clones were grouped as moderately drought tolerant clones. Although all important water relation characteristics pertaining to the canopy have been studied in this experiment, characteristics of the root system have not been observed due to lack of plants for destructive measurements. Hence, it is necessary to study root growth and take field observations before firm conclusions are made on these rating.

M.A.Wijeratne and W.M.D.D.Kulasinghe (Faculty of Agriculture, University of Ruhuna)

4). Clonal characteristics of tea amenable to shear harvesting.

Clonal characteristics amenable to shear harvesting were studied at St. Joachim estate, TRI, Ratnapura. The experiment was conducted using TRI 2023, TRI 2025, TRI 2026, TRI 2027, TRI 3052, TRI 3020, TR 3052, TRI 4053, S106 and KEN 16/3 clones of mature tea. Total shoot density, inter-nodal length (2^{nd}-3^{rd} leaf), mother leaf angle (between shoot axis and the mid-rib and tip) and percentage of dormant shoots were measured before harvesting 10 bushes per clone with the TSTH. Shoots of the harvested crop were weight and separated into different categories. Shoot counts including damaged shoots were recorded on the bush after harvesting for estimating % shoots harvested, % dormant shoots remained on the bush after harvesting and % of soft and mature leaves in the harvest. Results showed that clones with erect type leaves possess a higher density of shoots and have low % of dormant shoots. Percentage of soft leaf pieces in the harvest reduced with the decrease in dormant shoots and % mature leaf/pieces in the harvest also reduced with increase in inter-nodal length. Moreover, % of harvestable shoots that have been harvested by TSTH increased with increasing shoot density. Hence, clones with a longer inter-nodal length and less dormant shoots are amenable for shear harvesting. Further, use of shears are more effective during rush crop periods (high cropping months) characterized by high shoot density, fewer number of dormant shoots and fast extension rates of shoots (longer internode).

M.A.Wijeratne and P.N.Aberatne (School of Agriculture, Karapincha)

5). Growth of cuttings in the nursery under polythene tent of different colour and enhanced ambient CO2

Two experiments were commenced in August 2002.

a). Growth of single nodal cuttings of two clones (TRI 2026 and TRI 4042) grown under Blue, Green, Yellow and Transparent polythene tents are compared with control (without polythene tent).

b). TRI 4042 cuttings were separately planted under enhanced CO2 supplied by a decomposing layer of compost (1") applied on the surface of nursery bed. Treatments were enhanced CO2 under polythene tent, enhanced CO2 only (no polythene tent), polythene tent only and control (without polythene tent and normal ambient CO2).

Polythene tents of both studies were removed two months after imposing treatments. Assessments on shoot and root growth are being continued.

M.A.Wijeratne and P.Prematthunga

6). Impact of global climate change on the productivity of tea plantations

A new research project was initiated in collaboration with SLASS, CRI and Met Department and administrated by International START Secretariat, Washington D.C., USA. Collection of productivity and socio-economic data was completed and results are being analysed. Further a Sri Lanka Climate Change model **(SRILAKACLIM)** was built with the assistance of University of New Zealand. This model could forecast the possible future climate for Sri Lanka based on Global Circulation model down scaled to regional scale.

An experiment on impact of enhanced CO_2 on yield of mature tea was commenced in both St.Joachim Estate and St.Coombs Estate. Ambient CO_2 level (360ppm) was enhanced to 550 ppm by supplying CO_2 to open top chambers prepared by covering tea bushes with a thick polythene sheet. Tea bushes are plucked weekly and yield is recorded.

7). 100 day programme: Use of TSTH and plucking baskets

The main objective of the field programme was to enlighten and train tea pluckers, field staff and management of estates on the use of TRI Selective Tea Harvester (TSTH) and innovated baskets. The programme consisted of a lecture (sinhala and tamil), video film and a field demonstration cum training on the use of basket and TSTH. The lecture was aimed at changing the attitude of workers, field staff and the management of estates regarding mechanization of field practices on estates. The video film was on the proper use of TSTH with new baskets. The whole programme emphasized the importance of using new innovations in the light of improving worker productivity, reducing cost of production, minimizing drudgery of field work (plucking) and absenteeism, attracting younger generation for field work and improving income and the standard of life of workers. During the period of 100 day programme (from January 12-April 10), it has been able to conduct 73 programmes covering 106 company and some private estates in the Low and Mid country and in Uva. About 1800 estate workers including kanganies, 620 staff members (Superintendents/Assistant Superintendents and field officers) and more than 300 small holders were educated and trained on the use of TRI selective tea harvester and improved baskets.

Of the tea estates visited, about 25% had TSTH either using at present or used for some time and abandoned due to various reasons such as worker resistance, poor average or change of superintendent/management. Use of shears has been very poor in the low country plantations compared to other tea growing arrears. In most of the estates the TSTH have been used incorrectly i.e. with no selectivity or incorrect art of shearing. In many estates, workers have not been trained properly. Moreover, poor average has been resulted from the use of shears on poor yielding tea fields i.e. marginal seedling or VP tea fields and fields due for pruning. Use of sacks for leaf collection in place of a suitable basket has also contributed to their lower intakes. In some places the workers had an attitude that they won't get any extra income or benefits even though they plucked more leaf by shears. However, some estates have increased plucking intakes by about 50% with TSTH. But we found that intakes can be further improved by training workers and providing them with a suitable basket.

Workers, superintendents and field staff in many estates agreed that more leaf can be harvested by the TSTH than manual plucking leaving a greater % of *arimbus* once workers are get used to the shears and the leaf harvested by TSTH is of high quality. They also said that a suitable basket should be used with shears in order to increase plucking average. During manual plucking leaf is bruised or crushed by hand. Workers press leaf into their collecting sacks and damage leaf. This was shown to the workers during field demonstrations. Hence, provision of a suitable basket will

improve quality of harvested shoots. Field officers and managers in many estates have observed that workers tend to pluck *arimbus* and also shoots below the level (inside plucking). During field demonstrations, they found that this incorrect practices can be corrected by introducing TSTH. Further, it was emphasized that small dormant shoots left after shearing need to be manually removed at every round or at least after every few rounds of shearing in order to avoid their accumulation. They accepted that more damages (than leaving few half-leaved shoots and dormant shoots after shearing), are being done to the bushes by manual plucking with unskilled labour and due to labour shortage. They also accepted that such problems can be found even with the manual plucking.

In most of the programmes, it was observed that youngsters and below-norm pluckers were easy to train for shears and baskets. All workers were highly thrilled to see the film that had young workers who dressed in yellow suits and equipped with new baskets and shears.

There were also few problems with old shears such as breaking of the safety locks, loosening or falling of nuts and bolts etc. Although they were easily reparable, that has not been attended to by the field staff or estate management due to poor knowledge on such repairs and maintenance. There were also complaints that the shears were not sharp enough to cut shoots after using them for few months and we found that it was due to incorrect use i.e. poor shearing (not brushing blades on each other at every cut/shearing). New shears now on sale have been improved to a greater extent to answer such problems and hence will have better performance. Many estates requested baskets be made commercially and some copied the dimensions so that they can make few of them for their workers. Moreover, they wanted shears for left-handed pluckers too.

Many plantations have been unable to maintain plucking rounds and a satisfactory standard of leaf due to short supply of workers. Although the average turn out of workers is around 50% in many estates, some low country estates faces severe problem of poor labour turn out such as 25%. Moreover, it was said that the % of workers with below-norm intake is about 40-50%. This implies that the worker productivity is low and the cost of plucking becomes high. Therefore, the estates have been compelled to either abandon their tea fields or to diversify them into other plantation crops or timber. Tea extent of some estates has been reduced from several hundred hectares to about 20-30 ha due mainly to lack of workers. During the programme it was able to convince workers that their jobs are not secured if their youngsters do not work in estates and their attitudes are not changed to accept new technology like shear harvesting.

Recommendations

1). Training of field staff and workers on the proper use of TSTH should be continued.
2). TSTH should be used on correct fields i.e. fields due for pruning, soon after bringing into bearing and tipping and also very steep lands are not amenable for shear harvesting. In general about 50% of tea extent of each and every estate can be used for shear harvesting.
3). Young workers (male or female), casual workers and below-norm pluckers can easily be trained and deployed for shear harvesting.
4). A suitable basket and a dress (or raincoat) should be given to the users of shears.
5). Workers should be given adequate time for getting used to the TSTH without increasing the norm.
6). Implementations of a subsidy or a loan scheme for buying shears and baskets will increase the use of TSTH.
7). Innovated baskets need to be commercially produced and made available for plantations.

8). Spraying of Zn SO_4 instead of any other foliar applications (with hormones) is a must for fields earmarked for shear harvesting.

M.A.Wijeratne

8. Effect of different rates of earthworm cast and T 750 on growth and yield of tea - Stelenberg estate, Pussellawa, 1998.

This trial was initiated to investigate the effect of Earthworm cast on growth and yield of tea. The yield is presented in Table 18.

TABLE 18 - Yield (kg ha-1)

Treatments	
T1 Earthworm cast 300g per plant + T750 - 4 applications of each per year	2142
T2 Earthworm cast 300g per plant - 6 applications + T750 - 2 applications per year	1863
T3 Earthworm cast 300g per plant - 6 applications per year	2384
T4 T750 - 6 applications per year	1354

This experiment is in progress.

P.B.Ekanayake, S.N.Wijesekara and Janaka Jayawarna

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

Two experiments were conducted with young tea and mature tea of clone TRI 2025. The following treatments were tested in combination. The pH amendments are on the cycle basis and mulch application is on the annual basis

Mulch Treatments:

Control
Refuse Tea –25 Tons ha^{-1}
Mana (*Cympopogan Confertiflorus*)-35 Tons ha^{-1}
Dadap (*Erytrina lithersperma* -35 Tons ha^{-1}
Pangirimana (*Cymbopogan nardus*) - 35 Tons ha^{-1}
Trichoderma

Soil acidity -

1.Control
2.Dolomite -1000 kg ha^{-1}
3.Minplus - 1000 kg ha^{-1}
(Crushed basaltic rock)

The yield for young and mature tea are presented in the following Table.

TABLE 19 - Yield (kg made tea ha^{-1})

	Young Tea			Mature Tea		
	pH			pH		
	1	2	3	1	2	3
Mulch						
Control	2019	2002	1909	2571	2940	2994
Refuse tea	2098	2365	2190	3416	3289	2963
Mana	2006	1891	1902	3404	2930	2816
Dadap	2147	2083	2072	2992	2852	2798
Trichoderma				3113	2852	2798
Pangirimana	1773	1950	1930			

LSD(P=0.05) -Mulch
LSD(P=0.05) -pH
LSD(P=0.05) -Mulch xpH

M.S.D.L.Silva U.P Abeysekra

9. Study on Biodynamic Farming -Stassen Tea Project , Haldumulla

Biodynamic farming is one of the organic farming system. It is based on the applications of organic amendments and biodynamic preparations based lunar calender to get the maximum benefits from cosmic radiation to stimulate energy and nutrient recycling. Therefore, an investigation was commenced at Stassen Bio tea project, Haldumulla to compare the traditional organic farming with the biodynamic farming on tea yield. The biodynamic preparations used are BD500 - 507. The biodynamic prepartions consist of specific minerals or plants treated or fermented with animal organs, water and/or soil. The treatments are combinations of burying/no burying prunings, two levels of organic amendments to give 60 and 120 kg N ha^{-1} $annum^{-1}$ and conventional (non-lunar) and lunar based application of biodynamic preparations. There was a control with no application of biodynamic preparations. The experiment is in progress

Treatments and yield are presented in Table 20 .

TABLE 20 - Yield (kg ha^{-1})

	First year	Second year
T1 -No Burying prunings+Biodynamic preparations at Non-lunar time + Paring poonac (60 kg N)		
T2 - No Burying prunings+Biodynamic preparations at Non-lunar time + Paring poonac (120 kg N)		
T3 - Burying prunings+Biodynamic preparations at Non-lunar time + Paring poonac (60 kg N)		
T4 - Burying prunings+Biodynamic preparations at Non-lunar time + Paring poonac (120 kg N)		
T5 -No Burying prunings+Biodynamic preparations at lunar time + Paring poonac (60 kg N)		
T6 - No Burying prunings+Biodynamic preparations at lunar time + Paring poonac (120 kg N)		
T7 - Burying prunings+Biodynamic preparations at lunar time + Paring poonac (60 kg N)		
T8 - Burying prunings+Biodynamic preparations at lunar time + Paring poonac (120 kg N)		
T9- Burying prunings+ No Biodynamic preparations + Paring poonac (120 kg N)		
LSD		
CV(%)		

A.R.Amerasekara, U.P. Abeysekara, N.Gunaratne Gnanasekaram A.Anandacoomaraswamy

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BIOCHEMISTRY DIVISION

A M T Amarakoon and I S B Abeysinghe – Actg Heads of Division

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

This project started in 2000 with the objectives of studying the chemistry and biochemistry of disease resistance mechanisms in relation to blister blight leaf disease in tea. The ultimate objective was the control of the disease in an environmentally friendly manner by means of exploiting natural disease resistance traits inherited in the tea plant.

Currently chemical control is the only available method to control the disease. The main disadvantage of the continuous use of fungicides is that the fungus could develop resistance to the fungicide. Therefore the development of biochemical control methods based on natural resistance mechanism has become important for the survival of the industry.

The work carried out in 2000 and 2001 on the levels of flavanol, flavonols and anthocyanins in both healthy and infected tissues showed that epicatechin and anthocyanin could play a significant role in the resistant mechanism.

Flavanoid biosynthesis of many other plant species had been well documented but not much work has been done on tea. Therefore the work carried out in 2002 focused on the biosynthetic pathway in the tea plant to corroborate the data generated during 2000 and 2001.

The activity of the five enzymes, chalcone synthase(CHS), flavanone-3-hydroxylase(F3H), dihydroflavonol-4-reductase(DFR), leucoanthocyanidin-4-reductase(LAR) and flavanone-4-reductase(FNR) involved in the flavanoid pathway were demonstrated for the first time using 14C labeled precursors. The formation of catechin from DHQ and gallocatechin from dihydromyricetin DHM as double step reactions involving DFR and LAR were also demonstrated for the first time in the tea leaf. The activities of the above enzymes upon infection of the disease was carried out. It was shown that enzyme activities of CHS, F3H, LAR, DFR and FNR were enhanced upon infection denoting an up regulation of the flavonoid biosynthesis during the infection.

A new enzyme BANYULS which converts cyanidin to epicatechin was first reported from arabidopsis thaliana. A comparative study to identify the activity of BANYULS using camellia sinensis, malus domestica, taxus bacata, vitisvinifera, persea americana and fragaria x ananassa was carried out. All of the above species show BANYULS activity and the tea leaf showed the highest activity.

These investigations suggested that the formation of proanthocyanidins via epicatechin involving leaucoanthocyanidins (flavan-3,4-diols). One proanthocyanidin found in the infected leaf was identified as proanthocyanidin B2 (epicatechin-(4β→8)-epicatechin) by HPLC and LC-MS Studies.

P A N Punyasiri, A.D.M.Damayanthi, A Balasooriya (Pathology Division), S Kumar (University of Peradeniya) and I S B Abeysinghe

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

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

The volatile compounds present in the tea plant were studied to explore possibility of using them as semiochemicals to control SHB infestation. In the year 2001 25 volatile compounds in the leaves and stems of the tea plant were identified by GC-MS (Gas Chromatography-Mass Spectroscopy). This study was extended to identify the diastereoisomers of linalool and its oxides in resistant and susceptible clones and their changes upon SHB infestation.

The chiral study was carried out for ten clones belonging to TRI 2000, 3000 and 4000 series. TRI 2023, 4053, 4006, 3048 and 3072 were selected as resistant clones and TRI 3014, 4063, 2025, 3020 and 4071 were selected as susceptible clones. Dichloromethane extracts of tea leaves and bark were analysed by GC using chiral column.

Chiral analysis showed that the content of the *S*-isomer of linalool oxide-1 (0.2 ppm) and linalool (0.2 ppm) in the healthy susceptible clone is twice that of the *R*-isomer (0.1 ppm and 0.1 ppm). The content of *S*-isomer of linalool oxide-2 (0.7 ppm) was seven times that of the *R*-isomer (0.1 ppm) in this clone. In the resistant cultivar, the only difference was seen in linalool-oxide-2 where the *S*-isomer (0.2 ppm) content was more than twice that of the *R*-isomer (0.08 ppm).

Upon SHB infestation linalool oxide-2 content in both resistant and susceptible cultivars were incresed. A tenfold increase in S-isomer of linalool oxide-2 (1.1ppm) was observed upon infestation in the susceptible cultivars. Major differences between the resistant and susceptible cultivars were in the content of S-isomer of linalool and its oxides.

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

3. Project B18 - Use of DNA markers for molecular characterisation of tea

As a preliminary trial, 36 clones resistant, susceptible and moderately susceptible to Blister Blight were selected to do RAPDs (Random Amplified Polymorphic DNA) to check if there are any specific bands in the resistant clones which are not present in both susceptible and moderate clones. If such bands are present these could eventually be used in molecular screening for Blister Blight.

RAPDs have been carried out using 80 out of 100 primers on the DNA extracted from 36 clones. So far no specific bands have been identified.

A tea genomic library has been constructed to screen for SSRPs (Simple Sequence Repeat Polymorphisms) markers which are used for molecular characterisation. A few clones that are

thought to be positive have been identified. Secondary screening of these clones is being carried out at present.

A C Liyanage, K M Mewan, E Karunanayake (University of Colombo), Tirimanne T L S (University of Colombo), J M D T Everard (Coconut Research Institute), M T K Amarakoon (Division of Plant Breeding, TRI)

4. Project – B-19 – (a) Effect of black tea on oral microorganisms

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 other harmful microorganisms in the oral cavity was not studied extensively. Therefore, a project was initiated in collaboration with the Faculty of Dental Science, University of Peradeniya, to study the effect of black tea on oral microorganisms. In 2001 studies were done on *Candida* species which cause Candidasis (oral thrush). It was found that black tea extracts could inhibit the growth of *Candida* species. Polyphenolic fraction of the black tea extract was found to be the active fraction.

In 2002 studies were carried out to find the effect of black tea on *Staphylococcus* species which cause dental root canal infections. *In vitro* studies have shown that black tea extract could inhibit the growth of *Staphylococcus* species. Studies to find the active ingredient in tea revealed that the highest inhibitory action was in the catechin and theaflavin fractions. These fractions had similar magnitude of activity while the activity of thearubigin fraction was lower.

In the recent past an increase in the methicillin (a semi-synthetic penicillin, active against penicillin resistant *staphylococci*) resistant *staphylococci* variants had been observed. Therefore, the study was extended to find the effect of black tea on methicillin resistant *staphylococcus aureus* (MRSA) isolated from oral cavity and other body sites. Preliminary results indicate that tea extracts inhibit the growth of MRSA. Studies will be continued with more MRSA variants.

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

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

Teas produced in different up country regions such as Nuwara Eliya, Udapussellewa, Dimbulla, Bogo Valley, Malwatte Valley etc. are marketed as specialty teas in the world market. Therefore, this study was further extended and continued in 2002 to find the relative polyphenolic contents and antioxidant activity of teas produced in different up country regions.

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

The relative antioxidant activity (as minimum concentration mg l^{-1} of tea solution required to inhibit DPPH radical by 50%; note that this value is inversely related to antioxidant activity) of tea produced in different regions are given in table 7.

Table 7. Antioxidant activity of tea produced in different regions of Sri Lanka.

Region	Conc. (mg l^{-1}) for 50% inhibition of DPPH
Nuwara Eliya	12.2
Bogawantalawa	14.0
Lindula/Talawakelle	15.3
Agarapatana	16.2
Udapussellewa	18.2
Malwatta Valley	15.3
Bandarawela	15.5
Mid country	14.9
Low country	12.8

R.W.Thanuja Dharshani, G.J. Panagoda (University of Peradeniya), and A.M.T. Amarakoon

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

The changes of flavour profiles in made tea due to the seasonal variation in the Uva region were studied during this year. Made tea samples (22) from the Uva region during the season and subjected to gas chromatographic analysis for volatile chemical compounds. This is an on going project and will continue during the year 2003.

In addition, gas chromatographic analysis were carried out to find the differences in volatile optical isomers of linalool and their oxides in teas produced in Sri Lanka, Kenya, India, Ruwanda and Indonesia. A total number of 66 samples were analysed.

J Jayasundara, A M T Amarakoon and I S B Abeysinghe

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

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

Some teas produced in Bogo and Maskeliya Valley regions show an extra redness in their liquors, which cannot be totally accounted for by the contributions made from TF and TR to the liquor. In order to understand the factors responsible for this extra redness, tea samples were collected from Bogo and Maskeliya Valley regions (teas from Dimbula region were used as controls) and analysed for TP, TF, TR, B, TC and fluoride content in 2001. Further samples were collected from these regions and analysis was continued.

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 also included in the analysis. It was found that made tea samples from Bogo valley region contain more aluminium (882 ppm) than in Dimbulla (793) teas. The study will be continued in 2003.

M.L.D.P.Gunatilake, A. D. M. Damayanthi, A. Muthukumarana, A M T Amarakoon and I.S.B.Abeysinghe

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

Consumer awareness of the use of pesticides and concern about residues remaining in the edible crop has led to national authorities, particularly in the Western countries, to introduce legislation to restrict the use of pesticides to a minimal level. There is thus a growing demand from buyers that pesticide levels of exported tea be contained at acceptable levels.

Under such circumstances, it is of the utmost importance that pre-export testing for residues be carried out in order to establish their acceptability to destination markets since tea has a very high national economic importance. In addition, Sri Lanka imports tea from other tea producing countries for the purpose of blending and it had been noted that these countries use agrochemicals which are not recommended for use by the TRI in Sri Lanka. There is therefore a need for surveillance and compliance monitoring in order to safeguard the tea industry in Sri Lanka. In addition to this overseas customers requestin certification of levels of pesticides in keeping with international food quality standards. Therefore reliable and economical analytical methods for pesticide residue analysis is a Development of multi residue methods for the pesticides recommended by the Tea Research Institute and other concerned pesticides were carried out. Twenty one pesticides DDT, Bitertanol, Carbofuran, Carbosulfan, Chloropyrifos-ethyl Chloropyrifos-methyl, Copper oxychloride, Cypermethrin, Diazinon, Dicofol, Dimethoate, Diuron, Endosulfan, Ethion, Fenthion, Fenvalarate, Glyphosate, HCH, Monocrotophos, Propagite, Propiconazole (TRI recommended and other concerned pesticides) were selected for this study.

Initially two different solvent systems and two clean up methods were tested on five pesticides to develop multi residue methods for these pesticides.

a. Extraction with Acetone: Hexane (1:4) and alumina activity 5 or GPC clean up

Initially individual pesticides were extracted and cleaned up using alumina. Gas Chromatographic analysis showed that 70 % recovery levels for chloropyrifos-ethyl, chloropyrifos-methyl and diazinon. Ethion showed 66% recovery. Dimethoate was not extracted into the solvent system. Chloropyrifos-ethyl and chloropyrifos-methyl gave similar recovery levels when GPC method was used as the clean up method. However when these pesticides are in a mixture recovery levels were poor for all the pesticides.

b. Extraction with ethyl acetate and GPC clean up

Gas Chromatographic analysis showed 70 % recovery levels for chloropyrifos-ethyl, Dimethiate and diazinon. When the pesticides are in a mixture chloropyriphos-ethyl, Dimethoate and diazinon gave more than 70% recovery level indicating a possible use of this method in routine analysis.

J.M.D.Abaysinghe, J.Jayasundara and I.S.B.Abeysinghe

8. Project - New 3 - Comparison studies on organic non organic teas

Quality of organically grown tea and conventionally grown tea could be different due to the differences in inputs. Therefore, a study was initiated to find the chemical and organoleptic differences between organic teas and conventional teas.

Flush samples were obtained from experimental plots in field No.13, St Coombs estate. There were four treatments in the experiment where different fertilisers were used.

1. Tea waste (2 kg/ plant, 3 times per year)*
2. Neem oil cake (500g/ plant, 3 times a year)
3. Bio compost (2kg/ plant, 3 times a year)*
4. Conventional (Inorganic fertiliser and other cultural practices as per TRI recommendations)

* Organic agricultural management as per IFOAM standards.

Flush samples were manufactured using the miniature manufacturing facilities in the Technology Division, TRI. Made tea samples were sent to professional tasters for organoleptic evaluation. Chemical analysis were carried out for total polyphenols, EGCG, ECG, EGC, EC, C, Gallic acid, theaflavin, thearubigin, caffeine and flavour profile. Results are being statistical analysed. The study will continue in 2003.

9. Project A 29.2- Improvement of technology for producing a liquid tea concentrate

Effect of reduced levels of citric acid on the taste

It is being suspected that high level of citric acid imparts an off taste to the product. This Trial was carried out in year 2001 to check the effect of citric acid on the taste of tea concentrate. The trial was repeated.

Four samples of carbonated tea were prepared in duplicate with following levels of citric acid.

Treatment No	% of citric acid
1	Normal
2	75% of normal level
3	50% of normal level
4	Without citric

These samples were visually observed for their keeping quality and were tasted and ranked by 15 panelists by using the nine point hedonic scale. Tasting data was analyzed by the Friedman test.

Colour of the carbonated tea increased with reducing level of citric acid and all the samples are stable on storage todate (for about 3 months).

Results of statistical analysis;

Treatment	Sums of ranks				
	Appearance*	Colour / Brightness	Taste	Tea character	General acceptability
1	28	30	35.5	38	35.5
2	41.5	38	45	36	37.5
3	45.5	47	37	39.5	39
4	35	35	32.5	36.5	38

*Significant

According to the results of statistical analysis only the appearance of carbonated tea was significantly different and the treatment No 3 which contain 50% citric acid of the normal level, ranked the best. Though other parameters are not significantly different the same sample was ranked the best in terms of colour, tea character and general acceptability and sample No 2 which contain 75% of citric acid of the normal level, was ranked the best in relation to taste.

Trials to replace aluminium sulphate and bentonite with micro filtration

It has been found that aluminium sulphate and bentonite ($Al_2O.4SiO_2.H_20$) used as clarifying agents in the preparation of carbonated tea, increase the level of aluminium in the final product (annual report 1999 pp-62).

Trials on microfiltration were initiated with a view to replacing aluminium sulphate and bentonite. As a preliminary attempt two standards and two treatments were prepared ie. with clarifying agent, without clarifying agent and without filtering, without clarifying agent and filter through 0.3μm filter and without clarifying agent and filter through 0.22μm filter.

These samples were visually observed for stability on storage.

Sediments were observed in both standards (without micro filtration) after 10 weeks while the samples with micro filtration showed stability over standing during this period. A more detailed study is to be initiated in year 2003.

A C Liyanage, G A R P De Silva, P B Chandradasa, A. Muthukumarana and M W Silva

10. Project A 30.3 - Development of a Tea Sherry/Wine

The problems associated with wine/sherry were, poor clarity, after bitter taste, coating the tongue with polyphenols and lack of tea character were addressed during 2001 using different tea blends, different tea concentrations and maturation of the ferment using Halmilla casks. This led to a development of a product with good clarity and colour. Samples of the product were sent to the interested commercial parties and their comments indicated that fine-tuning of the product is necessary.

Experiments were carried out to fine tune the product and as a result optimum maturation period in the Halmilla (Berraya cordifolia) casks was established.

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

General

Dr. I S B Abeysinghe resigned from the post of Acting Head w.e.f. 31st March 2002

Dr. A M T Amarakoon was appointed as Acting Head, Biochemistry Division with effect from 1st April 2002.

Mr. P B Chandradasa retired from the service with effect from 17th May 2002 after 38 years of loyal and dedicated service to the Institute.

Mr. P K P Muthukumarana assumed duties as a Technical Assistant with effect from 3rd June 2002.

Dr. A C Liyanage was appointed as the Convenor/Secretary to the Tea Research Board with effect from 9th December 2002.

Mr. G A A R Perera commenced his Post graduate studies leading to a M.Sc. in Food Science and Technology on 25th January 2002 at the University of Sri Jayawardenepura.

Miss J M D Abeysinghe commenced her Post Graduate studies leading to a M.Sc. in Analytical Chemistry at Post Graduate Institute of Science, University of Peradeniya, Peradeniya.

Mr. M D L P Gunathillake was awarded a UNESCO Research Fellowship to follow the Post Graduate Diploma course in Chemistry and Chemical Engineering at Tokyo Institute of Technology, Japan from October 2002 to September 2003.

Mr. P A N Punyasiri attended training on Chemical and Biochemical Techniques in Flavonoid Research at Technical University, Munich, Germany from June to December 2002 as part of his Post Graduate studies on "Biochemical and chemical methods in the control of blister blight leaf disease of tea caused by *Exobasidium vexans*."

Dr. I S B Abeysinghe was appointed as a member of a Task Force on Quality Improvement by the Ministry of Plantation Industries. He was also appointed as a member of a Task Force on Process Improvement by the Ministry of Plantation Industries.

Dr. A M T Amarakoon was appointed as a member of a Sri Lanka Tea Board Sub Committee for preparation of the project proposal "Identification of distinct properties of teas produced in the different agroclimatic regions of Sri Lanka" for Common Fund for Commodities – FAO.

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

Dr. A M T Amarakoon continued to serve as a committee member of the section E2 of SLAAS.

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.

Students/Trainees

Miss. S P Rebeira undergraduate trainee from the Department of Food Technology, University of Peradeniya commenced her project on "Chemical composition of different parts of fresh tea flush and their contribution to quality of made tea" on 30th September.

Publications

Modder, W W D. and Amarakoon, A M T (2002) Tea and Health, The Tea Research Institute of Sri Lanka.

Mewan K M, Everard, J M D T, Liyanage, A C, Gunesekera, M T K. Tirimanne T L S and Karunanayake, E H A preliminary investigation towards developing molecular markers linked to blister blight resistance in *Camellia sinensis* L (tea) (2002). Proceedings of Annual Sessions of SLASS 2002 Sri Lanka Association for the Advancement of Science P65

S Mahendraraj, M D L P Gunatilake and I S B Abeysinghe Polycyclic aromatic hydrocarbons in Sri lankan made tea and their extractibility into the tea infusion, (2002) Proceedings of the58th annual sessions of the Sri Lanka Association for the Advancement of Science, 251.

Gyani de Silva, I Sarath B Abeysinghe and N Savithri Kumar, (2002), Changes in Volatile compound levels in susceptible and Resistant tea cultivars upon Shot Hole Borer Infestation, Proceeding of the Annual Research Sessions, University of Peradeniya, Sri Lanka p145.

Liyanage, A C, Punyasiri, P A N, Bandara, U B S, Jayasinghe, L and Ziyad, M T Z (2002) Microwave drying of tea. TRI Update vol.7. No.1, p5

Mohotti, A J, Kodithuwakku, R D, Liyanage, A C and Bandara, D C (2002) The effect of shade on rate of photosynthesis and Rubisco content on tea (*Camellia sinensis* L.) Proceedings of the 22nd Annual Sessions of the Institute of Biology Sri Lanka P50.

Liyanage, AC, Sathyapala, S K and Gunasekera, M T K Application of biotechnology for crop improvement of tea in Sri Lanka - a Review. accepted for the publication on 75 years of research excellence.

Liyanage, A C and Fernando, W M U Isozyme polymorphisms in tea - a review. accepted for the publication on 75 years of research excellence.

Abeysinghe, I S B, 75 years of Biochemical/Chemical research at the Tea Research Institute of Sri Lanka (2002). Accepted for the publication - Tea Research Institute Jubilee Volume.

L D Amarasinghe, M Sivanesan and I S B Abeysinghe, Response of Xyloborus fornicatus (Coleptera:Scolytidae) to some volatile compounds isolated from the tea bark. (Submitted to Sri Lanka Journal of tea science).

Donors:

1. Sida/SAREC and International Programme in the Chemical Sciences, Uppsala University, Sweden for Biological Pest Control Project
2. Council for Agricultural Research Policy (CARP) for Use of DNA markers for Molecular Characterisation of Tea
3. National Research Council (NRC) for Biochemical and Chemical Methods in the Control of Blister Blight Leaf Disease of Tea caused by *Exobasidium vexans*

Meetings/Seminars:

Dr. A C Liyanage attended the 2nd FAO/IAEA Interregional Training Course on Mutant Germplasm Characterisation Using Molecular Markers, 4-29 November 2002 in Austria.

Dr. I S B Abeysinghe participated in the seminar on "Advances in food research: Challenges to food industry" organised by the Sri Lanka Association for the Advancement of Science on 30th April 2002 at Colombo Hilton.

Mr. M D L P Gunathilake attended a training programme on Use of Power Point organized by the Department of Agriculture from 3-4th September 2002 at In Service Training Institute, Gannoruwa.

Mr. M D L P Gunathilake attended a training programme on Electronics and Nuclear Instrumentation organized by the Atomic Energy Authority from 4-29 March 2002 at Atomic Energy Authority, Colombo.

Mr. M D L P Gunathilake attended a workshop on Repair and maintenance of laboratory equipment from 1-4 March 2002 at Post Graduate Institute of Science, University of Peradeniya, Peradeniya.

Mrs. R W Thanuja Dharshani attended a training seminar on "Safety in Microbiological Laboratories, A need in the new millennium" organized by the Institute of Chemistry on 2nd February 2002 at SLAAS, Colombo.

Mr. M D .P Gunathillake attended a training course on GC-MS operation from 22-25 July 2002 in Singapore.

ENTOMOLOGY DIVISION

Sushila I Vitarana – Entomologist and Head of Division

1.Research Activities

A 1.2: Screening lines for resistance to Shot-hole borer & Live–wood termites

1. Phase II (Plant Breeding) Trial at Field No.12, St.Coombs Estate:

Field assessments on Shot hole borer damage were completed.
09 clonal lines (Codes: 116, Big 2, Mini 2, 2, 48, 139, 133, 50 and 9) were found to be resistant; 50 lines were attacked by borer to different degrees and; 03 lines (Codes: 272, 101 and 210) were certified as extremely susceptible and not suitable for Shot hole borer active areas.

2. *Camellia sasanqua* seed garden, Field No.9, St.Coombs Estate:

Field assessment on borer damage was completed. Out of a total of 79 only 04 lines were observed to be infested and the Plant Breeding Division has marked them for future reference.

A.R. Abeysekara, P.D.senanayake, C. J.de Seram, P.G.C. Priyantha

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

. **N1 A (2001/2002)** : Nematology Experimental Area, TRI ,Talawakelle :

The final assessment of the screening trial was carried out. Observations have been summarized in Table 1.

Table 1 - Summary of data collected at termination of trial.

Clone	√Mean Shoot weight(g)	√Mean Root weight(g)	√Mean Nematode count/1g root	Rating*
TRI 2024	5.827 e	4.003 e	13.7675 f	4
TRI 4042	9.855 bc	6.388 abc	11.755 ef	4
TRI 4047	11.195 ab	5.638 bcd	10.6275 cde	3
TRI 4053	11.302 ab	6.838 ab	10.9775 de	3
TRI 4046	7.705 d	4.490 de	10.915 cde	3
NIL 53	8.230 d	5.468 cd	9.890 cde	2
K 145	10.475 ab	6.458 abc	9.220 cde	2
DT 95	11.455 a	7.195 a	8.220 bcd	1
TRI 4052	11.470 a	6.960 a	7.973 ab	1
TRI 2043	8.725 cd	5.393 cd	6.375 a	(3)
TRI 2025	10.360 ab	5.393 cd	8.360 bcd	1
LSD P=0.05	3.03	1.27	2.36	

* This is the rating in relation to the susceptibility of the clone to the nematode.

Data with the same alphabetical letter have no statistically significant difference between them.
Of the test clones TRI 4052 exhibited the best performance and was on par with DT 95 and TRI 2025. The clones that were shown to be as tolerant as K 145 are NIL 53, TRI 4047and 4053.

Thus, the clones that can be used in nematode areas following all good agricultural practices are **TRI 4052, 4047 & 4053 and NIL 53.**

The clone **TRI 4042** proved to be a very good host to *P.loosi* like TRI 2024, while TRI 4042 and 4046 were observed to be the worst affected next to TRI 2024.

Of the standard clones, as expected, DT 95 exhibited the highest tolerance, while TRI 2024 proved to be the highest susceptible and the most affected. Unexpectedly, TRI 2043 which is well known as a susceptible clone did not facilitate build up of high populations compared to TRI 2024.

S.I. Vitarana, D.D.Liyanage, P.Udumulla & N.Navaratna

A 2.2: Screening lines for resistance to Shot-hole borer in Mid-country

ME17: Clonal Screening for Shot-Hole Borer:

Field assessments were carried out at the following sites:

(a) Rangala Estate- Field No: NC 99.
(b) Greenwood Estate- Field No. 01.

(a) Rangala Estate- Field No: NC 99

Borer damage was assessed on clones that have been planted on the estate. The observations are given in Table 2.

Table 2. Borer damage (Averages per 15 cm stems)

Clone		Live-stages per 15cm stem	Galleries	Avg. Gallery length (mm)
3019	P1	-	2	5.0
	P2	1 Female	2	-
3063	P1	1 Female	1	0.1
	P2	-	2	
3025	P1	1 Female	2	8.0
	P2	1 Female	1	-
4006	P1	1 Female	1	11.0
	P2	1 Female	1	-
3020	P1	1 Female (dead)	1	4.0
	P2	1 Female (dead)	2	-
3014	P1	-	1	3.0
	P2	1 Female	3	-

TRI 3063 showed the least amount of gallery making; however, the observations were inconclusive.

(b) Greenwood Estate - Field No. 01

Following clones were evaluated in October and the data is given in Table 3.

Table 3: Rating of clones at Greenwood Estate
(Mean of 8 branches of 30 cm in length)

Clone	Avg. Gallery count per 30cm	Susceptibility
4053	5.70	susceptible
2025	4.50	susceptible
4079	3.37	moderate
4052	2.25	moderate
4072	2.25	moderate
4071	2.25	moderate
4061	1.50	resistant
4078	1.20	resistant
4046	1.20	resistant

The clones **TRI 4046, 4078 & 4061** can be recommended for borer active areas. The clones TRI 4071, 4072, 4052 & 4079 may be planted in borer active areas but, sanitation measures should be undertaken compulsorily, at prune, to remove galleried stems of the previous cycle. The clone TRI 4053 should not be planted in such areas.

D.Pallemulla & S.Abeysinghe

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

N1B 1(2000/2): Nematology Nursery, TRI Station, Hantana :

Final assessments (destructive) were carried out on shoot-weight, root-weight, nematode infestation in the soil and, nematode infestation in the root samples.

Data was prepared for analysis.

S.I.Vitarana, U.B.Herath & P.Udamulla

N1B 2 (2001/3): Hantana Estate, Hantana:

Soil and Root sampling were carried out and the nematode counting was in progress.

S.I.Vitarana, U.B.Herath & P.Udamulla

A 3.2: Screening lines for resistance to SHB in Uva

Plant Breeding Phase III trial at Mahadowa Estate:

The clones were re-tested in order to revise the Advisory Circular No.6/02):

Three out of 29 clones, *viz.* **TRI 4043, 4042 & 4045**, were certified as tolerant and suitable for borer active areas in Uva, while the others were found to be susceptible to the borer.

A.R. Abeysekara, P.D. senanayake, C.J.de Seram, P.G.C. Priyantha

Project A 3.5: Screening lines for resistance to Tea Nematodes, *P.loosi* and *R.similis* in Uva

Studies in Uva have been initiatede for the first time. The reason being that the two nematodes *viz.P.loosi* and *R.similis* are both equally active in the area and also, there could be biological strains of these species which are predominant in this area.

N1C (2002/3):TRI Station, Passara:

Three testing tanks (1m x 1m x 3m) were constructed. Nematode population was being built up in the testing tanks to receive the new series of test clones in early 2003.

S.I. Vitarana, D.D.Liyanage, P.Udamulla, N.Navaratna & C.J.Rajasinghe

Project A 4.2: Screening lines for resistance to Low country Live wood Termite

LE 50 : Hapugastenne Estate, Lower Amunutenne Division (Planted 1990)

Of the 132 short-listed clonal lines (selected in Hathdaraganga Division of the estate), 26 clones (after 12 -20 years) were still free of live-wood termites and stem canker; they also, had good branching. Thus, the 26 lines can now be certified as suitable for live—wood termite active areas in the Low country. They are: **H27, H41, H71, H101, H102, H108, H117, H119, H122, H134, H153, H188, H211, H310, H314, H354, H374, H402, H424, H427, H467, H472 & H482** and also, the older estate selections, Pettigala PET 142, Tocklai TV 09 and Y2. The above 26 selections were pruned in October, in order to take cuttings for multiplication and other studies.

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

LE 78: Screening of 37 clonal lines selected for termite resistance (Planted 1998).
(selected in F.No. 4 , (old seedlings) Hadaraganga Division,
Hapugastenne Estate)

Two growth assessments were carried out while recording the yield weekly. The overall observations are given in Table 4.

Table 4. Performance of the clonal selections

Clonal Line	Growth	% Survival after 2 years	½ Yearly Yield (kg/ha)
HG 17	Good	100	1403.001
HG 1	Good	98	804.201
HG2	Good	96	885.772
HG 3	Good	96	1118.672
HG 6	Good	100	841.241
HG 4	Fair	88	599.715
HG 8	Good	100	761.629
HG 10	Good	97	1190.257
HG11	Good	100	833.224
HG 13	Good	95	869.871
HG 24	Fair	96	538.353
HG15	Good	87	605.823
HG 14	Fair	93	565.594
HG 9	Fair	93	382.623

HG 7	Good	100	915.446
HG 5	Good	98	734.680
HG20	Good	75	709.491
HG 21	Good	85	938.985
HG 23	Good	90	1013.124
HG28	Good	97	980.702
HG37	Good	100	1064.976
HG 48	Good	100	1304.651
HG12	Good	90	934..091
HG16	Good	100	753.958
HG49	Good	95	1212.827
HG 42	Good	100	1108.502
HG43	Good	80	930.984
HG44	Good	75	1016.541
HG35	Good	95	1135.452
HG33	Good	100	1053.416
HG32	Good	95	1381.560
HG30	Good	90	811.503
HG19	Good	90	1694.322
HG27	Good	70	841.645
HG45	Good	100	1081.010
HG47	Good	95	1295.173
HG50	Good	100	1202.301

The above plots will be maintained for further observations up to the end of the 2nd cycle and they are being recommended for the Plant Breeders use.

LE 81 Hapugastenne Estate, Upper Wewelketiya Division (Planted 1997)

Screening of TRI 4000 series clones for resistance to LCLWT was in progress and the plots are being maintained. A post-prune assessment was carried out on twelve 4000 series clones in August and the following observations have been recorded (Table 5).

Table 5. Observation on pest incidences on the clones of 4000 series

Clone (TRI)	Avg. branching / bush	Incidence of SHB	L.W Termite Galleries.	Scaveng. termite activity	Incidence of Wood-rot on cuts	Incidence of Stem Canker
2026	8.0	100	0	0	0	0
4089	6.8	40	0	0	10	0
4003	5.5	50	0	0	10	0
4088	4.5	47.5	0	0	0	0
4053	6.1	50	0	0	0	0
4015	6.0	90	0	0	0	0
4024	5.4	50	0	0	10	0
4036	4.5	87.5	0	0	0	0
4004	6.2	30	0	0	40	0
4019	5.7	100	0	0	30	0
4046	6.3	30	0	0	20	0
4052	6.8	90	0	0	10	0
4020	9.5	100	0	0	20	0

All the clones were free of live wood termites. However, the incidence of Shot-hole borer was considerable in most of the clones, **TRI 4004 & 4046** being the exceptions.

LE 83- Screening of 72 lines selected for pest resistance inclusive of SHB.
Balangoda Estate, Maratenne Division –
Three growth assessments were carried out; the overall observations are given in Table 6.

Table 6. Performance of the progeny of Maratenne Selections

Selection line	Growth	Avg. % Survival	Selection line	Growth	Avg. % Survival
MT 101	Good	52.00	MT 108	Fair	57.00
MT 102	Fair	40.00	MT 106	Poor	5.00
MT 104	Poor	40.00	MT 170	Fair	45.00
MT 105	Good	62.00	MT 168	Fair	35.00
MT 114	Good	55.00	MT 120	Poor	27.00
MT 165	Fair	70.00	MT 127	Fair	70.00
MT 158	Good	65.00	MT 142	Fair	50.00
MT 138	Fair	40.00	MT 121	Good	70.00
MT 122	Good	90.00	MT 128	Fair	60.00
MT 131	Good	75.00	MT 117	Poor	50.00
MT 116	Poor	55.00	MT 143	Fair	10.00
MT 141	Poor	20.00	MT 162	Poor	47.00
MT 133	Fair	60.00	MT 163	Fair	22.00
MT 153	Good	60.00	MT 171	Fair	45.00
MT 150	Good	50.00	MT 157	Poor	22.00
MT 166	Fair	40.00	MT 156	Poor	60.00
MT 119	Good	75.00	TRI 2025	Fair	90.00

Table 7 . Bioassay of Maratenna Selections compared to TRI 2023 (LE 83).

	Clone (MT)	**Observed Value vs. TRI2023**	**Expected Value**	**CHI-Square Value**		**Significant Level**		
				5% 5.841	**1% 8.635**			
1	131	135	162	9		SIG at 1%	√√	
2	105	127	158		12.06	SIG at 1%	√√	
3	101	120	154.5		15.4	SIG at 1%	√√	
4	150	198	205.5	0.54		NS		
5	114	204	208.5	0.194		NS		
6	133	230	221.5	0.652		NS		
7	121	294	260.5	8.6		SIG at 1%		√√
8	104	285	256	6.56		SIG at 1%		√
9	119	182	204.5	4.94		NS		
10	127	308	305	0.59		NS		
11	122	247	274.5	5.5		NS		
12	142	202	252		19.8	SIG at 1%	√√	
13	128	114	147		14.8	SIG at 1%	√√	
14	153	219	199.5	3.8		SIG at 1%		√√
15	165	90	135		30	SIG at 1%	√√	

Fifteen selections *viz.* **MT 131, 105, 101, 150, 114, 133, 121, 104, 119, 127, 122, 142, 128, 153, and 165** exhibited the best growth in the field (see Table 6). These fifteen were bio-assayed adopting the "Four-Channel Perspex Olfactometer", with reference to TRI 2023 as the standard and in six replicates running simultaneously (see Table 7).
Out of the 15 clones tested 06 clones were found to be resistant to Live-wood Termites (see Table 7). They are : **MT 131, 105, 101, 142, 128 and 165**. Arrangements have been made to prune those 06 clones in January 2003 in order to take cuttings for further studies.

S.I.Vitarana, S.M.Samarasinghe, E.St.R.Perera, A.K. Prematunga &S.B.Vithana

Project A 22.1: Screening of synthetic pesticides to reduce Shot hole borer in tea.

Screening of insecticides for the control of SHB

a. **ME14**: In Mid-Country - Rangala Estate, Field No: NC 99.

The following treatments were applied in a Replicated Complete Block Design with 3 replicates:

T1- Fenthion ("Laybacid 50%) @ 3500 ml/ha
T2- Fipronil ("Regent") @ 1 liter/ha
T3- Beta cyfluthrin ("Buldock") @ 750ml/ha
T4- Ethofenprox ("Trebon") @ 750ml/ha
T5- untreated control

Insecticides were applied first in February and repeated twice at 4-month intervals. The incidence of
SHB was recorded monthly by counting the number of branch breakages per plot. There was no significant differences seen between treatments up to 10 months. The experiment is in progress.

S.Abeysinghe, D.Pallemulla & U.B.herath

b. **E 307** :Mahanilu Estate, Field No.5

At this location two doses of fiprinol (1.0 and 1.25 liter /ha) were compared with the other chemicals tested in the experiment ME 14. Two-monthly assessments were carried out on borer population and Gallery making The data is given in Fig. 1-5. : Fipronil at either dose, and ethofenprox (Trebon) gave better control of the population as against the untreated.

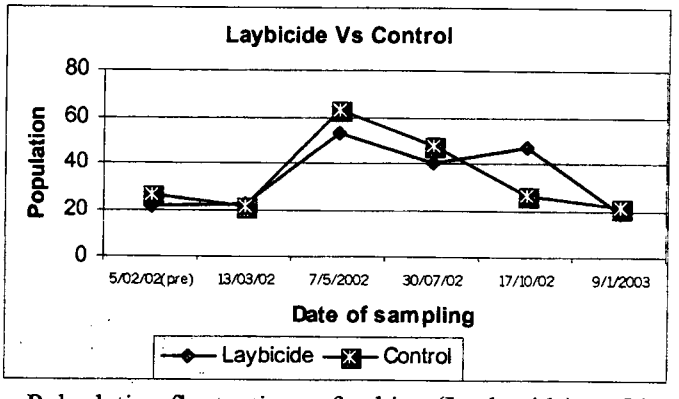

Fig 1. Polpulation fluctuations : fenthion (Laybacide) vs. Untreated.

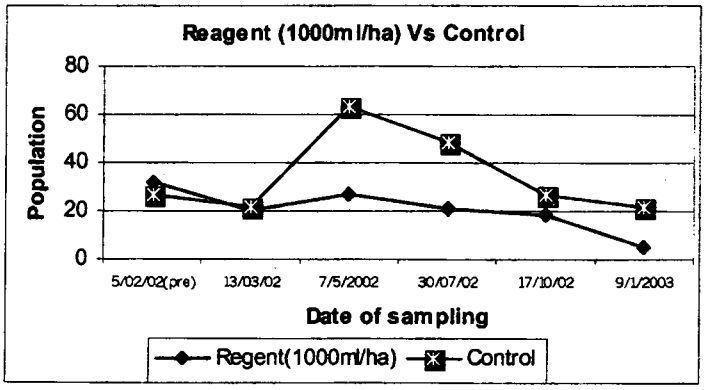

Fig 2 Polpulation fluctuations : Fipronil (Regent)@1.0 l/ha vs. Untreated

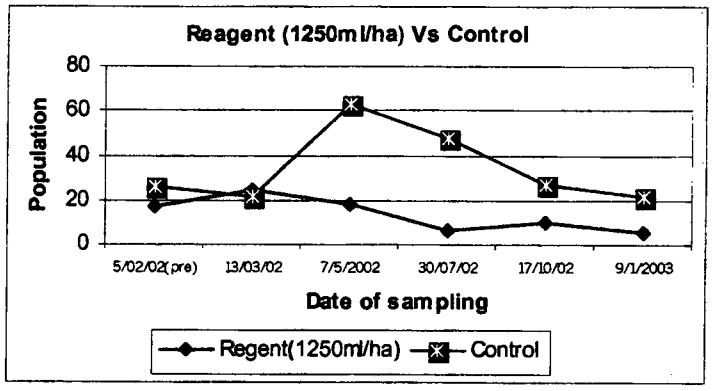

Fig 3 Polpulation fluctuations : Fiprinol (Regent)@1.25 l/ha vs. Untreated

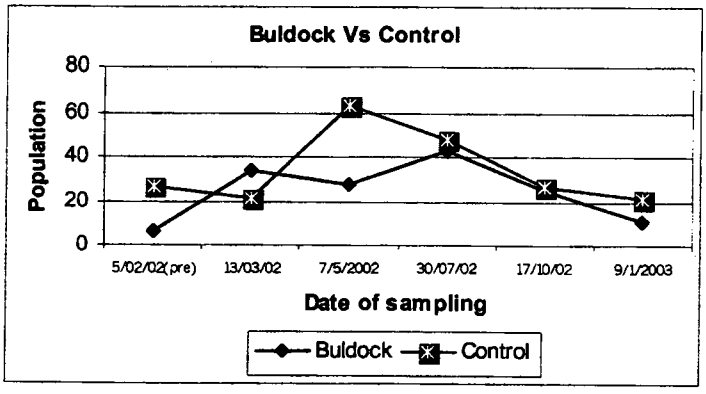

Fig 4 Polpulation fluctuations : Beta cyfluthrin (Buldok)vs. Untreated

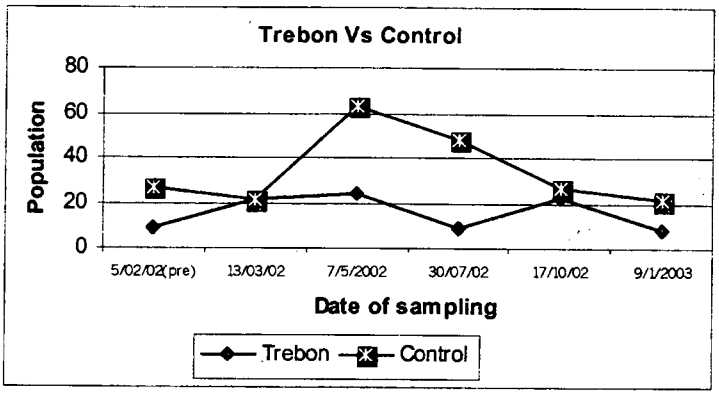

Fig. 5. Polpulation fluctuations : Ethofenprox (Trebon) vs. Untreated

Fiprinol (Regent) either @ 1.0 l and 1.25 l per ha and ethofenprox (Trebon) @750ml per ha, was superior in efficacy to both fenthion and beta cyfluthrin. Fenthion was not different from the untreated control.

A.R.Abeysekara, P.D.Senanayake, P.G.C.Priyantha & C.J. de Seram

Project A 22.2: Screening of biological control agents to reduce SHB damage in tea

Since the laboratory bioassay with *Beauveria bassiana* gave promising results, following observation trials were initiated to test the efficacy of the fungus on the borer in the field.

a. E 309 : Rangala Estate, Field No. NC 99

The following treatments were applied on five replicates, repeat applications were at two month intervals and mortality of the gallery inmates was recorded (Table 8):

T1 – One application of fungal suspension painted on the stem with a brush
T2 – One application of fungal suspension applied by spraying
T3 – Two applications of fungal suspension painted with brush
T4 – Two applications of fungal suspension applied by spraying
T5 – Three applications of fungal suspension painted with brush
T6 – Three applications of fungal suspension applied by spraying
T7 – Untreated control

Table 8. Mortality of the adult beetles

Treatment	1st Assessment		2nd Assessment		3rd Assessment	
	Live	Dead	Live	Dead	Live	Dead
T1	3	2	-	15	3	-
T2	7	3	-	7	6	-
T3	1	6	5	12	9	-
T4	4	4	8	16	4	-
T5	2	7	-	2	4	3
T6	5	9	-	20	5	3
T7	16	-	11	-	15	-

It has been clearly demonstrated that the fungus is able to enter borer galleries in the field, unlike in the past studies. Perhaps, the mother beetle does not recognize the spores of the particular biological strain of the fungus as an intruder, like in the case of the dipteran commensal that is occasionally found inside borer galleries. However, it was observed that only the adult beetles were killed by the fungus at this location (this was not the case in midcountry; see below). The fungal suspension was observed to be effective for at least two months after application.

b. E 310: Templestowe Estate, Rozella Field No. H-I, (2nd year after prune)
Same treatments as those used in E 309 were used at this location. This experiment is in progress.

S.I.Vitarana, A.R. Abeysekara, C.J. de Seram, P.D.Senanayake & P.G. C.Priyantha

c. ME 20: Morahena Estate
This experiment was laid down in a field of TRI 2025, one year after prune, in a Replicated Complete Block Design with 3 replicates having 25 bushes per plot. A suspension of *Beauveria bassiana* was applied only as a spray but, in three different ways :

T1 - One round of spray;
T2 - Two rounds of spray;
T3 - Three rounds of spray,
T4 - an untreated control.

The first samples indicated that even the larvae are susceptible to the fungus at this location. This experiment is in progress.

D.Pallemulla, S.Abeysinghe

Project A 22.3: Identifying tree species which can function as diversionary hosts to the Borer and reduce the damage caused by SHB on tea.

12"length and 1 cm in diameter stems of the tree species, *Montanoa bipinnatifida, Grevellia robusta, Calliandra calothyrsus* and *Flemingia congesta* were hung in SHB infested fields and it was observed that *Montanoa bipinnatifida does* not attract *X.fornicatus,* the shot hole borer of tea. Instead, it attracted one other species of *Xyleborus* that does not attack tea. It was arranged to further study the other three tree speices to see how best they could be used as trap crops or in trapping devices.

P.D.Senanayake, C.J. de Seram, P.G.C.Priyantha &
D.Pallemulla, S.Abeysinghe, A.R.Abeysekara

Project A 22.5: Modifying potassium fertilization in tea to reduce SHB damage

To study the effect of high potash application on SHB damage on different clones of tea.

a. E 289: Attampitiya Estate, Field No.2A, 1st Division (1997 planted)

At this location, there was no difference seen between potassium levels @ 1.5g, 3.0g & 4.5g and the untreated control; only the difference between the three clones (DN, TRI2025 & TRI4070) was continued to be seen.

A.R. Abeysekara, P.D.senanayake, C. J.de Seram, P.G.C. Priyantha

b. E 290 : Hantane Estate, Factory Division,Field No. 9A, Kandy (Planted1997)

At this location 3 levels of potash, *viz.* 2g, 4g & 6g of SOP per plant were being compared with an untreated control. Summary of branch breakage recorded over the 12 month period is given in Table 9.

Table 9. Average Branch Breakage (Jan-December, 2002)
(Average of 25 plants in 3 Replicates)

Treatment	TRI 2023	TRI 2025	DN
T1- 0g SOP	20	81	44
T2- 2g SOP	33	79	37
T3- 4g SOP	21	42	26
T4- 6g SOP	29	71	41

Difference in borer damage was distinctly seen in relation to the clones, TRI 2025 being the highest affected and TRI 2023 the least affected, but, not so much in relation to Potash levels. The decrease in branch breakage was considerable in the case of the susceptible clone (TRI 2025) and the difference was not so marked in the case of the moderately susceptible clone, DN. There was hardly any reduction in branch breakage with **4g** level in the case of the resistant clone (TRI 2023). There was no difference between the 2g and 6g application and the untreated control. Thus, it has been shown that potash has an optimum level of 2g per plant at reducing borer damage on immature tea.

S.I.Vitarana, D.Pallemulla & S.Abeysinghe

Project A 22.7- Computerized data base and Modeling of yield damage relationship for Shot hole borer

Formulation of a population model to describe dynamics of shot-hole borer for forecasting purposes is being investigated. The model is built using DYMEX®, a modular modeling package developed by the Corporate Research Center for Tropical Pest Management (CRCTPM) in Australia. Supplementary data needed to complete the model has been identified (W. Danthanarayana & L.D. Amarasinghe, Annual Report 1998) and experiments have been initiated to fill in the gaps of the knowledge in relation to biology of shot hole borer.

1. Rearing shot-hole borer at different constant temperatures to record the development time and the associated parameters for each life cycle stage, commenced. The temperatures were decided in such a way that they fall within locally possible extremes *viz.* 10^0C to 40^0C. Both cut stems of the clone TRI 2025 (the most susceptible for SHB) and the diet tube method will be employed for the development experiment.

2. Arrangements have been made to determine the fecundity/progeny production, the number of eggs that a female can produce during her life time under natural conditions (fecundity) and the rate at which a female lays eggs (progeny production rate) under different physical conditions, in order to model the reproduction of the beetle.

3. Longevity/survival – arrangements have been made to determine the periods of development of the immature stages and the survival of the adult beetle under different temperatures and under different agro-climatic conditions.

R.S. Walgama, A.R. Abeysekara, P.G.C. Priyantha

Project A 23.4 –Refining cultural practices for managing nematode pests in mature tea including the incorporation of various soil amendments and planting trap/cover crops to help reduce nematode population in tea lands.

ME16- Study of *Sesbania* spp. in nematode active areas in the Mid country.

It has been proven that *Sesbania sesban* is not a threat to tea in nematode active areas. In order to reintroduce the species into tea lands it was necessary assess its usefulness as a green manure crop and also, to confirm the availability of the species in tea estates. A survery conducted in the mid country showed that out of a total of 34 estates who responded to a questionnaire, *Sesbania sesban* was available only on Greenwood Estate, Nawalapitiya as confirmed by morphological studies. Planting material collected from there was propagated in tanks to assess the bacterial activity of the root nodules. The roots had not developed nodules up to the end of the year, whereas, the plants raised at Talawakelle for a period exceeding 12 months exhibited well formed nodules which had bacterial activity reaching nearly 100%. The experiment was in progress.

D.Pallemulla, S.Abeysinghe, U.B.Herath

Projects A 23.4 and A 32 :_Refining cultural practices for managing nematode pests in mature tea including the incorporation of various soil amendments using planting trap crops / cover crops to help reduce nematode populations, and Organic Farming systems for tea lands.

The following research activities were established in order to facilitate scientific validation of organic farming, biodynamic agriculture, nature farming and traditional practices in agriculture in relation to establishment, growth, restoration of biodiversity components, incidence of pest and diseases in tea.

a. Nature Farming Demonstration and Research Area:

Various composting techniques, a herbal area, an organic nursery, SALT and other soil fertility management and erosion control methods, wormy composting and vermiwash units, mix cropping, traditional agricultural methods and biodynamic practices were established in the Nematology Experimental Area at TRI, Talawakelle.

Keerthi Mohotti

b. 'TRI-ORCON' trial:

The long - term experimental plots established at Field No. 13 of St. Coombs are been maintained organically under IFOAM guidelines (OR) and conventionally as per TRI recommendations (CON).

Keerthi Mohotti

c. 'BIDORCON' trial:

A long-term field experiment with Biodynamic (BID) agricultural practices, organic (OR) and conventional (CON) methods of tea cultivation was initiated in May 2002 at Nematology Experimental area for comparison purpose.

Keerthi Mohotti

d. N369: Mass propagation of nematode bio control agents

Laboratory and pot cultures of different isolates of *Pastueria penetrans* and nematode trapping fungi, *Arthrobotrys musiformis*, *A. oligospora, A.* spp., *Dactylella* spp. and *Monacrosporium* spp. were maintained. Exploitation of these materials as indigenous biological materials for agricultural purpose and field dissemination on experimental basis will be done in the future.

Keerthi Mohotti

e. N371: Monitoring naturally occurring nematode antagonists of tea nematodes

Periodic monitoring of densities of nematode bio control agents and population of *P. loosi* in Needwood estate and *Radopholus similis* in TRI station, Kottawa was done in order to understand the natural mechanism of nematode antagonism under tropical conditions. Arrangements were made to conduct precision experiments in the temperature controlled water baths in the Nematology Glass House.

Keerthi Mohotti

f. The effect of organic tea cultivation on soil biomass with special reference to population densities of micro arthropods.

Organic agriculture avoids usage of synthetic agro. In turn, it enhances natural biodiversity within the system and minimizes environmental pollution.

The present study investigated the role of organic tea cultivation on the microbial activity and the population densities of micro arthropods in soil. Figure 6 shows the

population density of micro arthropods (total number of micro arthropods per 100g soil) in tea waste, neem oil cake and compost amended soils and in conventionally managed soils. Conventionally treated and neem oil cake amended soils showed a significant reduction in the micro arthropod density ($p = 0.05$).

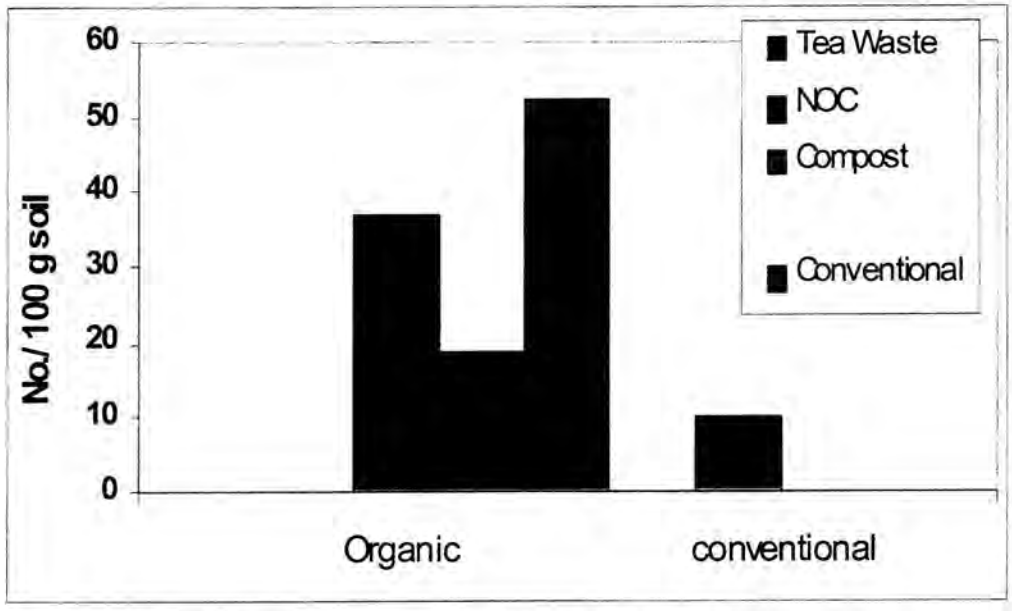

Fig. 6-The population density of micro arthropods in organically and conventionally managed tea soils (total number of micro arthropods per 100g soil).

Species composition of micro arthropods in the different systems studied was also different (Figure 7). The microbial activity measured as CO_2 evolution rate, showed significant improvement in organic tea soils as compared with conventionally managed soils ($p = 0.05$). The mean CO_2 evolution rates were in the range of 3.82 and 4.20 µg per g soil per hour in organic tea soils; it was 3.01 in conventionally managed tea soils.

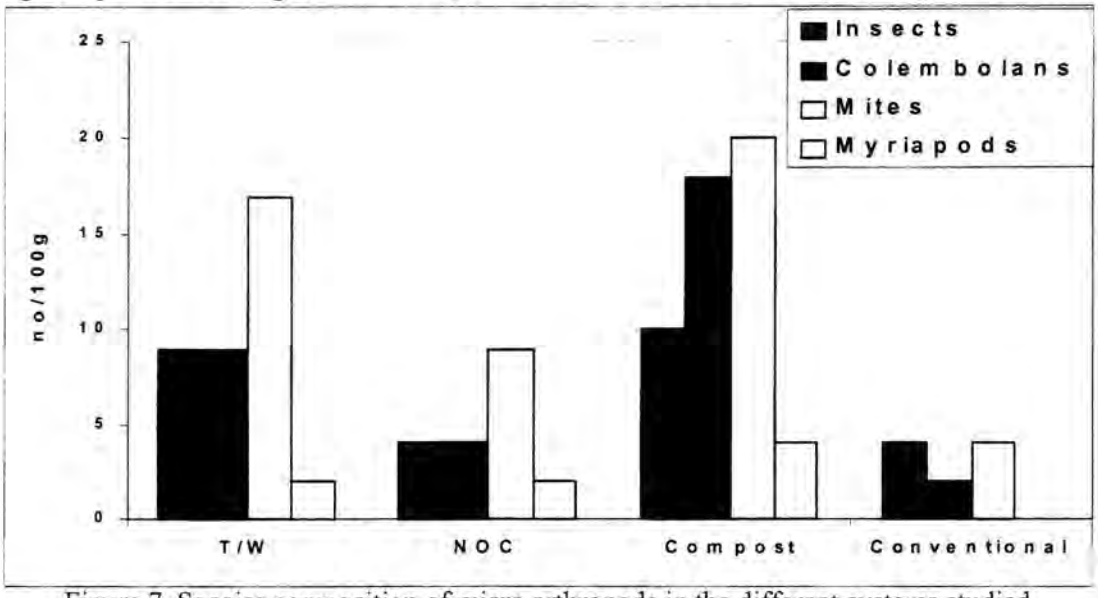

Figure 7 Species composition of micro arthropods in the different systems studied

Among the organically managed tea soils, compost amended soils showed the highest percentage increase in CO_2 evolution rate, which was 37.47 % with respect to the conventionally managed tea soils.

The bioassays indicated a significant improvement ($p = 0.05$) in root biomass, shoot biomass and root depth of plants grown in organic tea soils as compared with conventional tea soils. Compost amended tea soil showed the highest performances with respect to the shoot and root growth of plants. Thus, it was shown that organic tea cultivation could help improve the soil biodiversity and ecological restoration while maintaining the sustainability of the system with respect to crop yield.

Analyses to determine Humic acid content and E4:E6 ratio of soils collected from organically and conventionally maintained experimental plots at St. Coombs (TRI-ORCON trial) were also performed. This was extended to organic and conventional tea estates as well as a natural forest in the different agro-ecological regions. Correlations between densities of various soil fauna and plant growth are being determined.

R. W. Kulawardhana (Faculty of Agriculture, University of Peradeniya), K. M. Mohotti and H. N. P. Wijayagunasekara (Faculty of Agriculture, University of Peradeniya)

g. N 370 Management of tea nematodes under organic tea culture

Soils collected from organically and conventionally maintained experimental plots at St. Coombs (TRI-ORCON trial) were evaluated for various soil fauna in order to understand their relationship. Figure 8 shows the distribution of different soil fauna in different habitats studied. Extensive studies were in progress for use as biodiversity indices in soil productivity and health measurements.

Keerthi Mohotti

h. N 416 Scientific validation of traditional treatments in the management of plant parasitic nematodes

The bioassays conducted to study the efficacy of traditional plant materials *viz.* 'Kala vel' and 'Awari' did not show significant results in management of the root lesion and root knot nematodes. The experiment will therefore be repeated.

Keerthi Mohotti

i. Evaluation of different wormy-tech methods in relation to growth, nematode incidence and productivity of tea

Different wormy-tech methods available (*viz.* introduction of earthworms, application of wormy compost, casts and wormy wash) were compared with the conventional treatment and untreated control for determination of growth, nematode incidence and productivity of tea under glass house conditions. The experiments were in progress.

Keerthi Mohotti, Ajith Samarajeewa (CRI), K. W. L. K. Weerasinghe and Gamini Hitinayake (Faculty of Agriculture, University of Peradeniya)

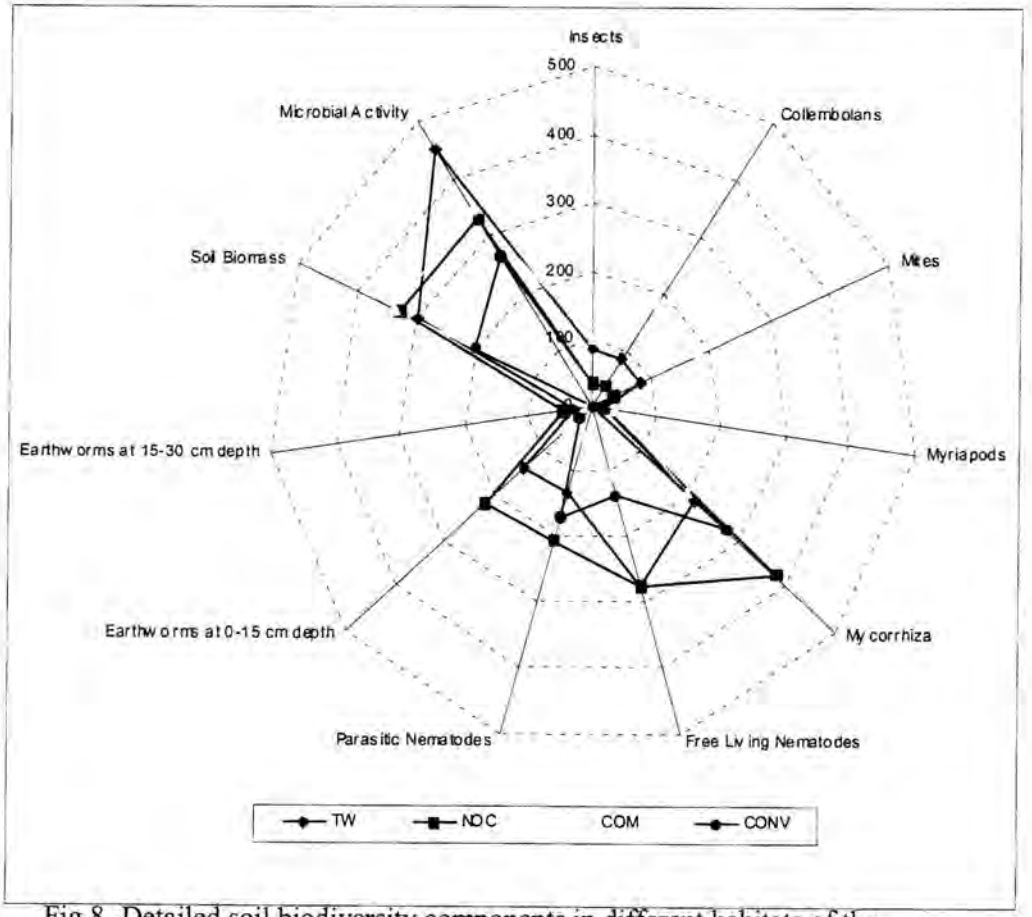

Fig.8 -Detailed soil biodiversity components in different habitats of the "TRIORCON" trial.

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

Soil populations of *P. loosi*, *R. similis* and *Meloidogyne* spp were maintained in the cement-lined tanks planted to *A. pintoi* at TRI, Hantane. Arrangements have been made to chemically extract the root exudates from the of soils and test for their allelomorphic characters. The experiment was in progress

Keerthi Mohotti, P. B. Ekanayake and Dr (Mrs) Rohini Ekanayake (Department of Agriculture.

k. Project A 32.3 - Evaluating Pest incidences in Organic Farming

ME19- SHB infestation in organic tea lands compared with that of conventional tea cultivation

One study was initiated to compare the incidence of SHB and the damage inflicted upon the tea in organic and conventional tea cultivations. This experiment is in progress.

D.Pallemulla & S.Abeysinghe

Project A 23.5 : Evaluating the effect of agrochemicals on non-target biota

i. Direct effect of pesticides on Soil Biomass and Productivity of tea :

Six soil pesticides (paraquat, diuron, glyphosate,(Round Up), carbofuran, phenamiphos and dazomet) were used to treat six different soils from Hantane, Passara, Kottawa, Deniyaya, St.Coombs and Ratnapura, to study their effect on the soil biomass, *Rhizobium* activity and productivity of tea, under glass house conditions. The experiments were in progress.

A. N. Abeykoon (Faculty of Agriculture, University of Peradeniya), K. M. Mohotti and Daya Ahangama (Faculty of Agriculture, University of Peradeniya)

ii. N 417- Health assessment of estate workers occupationally exposed to different cultural practices to see the indirect effect of agrochemical usage on productivity of tea lands

Health status of a selected group of workers of a conventional tea land (St.Coombs) and an organic tea land (Haldummulla) that adopted various cultural practices of both chemical and non-chemical were compared. Clinical data was collected and blood and other samples drawn from individuals were being analyzed.

K. Mohotti, Prof. Harsha Seneviratne and Mrs. Sumedha Wijeratne (Medical Faculty, Colombo)

Project A 23.6 Evaluating the effect of Biotic-materials on the tea-ecosystem

N 398 : Effect of biotic materials on soil biomass and productivity of tea

Four biotic materials (Biopack, China, Humat 2000 and EM) were screened to evaluate the soil biomass and productivity of tea under glass house conditions. Data were being analysed.

A. N. Abeykoon (Faculty of Agriculture, University of Peradeniya), K. M. Mohotti and Daya Ahangama (Faculty of Agriculture, University of Peradeniya)

Project A 23.8 Biological control of major pests

MeBr 71 - Biological control of nematodes.

The nematode trapping fungi viz. *Arthrobotrys dactyloides, A. oligospora, A.brochophaga, A. musiformis , Monacrosporium cianopagum & M. leptosporum* all extracted from soill in Australia were imported from the laboratories of Biological Crop Protection Pvt. Ltd., Australia, (at which laboratory one of the Experimental Officers was trained over a period of 3 months, to handled them). They are known to form different types of traps. The fungi were cultured in corn meal agar (CMA). The viability of the imported fungi was confirmed by introducing them individually, in to plain agar (1%) plates in which bacteria-feeding nematodes were placed. The different trap formations were recorded. Work was initiated to test the behaviour of those fungi towards *P.loosi*. Replicates were established at the laboratory at Hantane for *R.similis*. The study was ongoing.

In addition, a survey was initiated to isolate similar fungi and nematode parasitic bacteria from local soils. The mostly encountered nematode parasite was *Harposporium* sp, an endoparsitic bacterium. However, it was not confirmed whether this bacterium could parasitize tea nematodes. The study was in progress.

N.Navaratne

Project A 38.3 Soil-less media for tea propagation

i. N 375 Soil-less medium for tea propagation as an alternative to chemical treatments in tea nurseries

The tea plants raised on different soil-less media and planted on micro plots with heavy infestation of *P. loosi* were assessed for nematode infestation. Data did not show significant results contrary to expectation, and the experiment will be repeated.

Attempts have been made to set out different sizes of rubber latex coated soil-less media at the Rubber Research Institute laboratories, Ratmalana and Proflora work shop at Wennappuwa for further experimentations at TRI.

Keerthi Mohotti, Chandralal (Rubber Research Institute) and Meril Fernando (Proflora Co. Ltd.)

Project B 29: Refining the techniques of screening tea clones for natural resistance to the major pests of tea

1. **ME16-** To test the feasibility of Insect-Cage Bioassay for screening of tea clones against shot-hole borer

Following clones were tested for Shot-Hole Borer infestation using insect cage method in a 3- replicate trial, using 24 beetles per cage : TRI 3018, 3025, 3019, 3014, 3063, 3022, 4006 in comparison with TRI2023. Number of galleries, gallery length & brood development were assessed. Assessments were carried out 30days after introducing the beetles

Table 10. Bioassay observations on Live stages, galleries and gallery lengths (Avg. of 3 Replicates)

CLONE	Live stages	Gallery count	Gallery length (mm.)
TRI 3018	1	1.33	3.33
3025	0	1.33	0.01
3019	3	1.00	8.33
3014	4	1.67	5.00
3063	2	1.33	5.33
3022	2	2.67	33.33
4006	1.33	1.67	0.10
2023	0	0.33	0.01

The clone TRI 3025 was found to be comparable to TRI 2023, the least susceptible. The clones TRI 3022, 3019, 3014, and 3063 were shown to be highly susceptible and having large galleries, while TRI 3018 and 4006 are moderately susceptible.
These observations are comparable to field observations and therefore, indicate that the Insect-cage Bioassay could be used to screen out the highly susceptible clones at a very early stage of development of clones. However, as far as moderately susceptible clones are concerned field studies would be necessary to confirm host tolerance of such clones.

S.I.Vitarana, D.Pallemulla & S.Abeysinghe

1. Improvement of the Bioassay technique hitherto adopted for early screening of tea clones for low country live wood termites:
   Development of a bioassay which need not depend on wood-rot

The currently adopted bioassay needs rotted wood of the test clones. It takes several months after prune for the wood-rot causing microbes to convert die-back portions of pruned stems into wood-rot. Therefore, a method was being developed to see whether sound wood could be used in the bioassays.

A few new release clones were tested, in comparison with TRI 2023, the most susceptible clone, on fresh stems, 4 inches long and dried at 22^0C temp. for several hours, and kept inside plastic boxes with soft moist tissue underneath. Small holes were made with a dissecting needle at cut ends of each stem to facilitate their entry into stems. 50 pseudergate termites were introduced into each arena and were allowed to bore into the stems.

The following observations were recorded over a period of 5 days.

1. Number of termites exploring on the surface of stem
2. Number of termites sitting on tissue at the bottom of the arena
3. Number of dead termites
4. Feeding activity
5. Gallery making

The results have been presented in Table 11 :

The clones were found to be significantly different from each other in relation to the termite numbers on stem, the number on tissue, and the number dead. No consistent results were obtained. Therefore, it was decided to study their behaviour in relation to the following parameters:

1. Activity: a. Average gallery length
   b. No.of galleries made
   c. Increase in body weight (= (Initial weight – Final weight)/ Initial weight)
2. Termites showing positive behaviour (= (number on stem + number inside stem)
3. Termites showing negative behaviour (= (number on tissue + number dead)

Table 11 – Behaviour of termites towards test clones with reference to TRI 2023

Clone	Nos.on stem	Nos.on tissue	Nos.dead
	Pr.>Chi.Sq.	Pr.>Chi.Sq.	Pr.>Chi.Sq.
TRI 2023 vs T9	<0.0001**	0.0095**	0.301 ins.
TRI 2023 vs 2027	0.7979 ns	0.5420ns	0.0001**
TRI 2023 vs 2026	<0.0001**	0.8751ns	0.5495ns
TRI 2023 vs T4	<0.0001**	<0.0001**	0.5906ns
TRI 2023 vs T 139	0.0428**	0.5420ns	0.6952ns
TRI 2023 vs T 56	<0.0001**	0.0002**	0.0481**
TRI 2023 vs T 1	0.0162**	<0.0001**	0.3859ns
TRI 2023 vs T613	0.1640**	0.0001**	0.1343ns
TRI 2023 vs 2025	<0.0001	<0.0004	0.1431ns
TRI 2023 vs T 10	0.5606ns	0.0002**	0.3060ns
TRI 2023 vs T 146	0.4512ns	0.3304ns	0.0825ns

** clones that are significantly different from each other

Two sets of clones from the selections made from seedling progeny were tested, with reference to above parameters:

i. TRI 2023, 49 (34), 176 (26), 163 (29), 7/7 (2), 11 (11), 26/4 (10), 2025 (12), 4/6 (9), 10/1 (4), 39 (28), 145 (33), 149 (31).

ii. TRI 2026, 2024, 2016, 2027, 294 (14), 324 (16), 7/7 (2), 10/1 (4), 4/6 (9), 49 (34), 16 (35), 75 (39)

Data was analyzed using CATMOD procedure, and the results indicated the following : In relation to Gallery count, number with positive behaviour and number with negative behaviour, the clones exhibited significant differences, but CV% was too high for a reliable conclusion . The study was continuing.

S.M.Samarasinghe & S.B.Vithana

Project B 30: N 386 Biochemical resistance of tea clones towards major pests such as nematodes and Low country live wood termite

1. Nematodes : N386 Biochemical basis of clonal resistance to tea-nematodes

Biochemical investigations were made in view of developing a biochemical method to screen tea clones for nematodes resistance and susceptibility. Thirteen tolerant and susceptible clones growing in St. Coombs and Loolcondera Estate, Hewaheta, were selected for the study. *P.loosi* population and polyphenol content in roots were assessed periodically.

Stage I - The clones TRI 2142, 3016, DN, DT1, NEM 7 and K145 were considered as resistant and TRI 2024, 1526, 2043, 3015, DG39, TC9 and KEN15/7 as susceptible. Root extracts of tea clones were analyzed for total polyphenols and leucoanthocyanidins using colourimetric and HPLC methods (Table 12).

Table 12. Total Polyphenol Content of Resistant and Susceptible clones

Clone		Polyphenol Content mg/g	
Character	**Name**	**St.Coombs**	**Loolecondera**
Resistant	TRI 2142	64.59	27.14
	TRI 3016	52.91	*
	DN	52.63	32.76
	DT1	68.35	29.14
	NEM 7	62.94	*
	K145	59.11	32.97
	Mean	**60.08a**	**30.59b**
Susceptible	TRI 2024	60.26	26.37
	TRI 1526	64.08	24.48
	TRI 2043	64.34	25.32
	TRI 3015	60.45	*
	TRI 2026	*	31.89
	DG 39	60.62	*
	TC9	60.98	26.53
	Mean	**64.07a**	**26.74b**

Means with the same letters are not significantly different at $\alpha < 0.05$

* Not available for the study

Total polyphenol content is significantly different between the two locations. However, the total polyphenol content of resistant clones is not significantly different from that of susceptible clones at either location. But total polyphenol content of resistant clones is higher than that of susceptible clones in Loolecondera as shown in Table 12.

There was poor correlation between polyphenol content and the population of *P.loosi* at both locations. In St.Coombs the correlation between root polyphenol content and population of *P.loosi* of resistant and susceptible clones were 0.019 and 0.028 respectively. In Loolecondera it was 0.0219 and 0.0359. In both locations polyphenol content and nematode population were more correlated among the susceptible clones than among the resistant clones. Cyanidin and Delphinidin represent the condensed tannins in root. Condensed tannins could be one factor that contributes nematode resistance in tea plant. However, the study revealed that Cyanidin and Delphinidin contents were not significantly different between resistant and susceptible clones (Table 13).

Table 13: Concentrations of Delphinidin and Cyanidin in tested clones (St.Coombs)

Resistant/ Susceptible	Clone	Cyanidin content (mg/g)	Delphinidin content (mg/g)
Resistant	TRI 2142	5.06	3.58
	NEM 7	4.87	5.98
	DN	5.36	4.42
	DT1	5.37	5.23
	Mean	**5.17a**	**4.80a**
Susceptible	TRI 2024	5.12	4.90
	TRI 1526	4.30	4.71
	TC9	4.93	4.61
	DG39	5.80	5.14
	Mean	**5.04a**	**4.84a**

Means with the same letters are not significantly different at $\alpha < 0.05$

The data generated from this study is not conclusive and therefore, further studies need to be carried out under well-controlled conditions to minimize the external factors, which could affect the chemical composition of the tea roots.

P.D. Senanayake, I. S. B. Abeysinghe and Keerthi Mohotti

Stage II

Cuttings of selected resistant and susceptible tea clones to *P. loosi* were planted in the nursery for closely monitored experimentation to continue this study.

Keerthi Mohotti

2. Live wood termites: Biochemical basis of clonal resistance to Low-country live-wood termites

The clone, TRI 2016 was chosen for the study because it is immune to the low country live wood termites. Dichloromethane (CH_2Cl_2) extraction of TRI 2016 were carried out. The active fractions, S/16/4/2, S/16/4/9, S/16/4/11 were further fractionated. Of these S/16/4/9 was further fractioned using Medium Pressure Liquid Chromotography (MPLC) method. No significant activity was observed with the fractions S/16/42/1-11.

Different bioassay methods were used to study the activity of these fractions but no positive results were obtained. It was questionable as to whether, the activity was due to a collective action of many compounds or due to a single compounds.

Similar analysis was carried out with the termite susceptible clone, TRI 2023:
Dichloromethane (CH_2Cl_2) extract of TRI 2023 was fractionated using Vacuum Liquid Chromotography (VCL). 13 fractions were obtained (S/23/50/1-13).
They were bioassayed and the active fractionswere further fractionated to yield :
S/23/50/3, S/23/50/5, S/23/50/8, S/23/50/9, S/23/50/10, S/23/50/13 fractions which were further fractionated using MPLC method. Of these, the fractions,
S/23/50/3-2nd NPLC and 8th MPLC were significant at 1% and 5% respectively.
S/23/50/9 was not significant. This was thought to be due to dissociation of compounds.

Electro Antennogram Studies (EAG)
EAG signal is a voltage deflection between tip and base of an insect antenna when exposed to an adequate stimulus. This deflection can be measured with suitable equipment. Wood materials were extracted into a solvent. They were fractionated using MPLC. This extraction and bioassay directed fractionation and identification work was in progress.

S. M.Samarasinghe

C 2: Eelworm analysis

A total of 1146 root and soil samples were analyzed, and 36 reports were dispatched to estates.

D.D.Liyanage, N.Navaratne, P.Udamulla & U.B.Herath

D 17: Management of Nematode pests in tea lands

Most of the activities under this project were carried out under the sponsorship of the United Nations Overseas Project Services (UNOPS).

Thermal treatment of soil as a substitute for Methyl bromide fumigation :

1. Steam Sterilization of soil :

MeBr 9 -Development of a Steam Chamber for sterilization of infested soil for use in tea Nurseries:

A steam generator (boiler), a water reservoir and the Steam Chamber were constructed and tested. Arrangements were made to patent the equipment. Soil trays and a trolley to carry soil trays into the Chamber were designed. The designs were approved for construction. The study was ongoing.

S.I.Vitarana, D.D.Liyanage & D.E.Hettiarchchie

2. Use of Dry heat

MeBr 56 - Soil Roasting as a means of Nematode control.
Hauteville Estate, Agarapatna.

Construction of roasting plate (Galvanized iron) and gas hearth were completed. The gas hearth was constructd in the form of a series of perforated tubes fitted parallely on a rectangular frame; with the perforations made at 4 inch intervals and the gas tubes places at 6 inch intervals. The soil tray (3ft.3inch x 7ft x 6 inch deep) was supported on 2 inch angle iron frame kept above the gas hearth. Soil was spread in the tray to a height of 4 inches. The experiment had the following treatments :

T1- fumigation with Methyl Bromide – standard
T2- Roasting for 10 minutes, without mixing or adding water
T3- Fumigation with basamid- Standard
T4- Roasting while mixing and adding water
T5- Untreated soil

Testing the effective time period of heating the soil was ongoing.

D.D.Liyanage, U.P.Jayaratne & P.Udamulla

Formulation of IPM Programs using alternatives to Methyl Bromide

Studies carried out in the recent past have shown that Soil Solarization, and organic soil substitutes such as coir dust, refuse tea and paddy husk are nematicidal in nature and that they also, have crop boosting effect on the plants. However, in order to take care of any residual undetected populations that may survive and also, to cut down on the use of chemical nematicides for economic reasons, it was necessary to check for compatible combinations of these treatments that could exert synergistic action on each other. The following experiments were conducted for that purpose.

Evaluation of the synergistic effect of nursery Poly-tunnels on Soil Solarization.

1. **MeBr-48** - Diyagama East Estate, Dayagama

An experiment to study the synergistic effect of polytunnel on soil solarization, was laid down on a split-plot design, with 12 treatment combinations, replicated 3 times and with 500 plants per plot as follows :

Main Blocks - Tn1= With polytunnel
Tn0= Without Polytunnel

Sub-Blocks - N1 = 6 week soil solarization of Urea supplemented soil
N2 = 6 week soil solarization as in N1+ Neemazal at planting cuttings
N3 = 6 week soil solarization as in N1+ Neemazal at planting cuttings and repeated at 2 month intervals
N4 = Dazomate (Basamid)- standard treatment
N5 = Methyl Bromide – standard treatment
N6 = Untrated soil

Assessment carried out at 6 months showed that poly-tunnel usage and repeat application of Neemazal can exert a synergistic effect in relation to the growth of the plants in the nursery (Table 14).

Table 14- Assessment on tipping weight (g / plot)
(after 6 months of planting of cuttings)
(Average of three replicates)

	N1	N2	N3	N4	N5	N6	Avg.
Tn1	770.61	621.38	640.31	774.69	590.02	518.89	649.32
Tn0	520.68	558.43	594.29	608.78	545.67	503.63	555.24
Avg.	645.64	589.91	617.3	691.73	567.84	511.26	

All the nematicidal treatments have given better growth compared to the untreated control. Also, presence of the poly-tunnel enhanced the growth significantly in all treatments. In the absence of the poly-tunnel, Neemazal has shown synergistic effect on soil solarization.

2. **MeBr 52** –New Division Nursery, Rangala Estate (AR 2001)
(Effect of Poly tunnel on Soil Solarization)

Final assessment was being carried out at the end of the year. Following growth measurements were taken from 10 plants ramdomly selected from each treatment bed : Height, girth at 1" from the base of the plant, number of branches, state of epical bud (active or banjie), number of leaves in main stem and branches, number of leaves in main stem and branches. Root and soil samples were assessed for nematode infestation. Data was being statistically analyzed.

U.B.Herath & P.Udamulla

MeBr 54 - Effect of polytunnel on soil solarization.
Queenstown Estate, Hali–Ella.

Experiment to study the synergistic effect of polytunnel on soil solarization, in Uva was laid down on a split-plot design with 12 treatment combinations replicated 3 times and with 500 plants per plot. Nematicidal (N) treatments were the same as in MeBr 48 and 52. Data is presented in Tables 21 & 22.

Table 21.- Average of tipping weight
(Kg/ Block) after 8 months of planting of cuttings

	Tn0			Tn1		
Treatment	R1	R2	R3	R1	R2	R3
N1	2.6	1.5	1.5	3.0	2.7	3.5
N2	3.5	1.0	2.3	3.3	4.7	4.0
N3	2.9	2.9	2.2	3.7	2.7	3.1
N4	3.5	2.5	2.5	3.4	3.5	3.0
N5	3.8	1.5	3.2	1.3	3.3	2.0
N6	2.1	1.5	2.0	1.9	2.5	3.0

Table 22 - Treatment Interaction in re. Avg. tipping weight
(Kg/ Block, after 8 months of planting of cuttings)

	N1	N2	N3	N4	N5	N6	Avg.
Tn1	3.07	4.00	3.17	3.30	2.20	2.46	3.03
Tn0	1.87	2.27	2.67	2.83	2.83	1.87	2.39
Avg.	2.47	3.13	2.92	3.06	2.51	2.16	

At nine months from planting cuttings, nematodes were detected only in the untreated control. Polytunnel has given distinct advantage to the plants under any treatment. Plants treated with Neemazal and grown under polytunnel in soil subjected to soil solarization, had the best growth.

D.D.Liyanage, U.P.Jayaratne

MeBr 54A – Follow up of the Effect of nursery tunnel on nematodes.
Queenstown Estate, Hali–Ella.

A follow up study of nursery experiment, to see whether there could be latent residual populations of nematodes after treating the nursery plants with the MeBr alternatives, was initiated. The experimental plants of MeBr 54 were transplanted in the field. The experiment was on-going.

D.D.Liyanage & P.Udamulla

Synergistic effect of Soil Solarization on organic Soil Substitutes and chemical Nematicides in relation to control of Tea Nematodes and growth of nursery plants.

Two similar experiments were laid down on a split-plot design with 24 treatment combinations replicated 3 times and with 200 plants per plot, at Bandarawela and Diyagama:
Treatments are as follows:

Main-Blocks	S_1- 6-week soil solarization of Urea-supplemented soil
	S0- no soil solarization of the soil
Sub-Blocks	SS1- Coir Dust :soil ::1:1
	SS2- Paddy husk : soil :: 1:1
	SS3- only soil
Sub-Sub-Blocks	T1- ½ dose Dazomet
	T2 – ½ dose Metham sodium
	T3 – "Neemazal" (dilution @ 3 ml in 5 l of water) - 30 ml /plant
	T4- Untreated soil

1. MeBr 49 Nayabedda Estate, Bandarawela

At this location it was clearly shown that solarization could bring the nematode count to undetectable levels and help to cut down the dosage metham sodium and dazomet to even half the recommended dosage of these chemicals which is useful where cost cutting is involved under dire circumstances in plantations.
Data collected at the growth assessment is given in Tables 15, 16, 17, .

Soil Solarization by itself was better than no solarization. However, the interaction between the different factors was more significant in relation to nematode control (Table 17).

Table 15 - Assessment on shoot weight (g / plant) after 9 months of planting of cuttings

Solarzn.	S_0				S_1			
SoilSubs.	T1	T2	T3	T4	T1	T2	T3	T4
Coir Dust (1:1)	19.51	20.82	24.32	22.57	22.71	23.58	26.79	26.08
Paddy Husk (1:1)	28.39	23.57	24.71	24.14	23.74	26.9	24.15	28.04
Only Soil	20.04	27.31	26.45	22.2	21.5	22.26	29.68	26.07

Table 16- Replicate x Main-Blocks Interaction

	R1	R2	R3	Avg.
S0	304.74	292.94	255.7	284.46
S1	306.85	335.54	262.25	301.55
Avg.	305.79	314.24	258.97	

Table 17 – Nematode Assessment
(nematodes in 1 g of root; after 9 months of planting cuttings)

	S_0				S_1			
	T1	T2	T3	T4	T1	T2	T3	T4
Coir Dust (1:1)	1	0	0	0	0	0	0	0
Paddy Husk (1:1)	1	2	4	1	0	0	0	1
Soil	1	2	0	0	0	0	0	0

It was clearly shown that soil solarization had beneficial effect on all media with and without the reduced doses of the chemical nematicides.

3. MeBr-50 - Diyagama East Estate, Diyagama
(Treatments same as in MeBr 49)
Data collected at this location are given in Tables 18, 19 & 20.

Table 18-Assessment on shoot weight
(g / plant) after 6 months of planting of cuttings)

Solarzn.	S_0				S_1			
Soil sub	T1	T2	T3	T4	T1	T2	T3	T4
Coir Dust (1:1)	61.95	81.34	88.61	77.7	96.90	121.29	126.22	78.41
Paddy Husk (1:1)	76.6	145.12	96.62	116.81	195.01	128.6	217.91	144.55
Normal Soil	94.08	98.48	182.63	71.57	127.02	97.06	89.46	113.56

Nursery medium subjected to Soil solarization and then treated with Dazomet at half dosage or with "Neemazal"applied once at planting of cuttings gave the best growth of plants (Table 19).

Table 19 – Main-Blocks x Sub-Sub Block Interaction

Treatments	T1	T2	T3	T4
S0	697.91 d	974.82 b	1103.56 b	798.22 c
S1	1256.80 a	1040.85 b	1300.77a	1009.56 b
Avg.	977.35	1007.83	1202.16	903.89
LSD (p = 0.05) = 80.83				

Treatment with Metham sodium or Neemazal after soil solarization gave the best growth of plants. The next best were the dazomet, Neemazal and solarization which had no difference between each other.

Table 20 - Main-Blocks x Sub-Block x Sub-Sub Block Interaction

Treatments		T1	T2	T3	T4
S0	SS1	185.86 d	244.03 d	265.83 d	233.10 d
	SS2	229.8 d	435.36 c	289.85 d	350.42 d
	SS3	282.25 d	295.43 d	547.88 b	214.70 d
S1	SS1	290.71 d	363.86 d	378.65 d	235.24 d
	SS2	585.04 b	385.80 d	653.73a	433.64 c
	SS3	381.05 d	291.19 d	268.39 d	340.68 d
	Avg.	325.78	335.96	400.72	301.30
LSD (p = 0.05) = 62.16					

The medium made up of paddy husk mixed with pre-solarized soil that received "Neemazal" application once at planting of cuttings, turned out to be the best treatment. The second best was similar medium that had the soil pretreated with half dosage of dazomet instead of "Neemazal. This was not statistically significantly different from the "Neemazal" treatment. These two systems of treatment can be now recommended for all nematode active areas.

S.I.Vitarana, D.D.Liyanage, U.P.Jayaratne, A.K.Prematunga & P.Udamulla

MeBr 51(N382) –Tea Nursery, Handford Estate , Deniyaya.

At this location two soil substitutes and two methods of solarization were being tested in combination with reduced dosages of Metam Sodium [@ 300 ml m^3, i.e.1/2 the recommended dose], Basamid 98% G [@ 250 g /cube, i.e.1/2 the recommended dose] and
Neemazal 1 TS [@ 30 ml of dilution / plant, with a dilution of 3 ml in 5 l water, i.e.1/5 the recommended dose]. The experiment is in progress.

S.I.Vitarana, A.K.Prematunga & P.K.Jayawickrema

MeBr-58 Testing of different types of paddy husk.
Queenstown Estate, Hali-Ella

An experiment to study the influence of different types of paddy husk on its synergistic effect on soil solarization, was laid down on a split-plot design with 4 treatment combinations replicated 3 times and with 50 plants per plot, as given below:

Main-Block M1 = Local mill product of paddy husk
Mt2 = Husk produced by the Japanese huller
Sub-Blocks T1= Soil : Paddy Husk (1:1) + 6 week soil solarization
T1= Soil : Paddy Husk (3:2) + 6 week soil solarization

Towards the end of the nursery period the product from the Japanese huller proved to be superior to the local mill product in relation to the increased growth response (Table 21). The former contained unbroken husk while the latter is broken and crushed material. The unbroken husk takes longer to decompose and therby would release the ingredients in small quantities over a longer period compared to the local mill produce.

Table 21- Assessment on root and shoot weight (g / plant) after six and eight months

	After 6 months		After 8 months	
Treatments	Shoot Weight (g)	Root Weight (g)	Shoot Weight (g)	Root Weight (g)
M1 x T1	11.56	3.93	17.95	7.20
M1 x T2	9.94	5.02	16.20	6.90
M2 x T1	10.46	2.80	25.43	9.69
M2 x T2	12.52	3.78	25.98	9.02

U.P.Jayaratne &D.D.Liyanage

Modification of use of methyl bromide substitutes in tea nurseries in nematode active tea nurseries

Modifications have been proposed to the recommended methods of using soil solarization, refuse tea, coir dust and paddy husk. They were being tested in the following trials:

1. **MeBr 72** – To increase the organic matter content in the layer method
Queenstown Estate, Hali–Ella.

At this location, the proportion of soil and organic matter was changed to 1 to 3. Refuse tea (tea waste) and Saw dust were used in two treatments which were compared with methyl bromide treated soil and an untreated control. In this Nursery beds were prepared. The experiment was ongoing.

2. **MeBr 70** - Double-tent Soil Solarization.
Queenstown Estate, Hali–Ella.

The effect of the double layer poly-tunnel (double-tent) to enhance the synergistic Nursery beds were prepared. The experiment was ongoing.

3. **MeBr 67** – Soil substitutes in closed bags vs. open bags.
Hauteville Estate, Agarapatana.

Long polythene sleeves were used in place of 9" ones in the nursery to see the effect of sealed atmosphere when the cuttings were planted in organic refuse (tea waste, coir dust, spent tea and saw dust) inside top sealed bags (to protect the plant from other pest attacks and also, conserve the moisture. Cuttings were planted in June. The experiment was ongoing.

U.P.Jayaratne &D.D.Liyanage

4. **MeBr 53** – Screening of different chemicals to eradicate nematodes in the nursery. Rangala Estate, Rangala.

In this trial cadusafos (Regent) at 2g, 3g &4g per plant, was being tested for its efficacy in comparison with metham sodium (@600ml per m^3) and dazomet (@500g per cube of soil-the standard). The experimental beds were being maintained after treatment of soil and planting cuttings. Final assessment was delayed till January 03, as facilities were inadequate for processing.

U.B.Herath & P.Udamulla

5.**MeBr 40 B**- Treatment of Infested nursery plants at transplanting.
Hanford Estate, Deniyaya

The study at this location was to find effective nematicidal treatments to eradicate nematode infestation at field planting, because it has been observed that in spite of having fumigated soils at establishment of nurseries many a nursery sends out infested plants to new clearings. Plants of two clones from the control (untreated) plots of the nursery experiment, MeBr 40 where Soil Solarization had been tested, were used in this trial, in a split-plot design, with 6 treatment combinations replicated 3 times and with 100 plants per plot. The clones were TRI 2025 (C1) the tolerant clone, and TRI 2026 (C2) the susceptible clone. The field treatments included the following:

T1-Untreated control

T2-Metam Sodium @ 88 ml/planting hole (Metam 500 l +water,600 l /ha)+Vattiver in the inter-row for two years+ Neemazal @ 30 ml/plant (Neemazal 3ml +water1 l) every three months for two years or up to the 3rd assessment of zero counts.

T3- Nemacur @ 7g /plant in plating hole +Vettiver in the inter-row for two years + Neemazal @ 30ml/plant (Neemazal 3ml + assessments of zero counts)

Even though the untreated control exhibited more nematodes some time during the course of the year, the results were not conclusive.The study was being continued.

A.K.Prematunga & P.K.Jayawickrema

MeBr 40A (N 387) Follow up study of the nursery trial, MeBr 40
Handford Estate, 2002 NC, Deniyaya

Plants of the nursery trial MeBr 40 (in which soil solarization with and without nitrogen supplements had been tested) were transplanted in the field, in 3 replicates and with 100 plants per plot. The plots were under observation for any signs of build up of nematode.

A.K.Prematunga & P.K.Jayawickrema

MeBr 60 To confirm whether there could be adverse effects of pH changes of the medium on the growing plant when soill substitutes are used

Handford Estate , Deniyaya

pH was recorded at 2 weeks and thereafter every month up to 7 months after establishment of the nursery plants. pH of all organic materials changed very slowly during the 7 month period and the neat materials (either in layer or 100% medium) retained pH values well above 5.0.

Table 23- Change of pH in the nursery medium with time

		Months from establishment of nursery							
		1/2	1	2	3	4	5	6	7
Soil (100%)		4.1	4.60	4.62	4.80	4.05	4.12	4.05	4.15
TW+Soil(1:1) mixture		5.60	5.15	5.82	5.30	4.55	4.50	4.10	4.50
PH + Soil(1:1) mixture		4.62	4.60	4.8	4.61	4.00	4.20	4.00	4.02
CD+ Soil(1:1) mixture		4.80	4.70	5.00	5.20	4.10	5.00	3.70	4.10
TW+ Soil(in layer)	a.	4.82	4.8	4.74	4.8	4.00	4.72	4.00	4.02
	b.	5.50	5.30	5.80	6.25	4.95	5.20	5.25	5.20
PH + Soil (in layer)	a.	5.00	4.50	4.80	4.60	3.95	4.50	5.05	4.20
	b.	5.80	6.15	6.00	6.50	5.50	5.82	3.80	5.50
CD + Soil (in layer)	a.	4.73	4.60	4.72	4.80	3.60	4.75	3.90	4.20
	b.	5.90	5.85	6.00	6.00	6.05	5.90	5.15	5.00
TW (100)%		5.95	5.30	6.82	6.40	5.55	5.10	5.85	5.82
PH(100%)		6.00	6.70	6.75	6.70	4.85	5.85	5.40	5.60
CD (100%)		6.40	5.85	5.82	6.20	6.10	5.90	5.90	6.00

TW=tea waste (refuse tea), PH=paddy husk; CD=coirdust;
a=soil layer; b=organic layer..

However, organic material mixed with soil and the soil layer in the layer arrangement retained a pH well below 5.0. It is only the 100% organic medium that recorded pH exceeding 5.5. However, it was possible to obtain excellent growth in nursery plants in 100% coir dust. Therefore it is possible to recommend 100% coir dust and all three materials in mixture and in layer arrangement for tea nurseries.

S.I.Vitarana, A.K.Prematunga

D 18: Management of Up country Live wood Termite

E 311 – Termiticides for use at Burial Method to eradicate the termite from field.

Field No. 03 Valamalai Division, Laxapana Estate

The following treatments were applied adopting the "burial method". In which a termite infested bush is uprooted, all the plant parts containing live termites are dissected in situ and treated with a termiticide before burying the material in the same pit.

Treatments:
1. Imidachlorpid ("Admire SL 200") @ 6.5 l/ha
2. Fipronil ("Regent 50 EC" @ 3.5 l/ha
3. *Beauveria bassiana* spore solution
4. *Beauveria bassiana* sproe solution + Admire SL 200 6.5 l/ha
5. Fipronil ("Regent) granules
6. Untreated Control

All treated bushes (30 bushes per replicate per treatment) were marked and assessed at one month intervals, unearthing four bushes per treatment at a time. Observations of the two assessments carried out in the year showed near 100% mortality in the case of liquid formulation of fipronil (Regent 50EC). Treatment with *Beauveria bassianathe fungus* gave doubtful results as there were no head capsules of dead termites to be recovered. It could be that the head capsules too were disintegrated. The experiment is on going.

P.D.Senanayake, C.J.de Seram, P.G.C.Priyantha

D 19: Management of Low country Live wood Termite

The feasibility of adopting the new methods of soil treatment introduced for nurseries in nematode active area, in other areas need to be studied. One problem that could be foreseen at using organis soil substitues is in relation to scavenging termites in the lowcounty. Therefore two experiments were initiated,one in Horana and the other in Ratnapura.

LE88- Panambalana Tea Estate,
Ethamalahena Mawatha,Kahatapitiya, Kananvila(Horana)

This experiment was laid down in June, on factorial design, using coir dust and paddy husk (easily available in the costal area) in equal proportions with soil as the, in a nursery in Horana. At the same time, LCLWT tolerant clones were used to see whether they could be used with new technology for better advantage. The other objective was to see the small holder capacity for adoption of modified technology. The details of the trial as given below:

3M x 6C, where M= rooting medium; C=clone
Media :M1 - Soil and Coir dust (in layers)
M2 – Soil and Paddy husk(1:1 mixture)
M3-Only soil
Clones : TRI 4046, 4006, 3014, 4042, 4049 and 2027
200 plants were planted in a sub plot in one replicate, with 3 replicates making up the trial.Growth assessments were initiated in September. The study was in progress.

MeBr 65 : St. Joachim Estate , Ratnapura.
The following treatments were applied in a factorial design with clones as the 2nd factor:

T1 – pH + soil (1:1 mixture)
T2- CD + Soil (1:1 mixture)
T3- pH + soil (1:2 mixtures)
T4 – TW and soil (layer) 6" bags
T5 – Tw and soil (layer) 9" bags-
2C = TRI 2026 & TRI 2027

The plants survived only in the case of T4 , T5 and T6. Death of plants in the other treatments could not be explained. Growth assessments were carried out at 7 months and the plants were planted on the same estate.

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

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

1. ME 6(02) - Screening of insecticides to manage scavenging termites.

Duckwari Estate. Lolgama Division, Field No: 10

The second application of chemical termiticides was carried out in June 2002, after 15 months of the 1st application. The treatments included :

T1-Fipronil 5G (Granular formation) @ 30 kg /ha
T2-Fipronil (Regent 10EC) @3.5 liter/ha
T3- Fipronil (Regent 10EC) @ 2 liters/ha
T4- Untreated control

Monthly observations on fresh scavenger activity, presence of active termites and the whole bush damage were recorded. No conclusions were arrived at this year. The experiment will continue up to end of 2003.

L.A.S.Abeysinghe, D.Pallemulla & U.B.Herath

2. Study on the occurrence of the Pink Mite in the Midcountry

Field.No.6, Karagahalanda division, Bandarapola Estate, Matale

A heavy outbreak of all species of mites that was encountered in dry weather on Bandarapola Estate was studied in relation to the infestation levels of the different mite species and the efficacy of a few neem (margosa) based formulations on the Pink mite population, in comparison with sulphur and an untreated control. The formulations contained azadirectin as the major active ingredient. Azadiretin is reported to have the activity of a hormone mimic and therefore, inhibit the synthesis of the natural hormones and thereby interrupting normal growth of the organism.

Population studied showed that the Purple mite was the most predominant (at 73%), the second most predominant being the Pink mite (at 24%). Scarlet and the Red spider mites were in negligible proportions. Changes in population levels in the treated plots as against the untreated are presented in Fig. 9. The treatments, "Aum Neem-plus"[@ 600ml /ha], and "Neemazal 1% TS" [@ 1.5l/ha] have reduced the populations consistently and are comparable with Sulphur [@ 600g/ha]. The other treatments in the same study were Habitat [@ 1000ml /ha], Neemazal 1% TS [@ 1.0l/ha] and "Aum Neem-plus" [@ 100ml /ha]

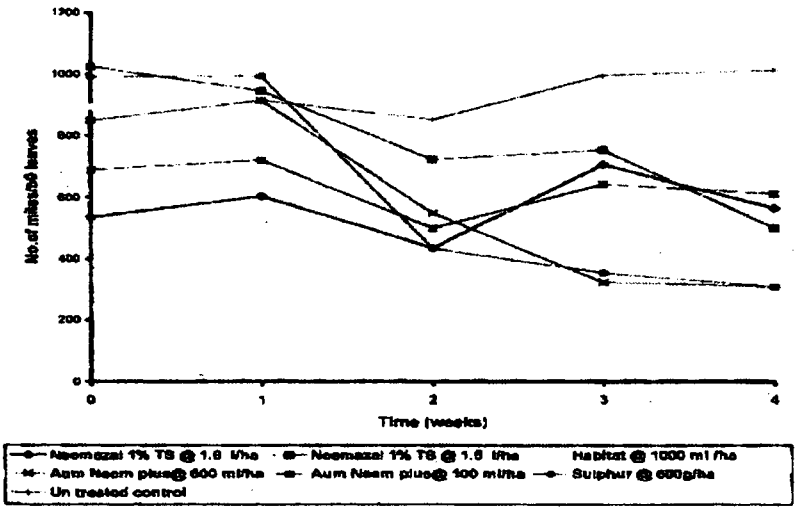

Fig 09 – Fluctuation of populations of pink mite (*Acaphylla theae*) in relation to treatments.

3. "Deniyaya Problem"

It was observed that some of the locations where symptoms of "Deniyaya Problem" were encountered (premature death of bushes) were infested with the nematodes, *P.loosi* and *R.similis*. Therefore, it was arranged to undertake experimentation to clear the soil of such patches of the nematodes.

(MeBr 64) Minirankanda ,Batayaya, Deniyaya.

Two applications of the following treatments were given in two large blocks and repeated after 6 months:

T1 Fenamifos (Nemacur3G) 10g / bush.

T2- Metam sodium 10 ml/ bush

Bushes in the fenamifos (T1) treated plots recovered well even before the second application could be given. This was indication enough that nematodes were responsible for the problem in this location. History of planting of the land revealed that the nursery plants had been obtained in mid 1980s, from an estate where there was a record of infestation in the nursery.

Similar experimentation was initiated on one of the company managed estate by the end of the year.

New Pest Outbreaks

Beetle attack on immature tea bushes

Minipura, Dumbara (small holding)

Plants in a new clearing were damaged by a leaf eating beetle identified as belonging to Family:Scarabaedae, Sub Family: Melolonthinae. The larval stage is a white grub, not damaging tea roots. The outbreak was brought under control with one application of fipronil 10EC diluted @ 50 ml of Regent 10EC in 15 l of water.

General:

1. 100-Days Revolution Programme of the Ministry of Plantation Industries

International Conference on Methyl Bromide Substitutes for Tea Plantations

A two day international conference was the 6th entry of the TRI, to the 100-Days revolution programme of the Ministry of Plantation Industries. It was held at The Hotel Lanka Oberoi, Colombo, from 5-6 April, under the patronage of the Hon. Minister of Plantation Industries, Mr.Laxman Kiriella who delivered the inaugural address. Mr.K.A.S.Gunasekera, the Secretary to the Ministry of Plantation Industries welcomed the guests and the participants. Ms.Sarwar Sultana, Officer in Charge of UNDP, Colombo addressed the gathering on behalf of the United Nations Overseas Project Services which funded the research project / SRL/99/G61. Dr.W.W.D.Modder, Director, TRI delivered the key-note address. Addional Secretary read out the message from the Hon Minister of Environment and Natural Resources.

Four technical sessions followed the inauguration, at which sessions the following papers were presented:

1.Objectives of the Conference-Dr.W.L.Sumathipala
2.Ozone layer and Ozone Depleting Agents-Dr.Chandana Jayaratne
3.An Overview of the Project SRL/99/G61-Phase out of Methyl Bromide from Nematode Control in Tea Plantations-Mrs.Sushila.I.Vitarana
4.Methyl Bromide Substitutes-How they are selected and how they work-Dr.Sheila Forsyth
5.Tea Nematodes and their significance in Sri Lanka-Mr.U.P.Jayaratne
6.Clonal Resistance in relation to Tea Nematodes-Mr.Palitha Udumulla
7.Neem formulations for use in tea -Dr.S.Vadivel.
8.Chemical and Non-chemical Substitutes of MeBr in tea nurseries and in tea new clearings-Mr.U.B.Herath
9.Total or Partial soil substitutes in tea nurseries-Mr.D.D.Liyanage
10.Soil Solarization in Tea-Mrs.Sushila.I.Vitarana
11.IPM Packages for Crop nematode problems-Dr.(Mrs) Rohinie Ekanayake
12.Methyl Bromide Alternatives-A collaborating Planter's View Point-Mr.Chaminda Gunaratne
13.Use of Tea Waste in nurseries: A Planter's Experience-Mr.Maxwell Perera
14.Nematode pests of te in southern India - Dr.Selvasundaram
15.A Panel discussion on "Desiging of IPM Systems for tea Nematodes in Sri Lanka" was chaired by Dr.Wijekoon while Mrs.Vitarana introduced the topic.

280 participants attended the conference

2. Staff Training and External activities undertaken by Staff

Mrs. R.M.D.T.Pallemulla was awarded M Sc degree by PGIA, University of Peradeniya, Sri Lanka in October. Her desertation was titled : Mite Problem of Tea in Midcountry with special reference to Pink Mite, *Acaphylla theae* Watt.

Mrs.B.Sureshkumar, Experimental Officer, continued with her post graduate studies leading to MSc.

Mrs. P.D.Senanayake completed a course of study leading to M Sc at the PGIS and was awarded the degree. Her desertation was titled : Effect of Root Polyphenols and Amino acids on Nemtodes in tea .

R.S. Walgama, Research Assistant returned to the island in November, after completing the first foreign segment of the post graduate study at the Department of Zoology & Entomology, University of Queensland, Australia.

Dr. Mohotti supervised the following research projects of external students:

a) final year research projects/thesis of undergraduate students of R. W. Kulawardhana, A. N. Abeykoon and K. W. L. K. Weerasinghe of Faculty of Agriculture, University of Peradeniya, b) M. Sc. research project of P. Dharmalatha of Post Graduate Institute of Science, University of Peradeniya and c) National Diploma in Plantation Management dissertation of J. M. B. N. Jayathilake.

Dr. Mohotti served on several committees as follows:

The country Coordinator of Asian Research Network of Organic Agriculture (ARNOA),

The general secretary of Lanka Organic Agriculture Movement (LOAM),

The secretary (Joint), National Agricultural Society of Sri Lanka (NASSL),

A member and Visiting Lecturer in Nematology of the Board of study / Plant Protection, Post Graduate Institute of Agriculture, Peradeniya,

A visiting Lecturer in Export Agriculture of Faculty of Agricultural Sciences, Sabaragamuwa University, Belihuloya, Sri Lanka.

A member of the Results Board –M. Sc. in Chemical Ecology and Pesticide Chemistry, Post Graduate Institute of Science, Peradeniya,

A resource person in Indigenous Knowledge in Agriculture of Sri Lanka Resource Center for Indigenous Knowledge (SLARCIK), University of Sri Jayawardenapura, Colombo,

A resource Person and member of expert committee on Organic Products Promotion Program of the Ministry of Environment and Natural Resources,

A resource Person in Nematology and Environmentally Friendly Tea Cultivation of NIPM and

A resource Person for Development of databases and documentation of Traditional Knowledge in Agriculture in Sri Lanka at the CARP and IUCN.

Team leader of the Task Force committee on preparation of organic standards on Pest and Disease Control under Asian context coordinated by ARNOA.

Seminars / conferences / workshops

Dr. Mohotti was invited by the Rural Development Administration and Dankook University of the Republic of Korea to attend the first ARNOA / RDA conference on 'Asian Organic Agriculture' held in Cheonan, Korea during 11 November – 15 November 2002. He made the following presentations in the direction of formulating Organic standards for Asia and also chaired a technical session at the conference.

1. Soil Biodiversity Measurements as Potential Determinants in Organic Certification: Supportive Evidence from Sri Lanka and
2. Bio Assessment of Productivity of Organic and Conventional Paddy Soils: A Preliminary Case Study in Sri Lanka.

Dr.Mohotti was selected as the team leader of the Task Force committee on preparation of organic standards on Pest and Disease Control under Asian context. During the visit, he was exposed to small and large scale organic farms in Korea.

Dr. Mohotti presented three scientific posters at the Fourth International Congress of Nematology held in Spain during 8-13 June 2002 in absentia.

Dr. Mohotti addressed the planters at the 204th E&E Forum on the topic entitled 'The feasibility of organic tea production: A preliminary examination'.

He made a presentation to the Tea Research Board on 'Organic Tea Research and Development in Sri Lanka' on 9 December 2002.

Dr. Mohotti delivered lectures on the following subjects :
'Environmentally friendly and organic tea cultivation' to the participants of the 11th Diploma course in Plantation Management – Tea module
'Cultivation of organic tea' for officers attached to the Tea Promotion Division at NIPM
'Management of nematodes' to the planter trainees at NIPM
'Regulatory aspects in nematode management' at the Regional training program on the application of sanitary and phytosanitary measures held on 13 March 2002 at the royal Botanical Gardens, Peradeniya.

'Economic and environmental benefits of organic farming' to the participants from government and non-governmental organizations held at the Tree Center, Randenigala

'Organic tea cultivation as a sustainable system' to the small holder tea growers at Galaha and Gurutalawa organized by the Gemi Seva Sevana and Future in Our Hands respectively.

Dr. Mohotti made a presentation at the E&E forum at TRI on 'Organic farming as a sustainable agricultural system in tea'

Dr. Mohotti attended the following symposia and workshops:
The 15th year world organic tea celebrations organized by Stassens Natural Food (Pvt.) Ltd. held at Haldummulla The Regional Seminar on best practices and empowerment success stories on sustainable development as the moderator held at Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo during 28-29 July 2002

Workshop on 'Biodyanamic agriculture for 21st century' held at the PGIA, Peradeniya on 25 February 2002.

Workshop for Development of a National Strategy for Incorporating Traditional Knowledge into Development Practices organized by NASTEC and IUCN held in Dambulla during 17-20 September, 2002 and made a presentation on 'Harnessing Best Practices of Indigenous Knowledge in Agriculture for Development Practices in Sri Lanka'.

Workshop on 'Organic Farming and Sustainable Agriculture: Future Directions' organized by the University of Peradeniya, Lanka Organic Agriculture Movement and National Agricultural Society of Sri Lanka held in Peradeniya on 10 August, 2002 and made a presentation on the 'Present situation of organic and sustainable agriculture in Sri Lanka'.

National Workshop on 'Towards high quality spice products' held in Department of Export Agriculture, Matale on 9 July, 2002 and made a presentation on 'New Frontiers: Potentials for organic spice and Beverages'.

Eighth Annual Forestry and Environment Symposium 2002 held in Hikkaduwa during 12– 13 December 2002 and made a presentation on 'Importance of improving biological activity of tea soils in southern province of Sri Lanka' at the RSC VI held in Ratnapura.

Annual Symposium of the Department of Agriculture (ASDA 2002) held at Gannoruwa, Peradeniya during 26-27 September, 2002.

22nd Annual Sessions of the Institute of Biology Sri Lanka held in Colombo on 26 September 2002.
8th Annual Symposium of the Engineering Research Unit of University of Moratuwa held at Moratuwa on 20 August, 2002.

Mrs.Vitarana prented the Country Paper for Sri Lanka, "Alternatives to Methyl Bromide for the treatment of Tea Nematodes in Sri Lanka.", at the Regional workshop on the use of Methyl Bromide Alternatives evaluated under the Multilateral Fund's demonstration projects for Asia and Pacific. Pattaya, Thailand, 25-27 September 2002.

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තේ තවාන් සඳහා පස් වෙනුවට යොදා ගතහැකි ආදේශ සහ තවානේ පස් ධූමනරනයට විකල්ප මාර්ග

R.S. Walgama attended a residential workshop on "Ecological Modelling" conducted by the Commonwealth Scientific & Industrial Research Organization (CSIRO) and the University of Queensland (UQ) from 21st – 25th January 2002 at the University of Queensland, during the stay in Australia.

Three extension programmes were conducted by Mrs.Vitarana and Mr.Udamulla, for the benefit of plantation sector personnel, to introduce the use of Soil Substitutes, Soil Solarization and chemical nematicides as means of nematode control in tea nurseries. They were held at Gouraville Estate, Talawakelle Estate and at the TRI Station, Passara Talawakelle and Passara. One extension leaflet was prepared for distribution at these sessions.

Establishment of Demonstration sites of MeBr substitutes : Factors that can be incorporated into area specific IPM packages were identified. Ten sites have been prepared at Gouraville, Hauteville, Diyagama East, Templestowe, Queenstown, , Luckyland, Brunswicke, Deniyaya and Rangala Estates and at the TRI station at Passara.

Publications:

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Vitarana, Sushila I., Herath, U.B., Liyanage, D.D., Jayaratna, U.P., Pramatunga, A.K., Udumulla, G.P., Navaratna, N. & Jayawickrama, , P.K. (2002). Chemical and Non-chemical disinfestations of tea soils. Conferance Monograph 3, Colombo, Sri Lanka, 5-6 April 2002. The Tea Research Institute of Sri Lanka, Talawakelle.

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PLANT PATHOLOGY DIVISION

A Balasuriya - Head of Division

1. APPLIED RESEARCH PROJECTS

1.1 Project A-1.2 Screening for Resistance - Upcountry

1.1.1 Screening for resistance to *poria*

PP/POR1/98 - Screening of new clones for the resistance/susceptibility to poria root disease (St Coombs Estate).

Objective: To screen new clones which are to be released by the Plant Breeding Division, for the resistance/ susceptibility to *poria* root disease (serialised activity)

The plants were uprooted and the trial discontinued after a final assessment and rating of the disease.

Assuming that the performance of bushes totally reflected the influence of *poria*, the following ratings were assigned to the individual bushes;

0 – Dead due to *poria*
1 – Very weak bushes
2 – Poor growth
3 – Average growth
4 – Very good growth

Overall ratings received by individual clones (average of 3 x 5 bushes per clone);

TRI 2025	-	2.48 (on a scale of 0 – 4)
TRI 3057	-	1.03
TRI 3072	-	2.55
TRI 4072	-	2.64
TRI 4052	-	2.48

Assuming that TRI 2025 is moderately resistant, the clones TRI 4072, TRI 3072 and TRI 4052 are slightly superior in their resistance to *poria* root diseases, in a descending order. This needs further confirmation when the materials are available.

PP/POR1/00 - Screening of new clones for their resistance/susceptibility to *poria* root disease (St Coombs Estate).

In spite of the poor quality of the starting material, the data collected were analysed for a preliminary guidance. The plants were uprooted and the trial discontinued aiming for a new series.

Using the same scale as above, the following overall ratings were received by individual clones (average of 3 x 5 bushes per clone);

TRI 2025	-	1.41 (on a scale of 0 – 4)
TRI 3014	-	1.18
TRI 4042	-	1.44
TRI 4006	-	1.18
TRI 4046	-	0.92

Even though the overall performance of plants were not good, on the same basis of comparison clone TRI 4042 could be superior in its resistance to poria. This also needs confirmation in the future.

PP/POR1/02 - Screening of new clones for the resistance/susceptibility of *poria* root disease (St Coombs Estate).

A new series of screening was started in August, using both pits afresh. In pit No1, the cultivars TRI 3014, 3047, 4059 & 4079 are being tested alongside TRI 2025. In pit No 2, the cultivars TRI 4006, 4042, 4053 & 4067 are being tested also, alongside TRI 2025.

A Balasuriya, R M A Ratnayake, W G N Udayangani, E M C S Edirisinghe

1.1.2 Screening/selection for resistance to blister blight

PP/BB3/99 - Selection of OST bushes for their resistance to blister blight disease (Diyagama East Estate).

Objective: To select tea bushes from existing old seedling teas that show good resistance/tolerance to blister blight leaf disease, with a view to recommending to the Plant Breeding Division for inclusion in their breeding programme.

Cuttings were obtained from 17 bushes selected and screened mainly for the tolerance of blister blight and secondly for other bush characteristics. Cuttings are being evaluated in the Estate's nursery under their supervision.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake, E M C S Edirisinghe

PP/BB3/02 – Screening of clones for the resistance/susceptibility of Blister Blight, VP 80-Phase II trial (St Coombs Estate).

Objective: To screen tea accessions from the existing Plant Breeding trial with a view to rating them on account of resistance/tolerance to blister blight leaf disease.

Completed assessing clones using total blister count of 2nd leaves in one replicate, involving 27 plots. Blisters per second leaf ranged from approximately 1 to 8 indicating a very high variability. In the absence of any standards it is considered that there is a reasonable natural resistance (relative) shown by the lines that are at the extreme left, while those at the extreme right are highly susceptible (Table 1).

Table 1. Relative resistance of lines to blister blight in LVP 80 trial in St Coombs

Plot No.	Blister/2nd leaf	Plot No.	Blister/2nd leaf	Plot No.	Blister/2nd leaf
50	0.69	208	1.94	89	2.96
189	0.92	215	1.96	22	3.49
497	0.93	498	2.06	10	4.23
24	1.03	5	2.25	272	4.72
53	1.29	557	2.35	30	4.77
15	1.50	193	2.49	230	4.99
43	1.60	190	2.60	35	5.45
12	1.62	88	2.88	21	6.79
20	1.65	213	2.88	39	7.79

1.2 Project A-4.2. Screening for Resistance – Low country

1.2.1 Screening/selection for resistance to *Macrophoma* canker/Wood rot

PP/MC1/00 - Selection of OST bushes for their resistance to *Macrophoma* canker disease (Hulandawa Estate, Akuressa).

Objective: To select tea bushes from existing old seedling teas that show good resistance/tolerance to *Macrophoma* canker and frame debilitation, with a view to recommend to the Plant Breeding Division for inclusion in its breeding programme.

Ten bushes were used as mother plants in obtaining about 25 cuttings each. These are now being evaluated in the Estate's nursery.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake

1.3 Project A-23.1. Screening and Evaluation of Biological Control Organisms

Objective: To screen and evaluate naturally occurring microorganisms from Sri Lankan tea soils in their ability to suppress some of the common root diseases of tea, with a view to reducing the usage of fungicides.

1.3.1 Response of root pathogens to dual cultures with saprophytes/antagonists

Poria hypolateritia, *Rigidoporus microporus* (*Rigidoporus lignosus*) and *Phellinus noxious* (*Rigidoporus noxious*) were successfully controlled by *A.niger*, *P.aurantiogriseum* and *T.pseudokoningii* in a pre-pathogen combination. All other combinations too gave reasonable suppression of pathogens thus showing their biological potential (Tables 2, 3 & 4).

Table 2. Growth area of *Poria hypolateritia* in dual cultures in square centimeters

	A.niger	*P.aurantiogriseum*	*T.pseudokoningii*	Control
Pre-pathogen	0.0	4.5	0.0	49.6
Simultaneous	4.6	11.6	3.5	50.5
Post-pathogen	38.3	35.3	13.8	50.4

Table 3. Growth area of *Rigidoporus microporus* in dual cultures in square centimeters

	A.niger	*P.aurantiogriseum*	*T.pseudokoningii*	Control
Pre-pathogen	5.5	4.4	8.9	39.4
Simultaneous	32.5	45.0	40.0	63.6
Post-pathogen	59.9	60.2	62.1	63.6

Table 4. Growth area of *Phellinus noxious* in dual cultures in square centimeters

	A.niger	*P.aurantiogriseum*	*T.pseudokoningii*	Control
Pre-pathogen	0.6	3.6	0.0	18.1
Simultaneous	3.9	7.2	2.2	18.6
Post-pahogen	10.0	14.4	13.2	18.6

1.3.2 Response of root pathogens to broth culture filtrates of saprophytes/antagonists

The response of *P. hopolateritia*, *P. noxious* and *R. microporus* were assayed against the metabolites of *A. niger*, *T. pseudokoningii* and *P. aurantiogriseum* grown in broth cultures. The saprophytic fungi were grown in czapek dox broth (CDB) at 25° C in reciprocating water bath (90 rpm). Filtrates of seven-day-old cultures were filter sterilized and incorporated into PDA medium at 5%, 10%, 15%, 20%, 30%, 40% concentrations. Variable reductions in the growth of pathogens were observed up to the concentration of 15%. The effects shown with further increases in the concentration were not significant.

Table 5: Growth response of three pathogens on culture media incorporated with different concentrations of culture filtrates using the three saprophytic fungi

Pathogen	*A. niger*				*P. aurantiogriseum*				*T. pseudokoningii*			
	Growth of pathogen (cm^2)				Growth of pathogen (cm^2)				Growth of pathogen (cm^2)			
	5%	10%	15%	Control	5%	10%	15%	Control	5%	10%	15%	Control
Poria	34.4	11.2	16.4	63.6	2.0	2.7	1.7	5.7	18.1	14.7	9.3	29.5
Phellinus	9.5	6.7	6.1	4.7	1.5	1.0	1.5	2.5	7.5	8.3	4.4	6.7
Rigidoporus	63.6	63.6	39.8	25.3	6.1	5.5	6.1	14.5	63.6	63.6	63.6	63.6

Compared with the control treatment, the growth of *P. hopolateritia* and *P. noxious* were significantly reduced by increasing concentrations of culture filtrates from *A. niger*, *P. aurantiogriseum*, and *T. pseudokoningii* in the medium. But the growth of *R. microporus* was suppressed only by the *P. aurantiogriseum* extract incorporated medium (Table 5).

1.3.4 Sensitivity of the three root pathogens and three saprophytes to some common fungicides, *in vitro*

The fungicide Bitertanol was effective only on *P.hypolateritia*. Tridemorph, Propiconazole and Tebuconazole are all effective in the control of all 6 fungal organisms. However for the control of *T.pseudokoningii* higher concentrations of Tridemorph and Propiconazole were required. Hexaconazole was not effective against *P.noxious* and *T.pseudokoningii* (Table 6).

Table 6. Effective concentrations of fungicides to suppress growth of fungal organisms, *in vitro*

Fungus	Bitertanol	Tridemorph	Propiconazole	Tebuconazole	Hexaconazole
P.hypolateritia	0.15%	0.05%	0.05%	0.05%	0.05%
R.microporus	-	0.05%	0.05%	0.05%	0.05%
P.noxious	-	0.05%	0.05%	0.05%	-
A.niger	-	0.05%	0.05%	0.05%	0.05%
P.aurantiogriseum	-	0.05%	0.05%	0.05%	0.05%
T.pseudokoningii	-	0.10%	0.15%	0.05%	-

1.3.5 Pot experiments

PP/BC1/02 A pot experiment to test the efficacy of saprophytic organisms in the control of Poria (Glass House, St Coombs Estate)

Used the clone TRI 2025 and the saprophytic fungi; *A. niger*, *T. pseudokoningii*, *P. aurantiogriseum* singly and in all combinations plus a control. The second application of treatments (approximately 10^5 spores ml^{-1}), using same organisms was completed.

1.3.6 Bulking and shelf life of biological control fungal organisms

PP/BC2/02 Bulking and Storage of potential antagonists (Laboratory tests).

The spores of *A. niger*, *T. pseudokoningii* and *P. aurantiogriseum* were introduced to sterilized soil and talc and maintained under room temperature. The viability of spores was assessed at 3 monthly intervals. All three organisms supported very high percentages of viability. Data obtained in sterilized soil are given in table 7.

Table 7. Viability of fungal spores in sterilized soil after 3 and 6 months of storage

Microorganism	Spore count	
	August	November
A.niger	$2*10^6$	$1*10^6$
P.aurantiogriseum	$5*10^6$	$4*10^6$
T.pseudokoningi	$2*10^3$	$1*10^3$

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1.4 PROJECT A-23.2. Screening and Multiplication of VAM

Objective: To decide the best possible plant/potting mixture (medium) combination for the multiplication of VAM under local conditions with a view to introducing in the planting hole of tea for multiple benefits.

1.4.1 Field assay of micorrhizal infections

Table 8. Mycorrhizal colonization and their absence of common non-tea plants in St Coombs Estate and their ranking

Plant species	Root Infection %	**Rank** (Class)	VAM spore counts ($100g^{-1}$ soil)
Mikania scandens (wathupalu-weed)	73.7	IV	86
Drymaria cordata (weed)	70.0	IV	48
Comellina bengalensis (Girapala- weed)	65.0	IV	74
Arachis pintoi (Mal ratakaju- cover crop)	60.7	IV	74
Cymbopogan confertiflorus (Mana-grass)	60.4	IV	20
Grevillia robusta (Shade tree)	50.0	III	392
Centella asiatica (Gotukola-weed)	45.0	III	160
Bidens chinensis (weed)	44.0	III	68
Crossocephalus crepidiodes (weed)	41.0	III	46
Erithrina lithosperma (Dadap-Shade tree)	34.9	III	40
Desmodium species (Undupiyaliya)	33.3	III	58
Gliricidia sepium (Shade trees)	23.3	II	38
Elusine indica (Balathana-weed)	15.6	II	42
Achyranthes aspera (Karalhaba-weed)	13.1	II	30
Browallia americana (Weed)	5.5	II	174
Alternanthera dentata (Weed)	2.0	I	186
Wedelia trilobata (Arunadevi-cover crop)	0.0	-	0
Lantana camera (Balolia-weed)	0.0	-	0
Hedyotis species (Gatakola-weed)	0.0	-	0
Emilia sonchifolia (Kadupahara-weed)	0.0	-	0
Erigeron sumatrensis (Sudana-weed)	0.0	-	0
Panicum repens (Atora-weed)	0.0	-	0
Sesbania sesban (Green manure)	0.0	-	0
Oxalis species (Ambul ambiliya-weed)	0.0	-	0
Cassia mimosides (weed)	0.0	-	0
Artemissia vulgaris (Walkapuru-weed)	0.0	-	0
Basella alba (Wal nivithi-weed)	0.0	-	0
Imporata cylindrica (Illuk-weed)	0.0	-	0
Phylanthus niruri (Weed)	0.0	-	0
Guatemala (Soil rehabilitating grass)	0.0	-	0

Thirty, non-tea plant species (including common weeds) found in St Coombs Estate were assayed for their natural VAM infections. Out of them ten were identified as potential VAM host species, based on their

infections and associated (rhizosphere) spore counts. Four species recorded infection levels at 13%, 16%, **65% & 70%**, the last two being very high. Fourteen species of them did not show any mycorrhizal colonization. *Alternanthera dentate,* a weed species recorded this at very low intensity thereby qualifying at Class I level. *Gliricidia sepium* a shade tree species and four common weeds have recorded this at Class II level. *Grevillia robusta* and *Erithrina lithosperma*, both shade tree species and four weed species have recorded these beneficial infections at Class III level. Five plant species, which included weeds, grass and a cover crop have recorded them at fairly high levels to be included at Class IV level and there were non falling in the highest Class level which is at V (Table 8).

1.4.2 Potential for natural multiplication of VAM

Table 9. Mycorrhizal colonization of plant species maintained in the glass house tanks

Plant species	Root Infection %	VAM spore counts ($100g^{-1}$ soil)		
		Initial	After 6 Months	% Increase
Centella asiatica	45.0	175	284	62
Browallia americana	5.5	55	174	216
Alternanthera dentata	2.0	104	186	79
Oxalis corniculata	0.0	48	0	0
Cassia mimosides	0.0	80	0	0
Artemissia vulgaris	0.0	102	0	0

Out of six plant/weed species that were assayed, three were found to be VAM host plants while the other three were not. VAM host plants have helped in the increase of spore counts in the rhizosphere after six months, which was not found with VAM non-host plants. *Browallia americana* with 5.5% root infections (at Class II level) has contributed to the highest percent increase in the rhizosphere soils of that plant. *Centella.asiatica,* which recorded the highest root infection levels (at 45%) contributed to a moderate spore level increase of 62% (Table 9). This corroborates previous experience that very high infection levels and very high spore levels in a given plant species/growing conditions are inversely related.

1.4.3 Biomass contribution

Of the six plants species tested, only 4 survived until the end without any draw back. These four plant species proved that in a pure stand, they could contribute considerable amounts of biomass (organic material) without any addition of fertilizer (Table 10).

Table 10. Total Biomass contribution in each plant species.

Plant species	Total bio-mass (Dry weight)	
	Actual per Tank (kg/6 months)	Estimated (kg ha^{-1} yr^{-1})
Centella asiatica	0.4545	12,625
Browallia americana	0.5648	15,688
Alternanthera dentata	0.5476	15,211
Artemissia vulgaris	0.0671	9,863

1.4.4 Variations in major nutrients in rhizosphere soil

The variances of major mineral nutrients were tested under each plant species that have survived the full test period (Figures 1-3). The results were analyzed using General Linear Model (GLM) on a Completely Randomized Block Design (CRBD).

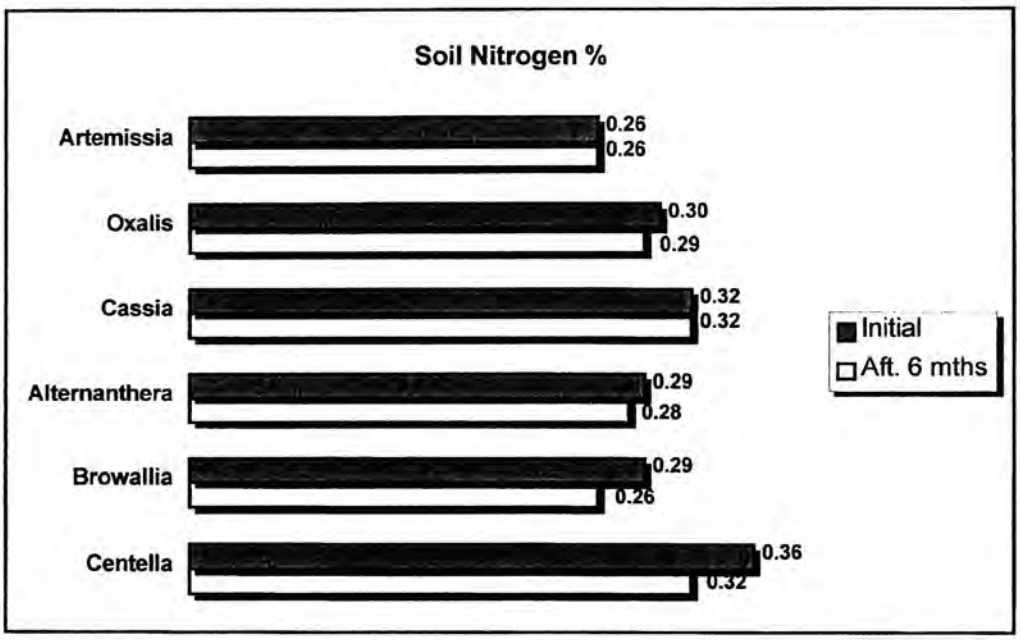

Figure 1. Nitrogen level of soils associated with plant species, initially and after 6 months

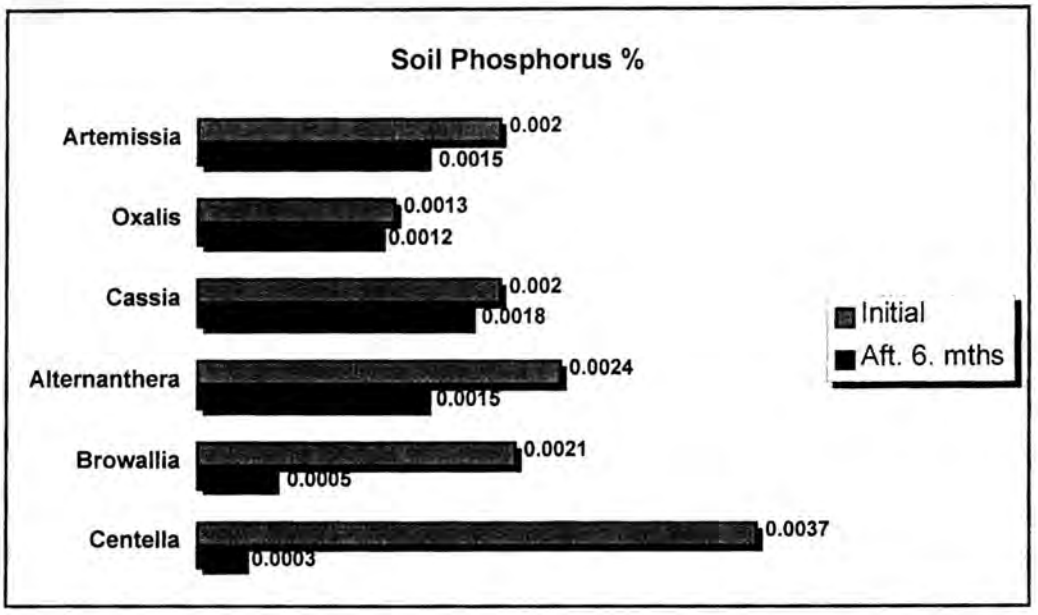

Figure 2. Phosphorus level of soils associated with plant species, initially and after 6 months

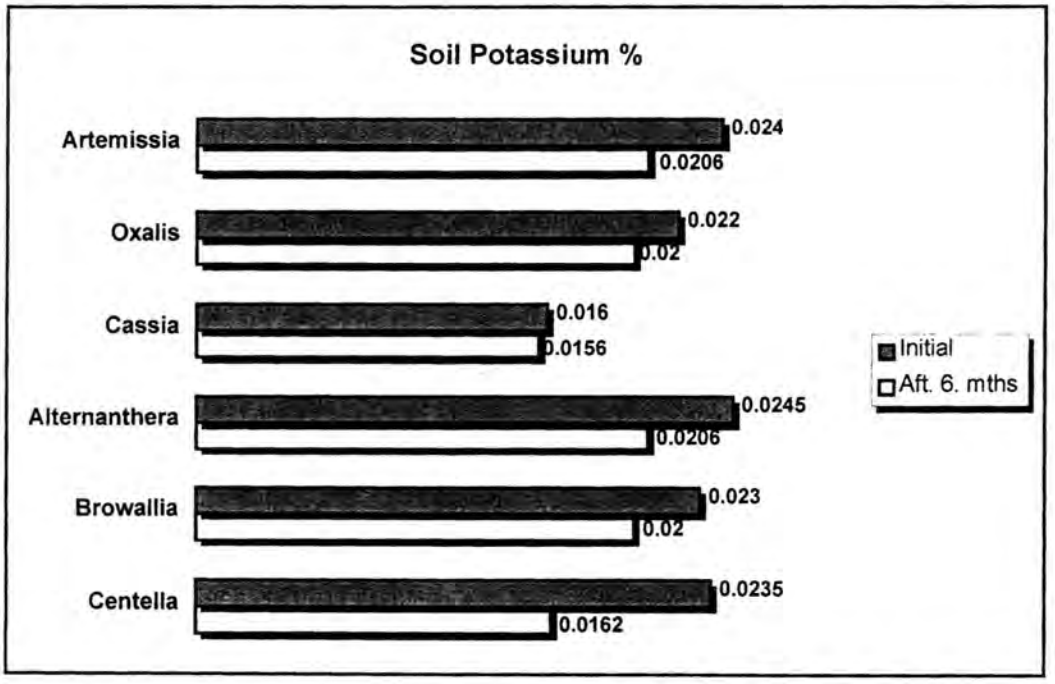

Figure 3. Potassium level of soils associated with plant species, initially and after 6 months.

Soil analysis indicated larger negative variations in potassium levels with VAM host plants than the non-VAM-host plants. However these differences were not significant (Figure 1).

Similar to potassium and phosphorus, the growing of VAM host plants has contributed to higher negative variances in the soil nitrogen levels after 6 months of such growing. Though these differences were not significant, the highest negative variance was observed with *Centella asiatica* while the lowest was recorded with *Alternanthera dentata* and *Oxalis corniculata*. The two non-VAM-host species, *Cassia mimosides* and *Artemissia vulgaris* did not associate with any variation in soil nitrogen levels (Figure 2).

Very large negative variations were found in soil phosphorus levels with VAM host plants than with non-VAM-host plants. These differences were found to be significant at P=0.05. Therefore it can be assumed that there is an increased uptake of phosphorus by the VAM-host weed plant species from its naturally available resources, because there was no addition of any fertilizer during this experiment (Figure 3).

Findings of this study was presented as a final year project report at the University of Ruhuna, entitled '*Mycorrhizal non-tea plants and their potential towards improved soil productivity in tea*', by Ms W G N Udayangani.

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2. SUPPORTIVE PROJECTS

2.1 PROJECT D-21 (D/LEAFDC) – Leaf Disease Control

2.1.1 Prevalence of bacteria on tea leaf surface

A fresh series of studies (Table 11) were initiated by an undergraduate student from Peradeniya University, aimed at biological control of blister blight disease drawing special attention to bacterial and yeast isolates from tea leaf surface. The first, second and mature leaves were used for isolations using 25 cork borer disks each of 1 cm diameter. Altogether there are 9 different isolates including two yeast isolates. All the bacteria synergised the initial growth of *E. vexans*, thus confirming previous findings by Balasuriya and Kalaichelvan in 1999.

Table 11. Locations and tea clones assayed for microbial populations

Location /Estate	Tea clone
St. Coombs, Talawakelle	TRI 2023, TRI 2024, TRI 2025, TRI 2043, DT 1
Nuwara Eliya Estate, Nuwara Eliya	TRI 2025, HS 10A, PK 2
Hanatana Estate, Kandy	DT 1

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2.1.2 Prevalence of yeasts on tea leaf surface

Orange and Pink yeasts (pigmented) were separated from tea leaf surface. There were two in the pink group *i.e. Rhodosporidium* sp. and *Geotrichum candidum,* which possess capacity to ferment sugars. However, *Bullera crocea* (orange type) does not claim to have this ability.

In a separate study using leaf-impress-technique, the following results were obtained using five clones on two occasions, spaced two months apart. It was revealed that there is a tendency in four of the five clones tested to have more microbial populations on the lower surface than on the upper. However, the clone TRI 2043 exhibited the opposite, which is characteristically more hairy on the lower lamina than any other clone. It was also clearly showed that the time/season could have a direct influence on the total microbial population and their compositions (Tables 12 & 13).

Table 12: Microbial colony counts on different clonal tea leaves (17/09/2002)

Microbe	Clone									
	DN		DT 1		K 145		TRI 2025		TRI 2043	
	Up	Low	Up	Low	Up	Low	Up	Low	Up	Low
White yeast	9.0	11.0	5.0	28.0	6.0	7.5	5.0	5.5	11.0	3.5
Pink yeast	30.0	0.5	10.0	2.0	0.0	0.0	0.0	1.0	0.0	0.0
Yellow yeast	0.0	4.0	20.0	24.0	15.5	16.5	14.0	6.0	10.0	0.0
Penicillium sp	67.0	140.5	59.0	42.0	13.0	114.0	42.5	131.5	4.0	0.0
Pestalotia sp	0.0	0.0	1.0	0.5	0.0	0.0	0.5	0.5	0.0	0.0
Other fungi	2.0	4.5	1.5	3.0	0.5	1.5	0.5	1.0	0.0	0.0
Total	108.0	159.5	96.5	97.5	35.0	139.5	62.5	145.5	25.0	3.5

Table 13: Microbial counts on different clonal tea leaves (24/11/2002)

Microbe	Clone									
	DN		DT 1		K 145		TRI 2025		TRI 2043	
	Up	Low	Up	Low	Up	Low	Up	Low	Up	Low
White yeast	6.0	3.0	4.5	3.0	3.5	1.5	7.5	17.0	5.0	3.5
Pink yeast	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow yeast	25.0	110.0	24.0	69.0	11.5	51.5	3.0	19.0	130.0	125.0
Penicillium sp.	33.0	15.0	20.5	20.0	2.5	5.5	2.5	1.5	0.0	4.5
Pestalotia sp	0.5	0.0	0.0	1.0	0.0	0.0	0.5	0.0	0.5	0.0
Other fungi	2.0	3.0	1.5	3.5	3.5	4.5	2.5	3.0	1.5	1.5
Total	66.5	131	70.5	96.5	21.0	63.0	16.0	40.5	137	134.5

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2.1.3 *In vitro* performance of *E. vexans*

A series of in vitro studies were initiated to see the effect of anti oxidants, which are used in the suppression of polyphenolic activity in tea leaf extracts, on the germination and germ tube elongation of *E.vexans*. Citric acid and Sodium meta-bi-sulphite inhibited germination of *E.vexans* spores.

Most suitable medium for *E. vexans* spore germination

Culture media used: Potato Dextrose Agar (PDA)
Czapek Dox Agar (CDA)
Tap Water Agar (TWA)
Malt Extract Agar (MEA)
Tea Leaf Agar (TLA)

Extension of germ tubes was observed up to 48 hrs of incubation. In the PDA medium, germ tubes started to branch after 24 hours of incubation. Five culture media; Potato Dextrose Agar (PDA), Czapek Dox Agar (CDA), Tap Water Agar (TWA), Malt Extract Agar (MEA) and Tea Leaf extract Agar (TLA) were tested for the performance (germination (Table 14) & germ tube elongation (Table 15)) of *E.vexan* spores. PDA medium was found to be the best followed by CDA. The new 'Micro-Image' software package proved very useful in this activity.

Table 14. Germination percentage of spores on different culture media

Culture medium	Incubation period in hours					
	Pre-incubation	2	4	6	24	48
PDA	78%	85%	100%	100%	100%	100%
CDA	97%	100%	100%	100%	100%	100%
TWA	99%	100%	100%	100%	100%	100%
MEA	0	0	0	0	0	0
TLA	0	0	0	0	0	0

Table 15: Length of the germ tube on different culture media measured in microns

Culture medium	Incubation period in hours					
	Pre-incubation	2	4	6	24	48
PDA	5.59	7.02	10.03	12.07	18.63	23.78
CDA	10.20	11.38	13.92	15.59	16.70	dead
TWA	5.95	7.64	9.34	11.32	15.23	dead
MEA	0.00	0.00	0.00	0.00	0.00	0.00
TLA	0.00	0.00	0.00	0.00	0.00	0.00

Screening of fungicides for *E. vexans*

Medium: Tap Water Agar
Incubation Period: 24hrs
Incubation Temperature: 25°C

In vitro studies were completed using Tridemorph (Calixin), Bitertanol (Baycor), Propiconazole (Tilt), Tebuconazole (Folicur), Hexaconazole (Contaf), Oligosachcharin (OS-Sterling), Plantomycin (antibiotic) on the performance of *E.vexans* spores. Except for Bitertanol and Plantomycin all the others were able to completely inhibit the germination of *E.vexans* spores at appropriate levels (Table 16).
Table 16: Effective concentration of fungicides in the control of *E vexans* (*in vitro*)

Fungicide	Effective concentration
Tridemorph	0.05%
Hexzaconazol	0.05%
Tebuconazole	0.05%
Propiconazole	0.05%
Oligosaccharin	0.15%
Bitertanol	-
Plantomycin	-

2.1.4 Morphological characterization of *E. vexans*

Size of the blisters in different clones from different locations

Table 17. Average diameter of 100 blisters from different clones/locations

Location	Tea clone	Average diameter (cm)
Nuwara Eliya	TRI 2025	1.24
Nuwara Eliya	HS 10A	1.21
Nuwara Eliya	TRI 2027	1.59
Nuwara eliya	TRI 2024	0.70
Talawakelle	TRI 2024	1.51
Talawakelle	TRI 2025	1.43
Talawakelle	TRI 2026 (red)	0.88
Thangakelle Estate	TRI 2025	1.13
Deniyaya	TRI 2025	0.89

Average diameter of 100 blisters was compared in different clones. Depending on the availability of time and material some of these comparisons were extended across locations. The highest and lowest blister diameters were recorded on TRI 2027 at 1.59 cm and on TRI 2024 at 0.70 cm respectively, both from Nuwara Eliya Estate (Table 17).

Size of the blister spores and their performance on agar medium from different clones x locations

Characterized blisters, blister spores, their germinability, *etc.*, collected from different clones, locations and clone x location combinations, to compare morphological characters. (Table 18).

Table 18. Assessment of spore size, germ tube length and germination percentage

Location	Clone	Average spore size (μ)		After 24 hrs of incubation	
		Length	Breadth	Avg. length of the germ tube (μ)	Germination percentage
Nuwara Eliya	TRI 2027	5.41	1.37	10.20	100
Nuwara Eliya	HS 10	3.35	0.89	11.10	100
Nuwara Eliya	K145	5.15	1.97	11.02	100
Talawakelle	TRI 2024	6.78	2.10	8.13	100
Talawakelle	TRI 1076 (red blisters)	6.41	2.22	10.87	100
Tangakelle	TRI 2025	5.41	1.37	14.10	100
Deniyaya	TRI 2025	3.14	1.45	14.10	100

It became apparent that clone x locations have some influence on the morphology of blisters and their spores (Tables 17 & 18).

2.1.5 Blister blight control in the field

PP/BB/01/02 Blister blight control using fungicides (Field No 13, St Coombs Estate).

Treatments:
1. Oligosachcharin (OS-Sterling) at 0.1%
2. Oligosachcharin (OS-Sterling) at 0.15%
3. Baycor at 0.05%
4. Baycor at 0.1%
5. Plantomycin at 0.1%
6. Control.

Design: RCBD
Replicates: three

Ten rounds of spraying and 11 rounds of assessments were completed and the results are summerised in Table 19.

Table 19: Percentage infection using second leaf percentage of second leaf

Treatment	Assessment No.									
	1	2	3	4	5	6	7	8	9	10
1	81.6	83.3	71.6	87.6	92.2	72.4	81.0	79.6	18.0	11.3
2	91.0	85.0	62.3	91.8	95.0	78.3	81.3	67.6	15.0	8.0
3	90.3	83.6	66.6	92.0	91.0	79.0	81.6	78.3	12.3	4.3
4	84.6	90.3	83.0	96.6	88.7	67.6	84.0	66.3	12.6	5.0
5	92.6	82.3	68.3	97.3	83.6	71.0	86.3	71.3	15.3	6.3
6	81.0	80.3	67.6	91.6	91.0	73.0	84.0	73.0	13.0	5.3

PP/BB/02/02 Blister blight control using fungicides (Field No 07, St Coombs Estate).

Treatments:
1. Perenox alone
2. Perenox + Latron (sticker)
3. Perenox + Leili (sticker)
4. Contaf alone
5. Contaf + Latron (sticker)
6. Control.

Design: RCBD
Replicates: three

Five rounds of spraying and 7 rounds of assessments were completed. (Table 20). Significant effects of treatments were seen only during inclement weather periods (also see figure 4). Rainfall and sunshine fluctuated very much during this trial period.

Table 20: Percentage infection using second leaf percentage of second leaf

Treatment	Assessment No						
	1	2	3	4	5	6	7
1	0.95	0.63	0.49	0.39	0.62	0.12	0.49
2	0.86	0.66	0.51	0.46	0.57	0.14	0.20
3	0.98	0.62	0.54	0.39	0.55	0.12	0.12
4	0.97	0.70	0.72	0.63	0.42	0.14	0.16
5	0.98	0.76	0.70	0.61	0.51	0.14	0.13
6	-	0.68	0.92	0.71	0.73	0.18	0.14

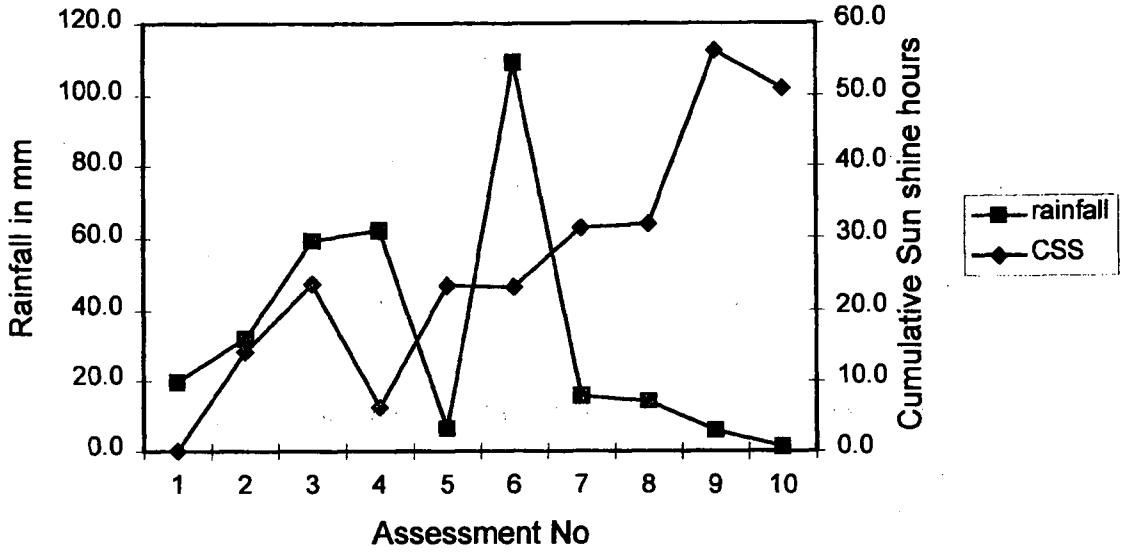

Figure 4. Cumulative (over 7 days) rainfall and sunshine hours during trial period

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2.2 PROJECT D-22 (D/STEMDC) - Stem Disease Control

2.2.1 Wood Rot control trials

PP/WRH4/96 - Observational experiment on training of bush frame (Nuwara Eliya Estate - Oliphant Division).

Objective: To discourage any new shoots arising at or near ground level of the bush, by periodic removal when they are still tender. In this manner it is intended to maintain a clearance from ground to the branching-off point (neck effect) so that, in the event of any future infection by *Hypoxylon*, the total infection could be removed through the process known as rejuvenation pruning.

Visited this trial on six occasions during the year, effecting the necessary treatments. There is no sign of any *Hypoxylon* Stem Blight (HSB) infections yet.

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PP/WRG1/99 - Replicated experiment to assess the effect of different protective paints in reducing the extent of wood-rot (St Coombs - Field 8).

Objective: Since pruning cuts serve as one of the main focal points in wood rotting, different protective paints were used to establish a suitable method to quantify such decay, under different treatments.

There was no new activity in this trial as pruning is awaited before the next round of wood rot assessments.

2.2.2 Dependence of wood rot on mineral nutrition

PP/WRG1/02 – Assessment of wood rot in SPND trial, treated with different levels of fertilizers with special reference to the levels of K (Houpe Estate, Kahawatte).

Objective: It is often argued that K has an important role in the wood matrix, which should among other things resist decay of wood frame caused by the involvement of natural microorganisms. It is aimed at assessing this phenomenon, using an already available trial of the SPND, where different levels of K, is being maintained.

Completed the assessment of wood rot development in stem snags, since last pruning (3rd) in July 2001. There was no significant effect on the extent of wood rot (volume) on stem snags developed, since last pruning. The CV was found to be very high (225%) which demands improvement to the assessment procedure using existing trials.

A Balasuriya, B A P Cooray, J W K K Jayasundara, W G N Udayangani, E M C S Ediringhe

2.3 PROJECT D-23 (D/ROOTDC) - Root Disease Control

Poria hypolateritia (Red root) isolate obtained from Lankaberiya Estate has proved to be a different 'pathotype' to that of the isolate coming from Moray, in Maskeliya. But both responded in a similar manner to the saprophytic fungi listed above.

PP/RDC1/02 – Field testing of systemic fungicides (new/revised) in the control of *poria* root disease, Lankaberiya Estate, Ittakanda.

Eighteen naturally infected patches were selected for six treatments. The treatments (5 fungicides plus control) were introduced in the field (Field No. 8 of Thungala Division) in June. Four rounds of treatments were completed.

Treatments (5):	Bitertanol (Baycor)	0.3%
	Tridemorph (Calixin)	0.2%
	Propiconazole(Tilt)	0.2%
	Hexaconazole (Contaf)	0.2%
	Tebuconazole (Folicur)	0.2%

Design: RCBD
Replicates: 3
Hygienic rating (due to *poria*) of bushes: Healthy – 2; Affected – 1; Dead – 0

Health rating of the bushes in the control treatment has gradually dropped from 2 to 1.41 during the eight months period. The best control was recorded with tebuconazole (Tables 21 to 24)

Table 21. Disease/health rating at the time of first round spraying in June 2002

Rep.	Bitertanol		Hexaconazole		Propiconazole		Tebuconazole		Tridemorph		Control	
	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush
R 1	10	2	10	2	8	2	18	2	8	2	10	2
R 2	09	2	11	2	11	2	11	2	9	2	11	2
R 3	08	2	11	2	12	2	8	2	9	2	12	2
Avg.	09	2	10.7	2	10.3	2	12.3	2	8.7	2	11	2

Table 22. Disease rating at the time of second round spraying in August 2002

Rep.	Bitertanol		Hexaconazole		Propiconazole		Tebuconazole		Tridemorph		Control	
	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush
R 1	10	1.9	10	1.4	8	2	18	2	8	2	10	1.6
R 2	09	1.7	11	1.9	11	1.6	11	1.2	9	1.8	11	1.7
R 3	08	2	11	1.73	12	1.75	8	1.88	9	1.33	12	1.67
Avg.	09	1.87	10.7	1.68	10.3	1.92	12.3	1.63	8.7	1.44	11	1.65

Table 23. Disease rating at the time of third round spraying in October 2002

Rep.	Bitertanol		Hexaconazole		Propiconazole		Tebuconazole		Tridemorph		Control	
	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush
R 1	10	1.9	10	1.4	8	2	18	2	8	1.88	10	1.5
R 2	09	1.7	11	1.9	11	1.64	11	1.27	9	1.89	11	1.64
R 3	08	2	11	1.73	12	1.75	8	1.88	9	1.22	12	1.67
Avg.	09	1.87	10.3	1.68	10.3	1.80	12.3	1.72	8.7	1.66	11	1.60

Table 24. Disease rating at the time of fourth round spraying in December 2002

Rep.	Bitertanol		Hexaconazole		Propiconazole		Tebuconazole		Tridemorph		Control	
	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush	Bush count	Score/ bush
R 1	10	1.8	10	1.3	8	1.88	18	2	8	1.63	10	1.1
R 2	09	1.4	11	2	11	1.55	11	1.36	9	1.78	11	1.45
R 3	08	2	11	2	12	1.67	8	2	9	1.11	12	1.67
Avg.	09	1.73	10.3	1.77	10.3	1.70	12.3	1.79	8.7	1.51	11	1.41

A Balasuriya, B A P Cooray, R M A Ratnayake, W G N Udayangani, E M C S Edirisinghe

2.3 PROJECT D-25 (D/MISCEL) - Miscellaneous Activities

2.3.1 Horse Hair Blight (HHB) problem in the low country

In an exercise to study the intensity of the problem measuring the actual length and weight of rhizomorphous mycelium the following figures were collected (Table 25). Four branches of 45 cm length each were collected from three plots. It revealed that plot number 2, which is associated with relatively more shade, had associated with it the highest weight, length and the highest unit weight of the fungus thus confirming its affinity to shade levels.

Table 25. Intensity of colonization by HHB fungus and its unit weight

Plot	Branch	Total weight (mg)	Total length (cm)	Unit weight (mg/cm)
1	1	79	991.5	0.080
	2	36	452.5	0.080
	3	60	660.0	0.091
	4	92	954.0	0.096
	Average	**66.8**	**539.5**	**0.088**
2	1	115	1164.5	0.099
	2	41	330.5	0.124
	3	355	3274.5	0.108
	4	137	1340.0	0.102
	Average	**162.0**	**1527.4**	**0.108**
3	1	17	233.0	0.073
	2	51	645.5	0.079
	3	55	686.0	0.080
	4	12	162.0	0.074
	Average	**33.8**	**431.6**	**0.077**

PP/MSC/02/02 – Horse hair blight control trial using hydrated lime and fungicides (Silvery Estate (Pvt), Nagoda).

Objective: The reason for HHB in the low country is believed to be non-cleaning of bushes following pruning. Spraying of hydrated lime has been advocated to remedy this situation in the past. This is being retested along with other treatments. A new concept in which flood water carrying spores to start fresh populations is also to be addressed.

A repeat observational trial using 6 treatments, each plot having approximately 30 bushes.

Treatments :

Main Plots	- Spraying of fungicide following floods	
	- No spraying of fungicides following floods	
Sub Plots	- Propiconazole (Tilt)	0.2%
	- Tebuconazole (Folicur)	0.2%

- Champion (Cu) 0.2%
- Hydrated lime 10%
- Manual removal

- Control (no manual cleaning following pruning)

Design: Split Plot
Replicates - 2
Having pruned the required area, two rounds of spraying were completed.

A Balasuriya, J W K K Jayasundara, R M A Ratnayake, W G N Udayangani, E M C S Edirisinghe

PP/MSC/03/02 – Survey on Horse hair blight (HHB) in the Galle District

Objective: To establish the extent and intensity of spread of the problem in the Galle District, where this problem has been regularly reported.

A survey, covering a good proportion of the Galle district was initiated with the involvement of an undergraduate student from the Wayamba University in order to assess the extent, intensity and the factors that have contributed to the current situation. Already 50 fields have been covered.

A Balasuriya, C Edirisinghe, J W K K Jayasundara, R M A Ratnayake

2.4.2 Investigations into TRI 2025 Die Back Syndrome (High Forest problem)

Objective: To identify the cause of the problem with special reference to any potential microbial involvement with a possible interaction with the environmental factors and physiological condition of the tea bush.

Prof N K B Adikaram of University of Peradeniya was of the view that this could be a pathological situation, sometimes with affinities to stress conditions. To retest this, a series of isolations were done using stem and root material from infected plants on culture media incorporated with Plantomycin, Captan and Oligosaccharin (a new product by Heychem). Plantomycin and Oligosccharin were able to suppress bacterial growth in all the samples.

Continued the application of treatments in the field, Plantomycin (100 ppm), Captan (0.1%) and Oligosaccharin (2500 ppm). Plantomycin seemed to have some suppressing effect on the rate of spread of the problem. Therefore continued the application of only Plantomycin (100 ppm).

A new occurrence of this syndrome has been reported from nearby Tangakelle Estate as well. An indepth series of studies were undertaken from October 2002. The main experimental area was selected from the Nuwara Eliya (field no. 1, Upper division). Field no. 18A, 3rd division of High Forest Estate and field no. 6A, upper division of Tangakelle Estate were also selected for parallel observations of a lesser magnitude.

An isolated patch was selected from Nuwara Eliya Estate to measure the spread of the disease. Measurements were taken at regular intervals of 2 weeks. From 23/10/2002 to 01/01/2003 the patch

expanded from 104.25 m^2 to 125.00 m^2 an increase of approximately 20.75 m^2, a 20% increase (fig. 5).

The disease shows a spreading pattern from an original lower elevational point towards higher elevation. The spread also followed the direction of the wind. It was also noted that the spreading is faster during dry windy climates than under rainy conditions.

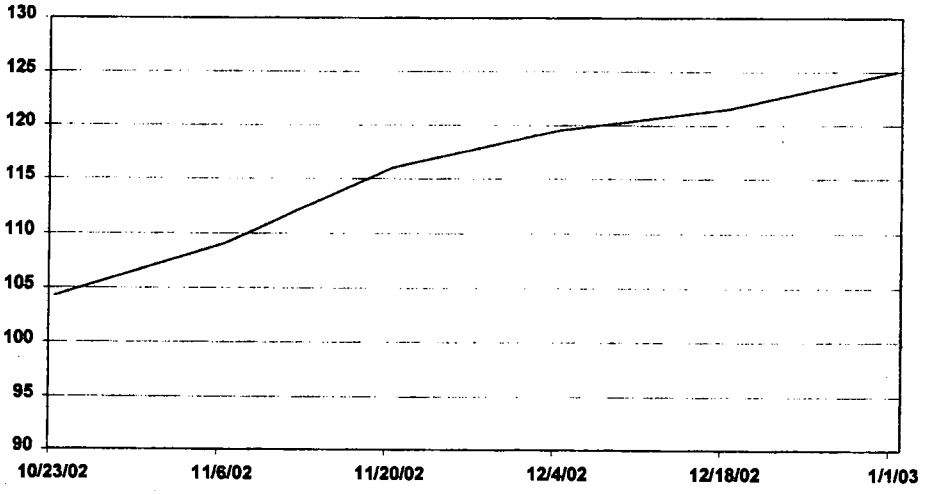

Figure 5. Rate of spread of the disease in square meters

Soil analysis was also done to isolate significantly different Bacteria and Fungi to relate their contribution to the syndrome (Table 26).

Table 26. Microbial population in soils of diseased areas

Location	Bacterial population cfu/g (soil)	Fungal population cfu/g (soil)
Nuwara Eliya Estate	1.6×10^5	9.2×10^4
Tangakelle Estate	2.75×10^5	1×10^5

Further, the isolations of organisms were attempted using stem and root sections and the xylem saps of affected plants. Many distinctively different bacteria were found. All the isolates of bacterial (30) and fungal (24) cultures are being maintained as pure cultures. The bacterial isolates were tested for their motility, gram's reaction and possible spore formers.

A Balasuriya,C P Ranasinghe, A Ratnayake, J W K K Jayasundara

2.4.3 Smut of *Panicum repens* (Couch grass)

Objective: A natural fungal infection of *Panicum repens* was found to occur in and around St Coombs Estate. Since this fungus (*Ustilago digitariae*) causes a smut of its panicle, the situation is considered a

favourable one, in the control of *P. repens* weed, in tea plantations. In this exercise it is intended to test and quantify the significance of this phenomenon as a biological weed control tool.

PP/MSC/01/02 –Biological control of cooch grass (Field No 10, St Coombs)

Trial area was prepared last year. Since there was no uniform germination of rhizomes due to the dry spell that prevailed soon after planting them, plots were cleared of all remaining rhizomes for a repeat start.

Treatments (4): Control
Emerging plants, sprayed with a spore suspension of smut
Grown up plants, sprayed with a spore suspension of smut
Spraying of Glyphosate

Design: RCBD
Replicates: 3

A Balasuriya, R M A Ratnayake

2.4.4 Deniyaya yield decline

A debilitated patch of tea was selected in Hanford Estate (Field No 4) and effected three treatments for observational purposes. The treatments are Nemacur, Captan and the control. The treatments were repeated in the patch of field in Hanford Estate (Field No 4).

A Balasuriya, J W K K Jayasundara, R M A Ratnayake

2.4.5 Made Tea Quality

Mr Jayasundara (EO) started a training programme with the Kelaniya University aimed at enumerating potential microbial contaminants in made tea, representing produce from the entire country. Tests are undertaken to establish the presence/absence of the following;

Total aerobes
Total yeasts
Total moulds
Total coliforms
Escherichia coli
Salmonella sp.

Already 30 samples have been completed.

A Balasuriya, J W K K Jayasundara, D L Jayaratna

2.4.6 Identification of Organisms

Five fungal isolates were sent to the CABI Bioscience Centre in the UK for identification. Confirmed identifications are awaited.

A Balasuriya

3. DIVISIONAL ACTIVITIES (OVERHEADS)

3.1 PROJECT D/PLPA

3.1.1 Estate Visits

The following estate visits were undertaken during the year;
Several visits to Nuwara Eliya, on TRI 2025 die back syndrome and on *Hypoxylon* stem blight
Hanford in Deniyaya in connection with treatments on Deniyaya problem
Hulandawa, in Akuressa on screening of bushes resistant to canker/wood rot
Diyagama East, on screening of bushes resistant to blister blight and to investigate a *poria* infection
Haupe, in Kahawatte on wood rot assessment of the SPND trial.
Medakanda and Pettiagala in Balangoda on suspected *poria* infections, accompanied by Advisory staff at Ratnapura.
Iona Estate (private) in Lindula on *poria* root disease report.
Several visits to Lankaberiya, in Ittakanda on *poria* control trial activities.
Dunsinane and Sheen, in Pundaluoya on *poria* root disease report.
Baddegama Estate and a small holder in Kirinda (Kottawa) on horse-hair-blight problem.
Pedro, in Kandapola on a suspected virus problem but turned out to be a phytotoxic effect.
Several visits to Thangakelle, in Lindula on TRI 2025 die back syndrome.
Sommerset Estate and Organic Tea fields at TRI, accompanied by the Director and senior staff for an exposure on current investigations.
Sooriyagoda, TSHDA property, on a root disease report.
A second visit to Sheen, in Pundaluoya on a field inspection of debilitated tea bushes.
Gouravilla, in Upcot on a field inspection of debilitated tea bushes.

3.1.2 Other visits

Department of Food Science, Faculty of Agriculture, Peradeniya to meet and discuss with Prof U Samarajeewa, the microbiological methods in food products and its applications to made tea.
Department of Biochemistry, Faculty of Medicine, Colombo to meet and discuss with Prof Erick Karunanayake, a possible collaborative work on Molecular Biological studies connected with blister blight disease.
RRI, Agalawatte on invitation to be on an interview panel for the promotion of two internal scientists to the promotional grade in the Plant Pathology Division.
Chemistry Division of the RRI in Ratmalana, to discuss a collaborative project on a protective paint.
Microbilogy Department, University of Kelaniya to discuss the proposed training programme.

3.1.3 Seminars/Workshops/Lectures

Dr Balasuriya attended/participated in the following;
Seminar by Dr I D Singh, 'Towards a golden clone for improved productivity and quality of Sri Lankan tea' sponsored by the Planters' Association in Colombo.
Seminar organized by the section B of SLAAS on 'Rice cultivation with reduced water inputs (SRI)' at SLAAS auditorium in Colombo.
Seminar organized by the environment committee of SLAAS on 'Role of Scientists and Technologists in

sustainable development' in SLAAS auditorium, Colombo.
RSC seminars in Ratnapura (VI), Kegalla (Kelani Valley), Galle (VII) and Kandy (IV) as panel member.
Workshop on 'Future research directions of Sri Lanka' organized by the NASTEC.
Seminar on Oil Palm organized by SLAAS Section-B in Colombo.
Seminar on 'Agricultural Research in the New Millenium' (two day) organized by the NASTEC at the HARTI auditorium, Colombo.
MeBr conference (two day) at Hotel Oberoi, Colombo.
Bamboo Awareness Conference at Hotel Intercontinental, Colombo
Seminar on Ergonomics at the SLAAS auditorium, 120/10, Vidya Mawatha, Colomob 7.
Seminar on 'Forest Die Back at Central Highlands of Sri Lanka', organized by the SLAAS Section B Committee at the PGIA auditorium, Peradeniya.

Workshop on 'Organic Farming & Sustainable Agriculture: Future Directions' at PGRC auditorium in Gannoruwa, organized by the University of Peradeniya, Lanka Organic Agriculture Movement (LOAM) and the National Agricultural Society of Sri Lanka (NASSL).
The second Biennial Conference (BICOST II) of the NASTEC in Riverina Hotel, Beruwala in the capacity of a rapporteur.
Divisional staff attended seminars by Dr Glendon Gee of the Washington State University on 'Need for Water Flux meter' and by Mr V S Sithakaran of TRI on Agricultural Research for Development (ARD).
Delivered lecture on disease management of tea at NIPM in Athurugiriya.
Attended seminar on 'Tea & Health' in the Committee room A of BMICH.
RSC seminar in Kandy, Hotel Tourmaline.
58th Annual Session of the SLAAS in the capacity of Secretary, Section-B spanning over one week.
Delivered a special lecture on blister blight control, at Alagolla Estate, by invitation.
Lecture on tea disease management for the 11th NIPM diploma module at TRI auditorium.

Dr Balasuriya and Ms Cooray participated in the following;
204th E&E (English) forum at Talawakelle.
9th E&E (Sinhala) forum at Talawakelle.
Presented paper on 'The potential role of natural tea phylloplane microorganisms in the control of blister blight leaf disease of tea' at the 205th E&E Forum at the TRI auditorium, Talawakelle.

Ms BA P Cooray attended the following workshops;
On 'Research Methology' organized by SLAAS and sponsored by NASTEC at the ITI auditorium.
On 'Plant Molecular Biology' organized by SLAAS at the CRI, Lunuwila.

Divisional staff attended seminars conducted by the following:
Seminar on 'Climate Change' by Dr Dharamawardana, at TRI.

3.1.4 Discussions/Meetings

Dr Balasuriya was involved in the following;
Two discussions on the revision of circular on clones.
Postmortem discussion on the 204th E&E forum.
A video programme discussion on divisional activities, on a request made by the Ministry.
Two preview discussions of the 205th E&E presentations.

Two discussions leading to a 'Draft Policy' on Tea.
Restructuring of TRI Corporate plan and CESS allocations.
Discussion on the 205th E&E postmortem.
A discussion on 'Energy saving activities' with the staff of National Engineering Research & Development Centre of Sri Lanka (NERD).
10th Sinhala E&E preview
Advisory and research linkage session
Discussed matters pertaining to reforms on TRI with the ADB mission.
206th E&E preview
A discussion dedicated to the 'necessity of soil rehabilitation'.
Advisory circulars on weed management and infilling.

Dr Balasuriya attended the following;
Ten committee meetings of SLAAS Section B, in the capacity of its secretary.
Seven SSF (Senior Scientist Forum) steering committee meetings of the NASTEC, in the capacity of its member.
The inaugural meeting of the Plant Protection Society of Sri Lanka (PPSSL) at the PGIA auditorium in Peradeniya.
Two 100 days' progress review meetings.
Three ACMSC (Agricultural Chemicals & Machinery Screening Committee) meetings
The AGM of the Lanka Organic Agriculture Movement (LOAM) in Kandy.
One CCR meeting at Talawakelle to explain about 'TRI 2025 die-back syndrome' (High Forest problem) and 'Deniyaya' problems.
A meeting with the Director, DDR(T), DDA, AO and the Internal Auditor on HOD positions.
A special meeting of Senior Scientific Staff with the Director.
Technical evaluation committee meeting at the TRI
Special meeting with the Director to prepare calendars of schedules for Administrative and Performance Reviews.
Special meeting to discuss CARP funded projects and TRI's participation.
One council meeting of the SLAAS to prepare for the upcoming (58th) annual sessions.
A preparatory meeting prior to Colombo CEO's meeting on TRI Corporate Plan.
On Tea Processing policy document, at Tea Board auditorium in Colombo.
TRI/TSHDA interactive committee meeting at TRI, Talawakelle.
TRB meeting held at Talawakelle.

Dr Balasuriya convened;
Seven HOD meetings with the Director.
One Thrusts & Project Leaders' (2nd) meeting with the Director.
Three meetings to discuss transport related matters for a report to the Director.
Two meetings to discuss and propose a suitable scheme for the posts of HODs.
Meeting with the CEO's of Pussellawa & Maturata Plantations on Corporate Plan reviewing.
Meeting with the CEO's of Agrapatana & Kotagala Plantations on Corporate Plan reviewing.
Meeting with the CEO's of Kegalla Plantations on Corporate Plan reviewing.
Prepared summery action plan of TRI for year 2003 on request from the MPI.

Dr Balasuriya headed three divisional meetings involving all the divisional staff.

Divisional staff attended one Grades I-V meeting with the Director.

3.1.4 Staff training

Mr R M A Ratnayake (EO) continued and completed his training programme (part time) on laboratory technology at the Open University in Nawala.

Mr J W K K Jayasundara attended a two day training programme on the 'Use of Power Point Medium' sponsored by the TRI at the In Service Training Centre at Gannoruwa..

Mr J W K K Jayasundara (EO) started an on-the-job training programme, affiliated to the Microbiology Department of the Kelaniya University, with the aim of establishing bench marks on microbial contaminations of made teas, produced in Sri Lanka.

3.1.5 Visitors/Trainees

A group of Assistant Managers from Talawakelle Plantations Ltd., spent one morning on a familiarization visit.
A group of farm school students from Kundasale on a familiarization tour.
Two Trainee Assistant Superintendents from Agalawatte Plantations Co. Ltd., and fiveTrainee Assistant Superintendents from Brunswick group, Maskeliya were exposed to the divisional activities during one-half-day session each.
New Director Dr S S B D G Jayawardane visited the division accompanied by DDR(T).
Dr Devika de Costa of the Department of Agricultural Biology, Faculty of Agriculture to discuss a research proposal for an undergraduate project work.
Dr D L Jayarathne of the Department of Microbiology, University of Kelaniya to finalise arrangements for a post graduate research project investigating into the 'TRI 2025 die back syndrome'.
Twenty NDT (Agriculture) students from Dambulla technical college visited on 03/08/2002.
Thirteen Japanese students on 28/08/2002.
Twenty five Agriculture Students of the University of Jaffna visited on 16/09/2002.
Eight undergraduate students accompanied by two lecturers from Wayamba University.
17 undergraduate (3rd) students from the Eastern University visited on 12/12/2002.

A team of visitors from Rallis India Ltd., led by Dr M S Mithyantha made a goodwill visit to the Division.
Members of the Kenyan Tea Board visited the TRI and met them at the auditorium for a discussion. Dr N Muraleedharan (Director, UPASI), Mr J B Hudson (Asst. Director, Extension), Dr B Radhakrishna (Senior Advisory Officer) and Dr R V Elango (Botanist) of UPASI, South India, visited on 16/09/2002.
Met two visiting journalists, Messrs Steve Hughes and Michael Bender from Canada at the board room on 23/12/2002.

3.1.7 New Capital Items

Purchased one heavy duty warring blender.

3.1.8 Publications

Cooray B A P, Balasuriya A, Edirisinghe E M C S, 2002. Systemic fungicides in the control of tea root diseases. TRI UPDATE, 7(1). Tea Research Institute of Sri Lanka, Talawakellle. (short communication)

Jayasundara J W K K, Balasuriya A, Raveendran K, Mohamed M T Z, 2002. Microbial populations in black tea during storage. TRI UPDATE, 7(1). Tea Research Institute of Sri Lanka, Talawakellle. (short communication)

Cooray B A P, Balasuriya A, 2002. Antagonism of three naturally occurring fungi against major tea root diseases of Sri Lanka and their sensitivity to recommended systemic fungicides. An abstract paper presented at the 58th Annual sessions of the SLAAS (4-7 December).

4. General (Administration)

The staff position as at 31st December, 2002;

Dr A Balasuriya	- Acting Head
Ms N H L Pradeepa	- Research Assistant (on overseas study leave)
Ms B A P Cooray	- Research Assistant
Mr J W K K Jayasundara	- Experimental Officer (Graduate)
Mr R M A Ratnayake	- Experimental Officer
Ms W G N Udayangani	- Technical Assistant
Mr E M C S Edirisinghe	- Technical Assistant

Two in-plant trainees, Mss J G H L Gamage and S N N Sooriyappepruma, from the Advanced Technical Institute (ATI) of Naiwala, were assigned to the division through the National Apprentice and Industrial Training Authority (NITA), for four months from 11th March 2001. Ms T S Karunadasa of ATI Naiwala and Mr G G B Senanayake of the Aquinas College of Higher Studies underwent training July to December.

Mr C P Ranasinghe, post graduate student (MSc) from Kelaniya University (Department of Microbiology), Ms Sujeewa Ratnayake, undergraduate student from Peradeniya University (Faculty of Agriculture) and Mr Chaminda Edirisinghe, undergraduate student from Wayamba University (Faculty of Agriculture & Plantation Management) commenced their research programmes in October, under the supervision of Dr Balasuriya.

PLANT PHYSIOLOGY DIVISION

A Anandacumaraswamy – Actg Head of Division

1.Basic Research Projects

1.1 B 11-Studies on Photosynthesis and Dry Matter Partitioning

Partitioning of assimilates in relation to aging of clonal tea in a pruning cycle, St Coombs Estate – (1992)

The annual yield of clones TRI 2025 and DT1 with age is presented in Table 1.

TABLE 1 Effect of age on yield (kg MT ha^{-1})

Clone	TRI 2025	DT1
Year after Prune		
1	945	914
2	2011	2138
3	2014	2507
4	2112	2044
LSD(P=0.05)		
SE	128.7	144.2
CV(%)	10.7	12.7

The yield in the first year was significantly lower than the rest of the years in the cycle. There was no significant difference in yield among the second, third and fourth years of the cycle.

V Sithakaran

1.2. Effect of Source Capacity on shoot growth

A short term study was undertaken to investigate the effect of source capacity of the growth of shoots of TRI 2024 and DT1 under up-country conditions during March-July. These clones were second year of their current cycle. The treatments and the final shoot sizes are presented in Table 2.

TABLE 2. - Shoot length (cm)

	TRI 2024	DT1
T1-With full mother leaf	6.7	11.6
T2 -Fish leaf only	4.8	9.4
T3- 3/4 Mother leaf	6.3	10.3
T4 -1/2 Mother leaf	6.0	10.9
T5 -1/4 Mother leaf	5.2	10.2
T6-No Mother leaf	2.5	7.2

* Each value is a mean of 20 shoots

This study clearly demonstrates the importance of full mother leaf for healthy and vigourus shoot growth. The thermal time requirement was 380-390 day degrees.

Nilantha Chandrasena, NDT Hardy Advanced Technical Institute

2. Experiments on shade effects and shade trees

2.1 Effect of shade on yield of mature clonal tea TRI 2025 -St Coombs Estate (2002)
An experiment was initiated to study the effect of the levels of shade on mature tea yield at St Coombs Estate. The levels of sunlight tested are (1) full sunlight (2) 70% of the full sun light and (3) 30% of the full sunlight. Nylon netting is used to vary the sunlight level. The treatments were replicated three times.

The yield of tea under different shade treatments are presented in Table 3.

TABLE 3 Yield (kg Made Tea ha-1)

No Shade (Control)	2182
Medium Shade (70% of Full Sunight)	1924
High Shade (30% of Full Sunlight)	1784
LSD	NS
CV(%)	15.8

J. Mohotti and V. Sithakaran

2.2 Photoinhibition of photosynthesis in tea

Physiological parameters are monitored in order to assess the photonhibition in shaded and unshaded treatments.

The experiment is in progress.

Asha Krunaratne, A. J. Mohotti and S. P. Nissanka

2.3 Alternate shade tree species
2.3.1 Possible new shade tree species

A data base on the possible 56 shade tree species including indigenous and a exotic varieties that can be used as alternate shade was compiled based on canopy, leaf and root characteristics.

Identification of the best species from this list and the feasibility of using these species in tea plantations based on physiological measurement are being studied.

H. P. Baddage and A. J. Mohotti

2.3.2 Growth and yield of tea (TRI 2025) under medium and high shade at high elevation.

2.3.2.1 Plots containing approximately 16 plants around the shade trees were marked out. Plots with *Erythrina lithosperma* and *Grevillea robusta* as the shade trees and unshaded plots also were marked as the control. Shoot growth and yield of these plots are monitored.

The yield from January -December 2002 is presented in Table 4.

TABLE 4 - Yield (kg made tea ha^{-1})

Grevillea	3012
Control	2885
Dadaps	3269
Control	2913

V. S. Sithakaran and A. J. Mohotti

3. Project New 1(A33) - Identifying factors responsible for yield decline in mature tea
A new project was formulated to identify the factors responsible for defoliation, apical die back and yield decline in mature tea. Under this new project, investigations were carried out on (1) High Forest problem and (2) Deniyaya problem. The High forest and Deniyaya task forces were reactivated.

3 1Experiments on 'High Forest Problem'.
Two possible causes for the problem were identified as (1) stress and (2) diseases.

3.1.1 Examination of the plant samples for possible pathogens
The Plant Clinic of the CABI Bio Sciences, UK, offered to examine and test samples from High Forest Estate for possible pathogens free of charge. Different parts of the affected plants and soil were sent to CABI Bio Sciences, UK for this purpose.

According to an interim report sent by Dr J Waller, Consultant Plant Pathologist, CABI Bio Sciences, a basidiomycete fungus *Phellinus noxious*, pathogen causing brown root rot was reported to have been isolated from the affected parts. However, according to the final report sent on 15 November, no fruiting bodies of *Phellinus noxious* were induced.

A. J. Mohotti and D. M. S. Navaratne

3.1.2 Glass house experiments with different extracts of xylem sap of affected bushes

Experiment 1:

The xylem sap and different parts of the bush (stem bark, stem without bark, whole stem and roots) were extracted using different solvents, namely hexane, di-chloro methane and methanol, from affected and unaffected bushes from High Forest and Nuwara Eliya Estates. These extracts were separately mixed with autoclaved soil from St Coombs estate. One-year-old plants of the susceptible clone TRI 2025 and DN as non-susceptible clone were planted in these soils. In addition, fresh xylem sap, xylem+phloem sap was also mixed with soil as treatments (Annual Report, 2000).

No symptoms were developed in any of the plants for a period of 34 months, hence the experiment was terminated.

M. D. L. P. Gunatilake, D. M. S. Navaratne, J. Mohotti and B. P. Chandradasa

Experiment 2:

Xylem sap was poured on the young tea plants of the above two clones of same age after scraping the leaves, the stems and roots, without wounding the plants, and by direct injection of the sap to the stems. A control was left without adding the xylem sap.

No symptoms were developed in any of the plants for a period of 26 months, hence the experiment was terminated.

D. M. S. Navaratne and A. J. Mohotti

Experiment 3- Modification of microclimate in the field.

Part of the affected area in the TRI 2025 block in field no 18A of third division at High Forest estate was shaded with coir matting and ground was thatched to minimise the 'insolation'. Further, temporary shading was given to the affected plants with coir mating. To alleviate water stress plants in the affected area were watered at two weekly intervals during the dry weather. About 75% of the affected bushes had recovered. Harvesting was commenced on the recovered bushes in December 2001 and continued till July 2002. Shade trees, both Grevillea and Dadaps were established. Vetiver was planted in between tea rows to break down the allelochemicals produced by tea roots during the stress. While planting the grass, it was observed that forking was not done properly in this area earlier and there were boulders 15-30cm below the soil surface.

Symptoms similar to High forest problem was also observed at Tangakelle Estate, Agarapatana. Similar alleviation measures were given to the part of the affected area.

A.Anandacoomaraswamy

4. Tea Root physiology

Experiment 1:

Approximately one year old tea plants (clone DT1) were established in rhizotrons in order to study the physiology of the tea root system. The treatments included different organic manures and bulk densities.
The experiment is in progress.

Mahesha Vajirakanthi, A. J. Mohotti, K. M. Mohotti and D. C. Bandara

Experiment 2:

Periodic samples were taken from the 'TRI-ORCON' organic vs inorganic field experiment, in order to study the root physiology of field grown tea. The root measurements were related with the shoot measurements and some soil properties.

The experiment is in progress.

Mahesha Vajirakanthi, J. Mohotti, K. Mohotti and D. C. Bandara

Experiment 3:

Periodic samples were taken from the 'TRI-ORCON' organic vs inorganic field experiment, in order to study possible anatomical changes in roots of field grown tea with organic and inorganic treatments.

The experiment is in progress.

Nalika Damayanthi, J. Mohotti, K. Mohotti and U. R. Sangakkara

5. Studies on organic tea

Second year after the first pruning of the 'TRI-ORCON' organic vs inorganic field experiment was completed. The yield showed no significant difference between the treatments (Table 5).

TABLE 5 – Yield (kg ha^{-1})

T1 – Tea Waste	2051
T2 – Neem Oil Cake	1970
T3 – Compost	2026
T4 – Conventional (Inorganic fertilizer)	2230
LSD (P=0.05)	NS
CV (%)	15.1

The experiment is in progress.

K. Mohotti and J. Mohotti

6. Studies on drought mitigation

An experiment was initiated to assess the drought stress effects on nursery plants after spraying of K, at the controlled environment facility, Crop Science Department, Faculty of Agriculture, University of Peradeniya. One clone each of a drought susceptible (TRI 2026) and drought tolerant (TRI 4046) were selected. KCl and K_2SO_4 were sprayed and the physiological changes monitored.

The experiment is in progress.

S. Wickremaratne, A. J. Mohotti, S. Munasinghe, LSK Hettiarachchi and S. P. Nissanka

7. Effect of change in level of carbondioxide on physiological process and growth of tea

The objective of the study was to determine the effects of elevated CO_2 and different nitrogen levels on growth and some selected physiological processes in clonal tea. The experiment was carried out with nursery plants on the fast-growing tea clone TRI 3072 and the slow-growing tea clone TRI 3019 using sand culture technique within closed polythene houses. Three levels of nitrogen (0, 105, 157.5 ppm) and two levels of CO_2 (ambient CO_2 and elevated CO_2) were used in this experiment.

In TRI 3019, elevated CO_2 significantly increased total dry weight and root dry weight. However, the growth of TRI 3072 did not respond significantly to elevated CO_2. Growth of neither clones responded significantly to different nitrogen levels. Photosynthesis increased under elevated CO_2 in both clones. The response was higher in TRI 3019. In both clones photosynthesis increased from 0 ppm nitrogen to 105 ppm nitrogen. But from 105 ppm nitrogen to 157.5 ppm nitrogen, there was a decrease. Stomatal conductance increased significantly under elevated CO_2 in TRI 3019 only. In TRI 3019, transpiration rate increased significantly under elevated CO_2. However, in TRI 3072 elevated CO_2 significantly decreased the transpiration rate. In TRI 3019, water use efficiency was significantly lower under elevated CO_2. However, in TRI 3072 water use efficiency showed an increase under elevated CO_2. Water use efficiency increased with increasing of nitrogen levels. In both clones, chlorophyll content increased with increasing of nitrogen levels and with elevated CO_2. In both clones, total leaf nitrogen content increased with increasing nitrogen. On the other hand, leaf nitrogen content showed a reduction under elevated CO_2 in both clones.

W.S.B.Ariyapala, A.Anandacoomaraswamy and W.A.J.M.De Costa

8.Publications:

A Anandacoomaraswamy, W A J M De Costa, P L K Tennakoon and Adrie van der Werf (2002). Physiological basis for increased biomass partitioning to roots upon nitrogen deprivation in young clonal tea. *Plant and Soil*, Vol. 238 (1) :1-9

Mohotti A J and Lawlor D W (2002). Diurnal Variation of Photosynthesis and Photoinhibition in Tea: Effect of Irradiance and Nitrogen Supply during Growth in the Field. *Journal of Experimental Botany*, 53 (367): 313-322.

Mohotti A J , Kodituwakku R D, Liyanage A C and Bandara D C (2002). The effect of shade on rate of photosynthesis and Rubisco content of tea (*Camellia sinensis* L.). *Proceedings of the 22nd Annual Sessions of the Institute of Biology Sri Lanka, Abstracts of Mini-Symposium & Scientific Sessions*. 50-51.

PLANT PROPAGATION AND BREEDING DIVISION

V. Shanmugarajah - Officer-in-Charge

Highlights

- For the development of new clones 1043 genotypes were evaluated under different phases in different regions.
- Two clonal evaluation trials (one each of Phase I and II) were established.
- Cuttings of promising seedling bushes selected at Labukelle Estate and Liddesdale estates were propagated in the nursery at Talawakelle.
- Commenced monitoring the yield of the different seed stocks planted in the different regions.
- Three micro seed gardens were established as a measure of broadening genetic base.
- Two new nursery trials were initiated at the low country station.
- Initiated another trial to compare the performance of mature bushes of seed stocks already available in estates, for use as seed cultivars.
- Major portion of the cuttings were issued to the ADB project.
- An Advisory Circular on "The Suitability of Tea Clones for the Different Regions" was published.

Towards meeting the objectives of the TRI Corporate Plan 1999 – 2003, the following activities were undertaken by the Division.

1. Thrust A 1 - Development of clones for the up-country

Project 1.1 - Evaluation of clones for the up-country

Of the 529 genotypes evaluated under Phase I trials, 76 were found promising (Table 1).

Average cycle yields of the genotypes of the two trials VP 75 and 76, which completed one pruning cycle, are given in Table 2.

Cuttings of the promising clones of trials VP 71, 72 and 73 were propagated for Phase II evaluation.

1.1.1 Phase I trials

TABLE 1 - *Clones under evaluation for the up-country*

Serial No.	Trial No.	Year of planting	Origin #	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control Clones	Yield of the control clones (kg MT ha^{-1})
1.1.1	VP75	1995	N	Field No. 14 St. Coombs	28	10	First cycle completed. See Table 2		
1.1.2	VP 76	1995	O		58	14	First cycle completed. See Table 2		
1.1.3	VP 77	1996	P		121	15	5769 -3281	2025	3186
1.1.4	VP78	1996	K	Field No.12	210	11	5229- 3322	2025	3100

1.1.5	VP82	1998	F	St. Coombs	46	26	4152 - 2391	4052 2025	2753 2844
1.1.6	VP84	2001	R	Field No.10 St. Coombs	44	-	-	2025	-
1.1.7	VP88	2002	S	Field No10 St. Coombs	22	-	-	3072 2025 4052	-
Total					529	76			

[#] *Origin of the clones - Refer page 4*

TABLE 2 - *Cycle yields of Phase I trials completed*

VP 75 Genotypes selected for phase II trial	Average Cycle yield (kg MT/ha)	VP 76 Genotypes selected for phase II trial	Average Cycle yield (kg MT/ha)
7	3797	R2/28	3215
2025	**3509**	R6/1	2991
265	3482	R6/41	3330
49	2944	R6/39	3906
69	2884	R6/48	3799
248	2861	R7/41	3157
55	2786	R3/23	3096
45	2668	R6/52	3639
53	2621	R8/3	3461
255	2232	R7/5	3604
27	1687	R6/77	3619
		R8/4	3819
		R7/35	3199
		R11/24	3560
		2025	**3819**

1.1. 2 Phase II Trials

Of the 118 genotypes under evaluation, 10 were found promising (Table 3).

TABLE 3 - *Clones under evaluation for the up-country*

Serial No.	Trial No.	Year of planting	Origin[#]	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones	Yields of the control clones (kg MT ha^{-1})
1.3.1	VP 80	1996	D	St. Coombs Field No.12	31	4	3313 - 2802	DN 2025	1556 2657
1.3.2	VP 81	1998	E		22	1	2700	2024 2025 3016 3072 3073 4052	1268 2499 3366 2553 2203 1852

1.3.3	VP 83	2001	A	St. Coombs Field No.10	20	----------	----------	4006 4052 4053 2025	Due for 1st centering
1.3.4	VP 85	2000	G	St. Coombs Field No.6	19	5	2678 - 2320	2025 3072 4052	2259 2136 2638
1.3.5	VP 87	2001	T	Pedro Estate Field No. 12 B	26	--	--	2025	--
Total					118	10			

Origin of the clones - Refer page 4

Origin of the clones under evaluation

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 I/58, DG 39 and China types)

C - *VP 44 selections* (crosses made in 1984, using clones TRI 777, TRI 2025,TRI 2142, TRI 2143, ASM 4/10, DN, CY9, DT1 and DG 39)

D - *VP 37 selections* (obtained after open pollination of clones TRI 777, TRI 2025, DT1 and TRI 2043)

E - *VP 38 selections* [Bi-clonal seed selection of Aislaby (2025 X 2024), Hugoland (2025 X 2024), Hantane (2025 X 2023) stocks]

F - *VP 65 selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks at Carolina Estate, Watawala (1992)]

G - *LVP 30 Selections* [Bi-clonal seed selections of Aislaby (2025 X 2024) and Hugoland (2025 X 2024)]

H - *LVP 42 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks at Parambe Estate, Kegalle (1989)]

I - *LVP 28 Selections* [Bi-clonal seed selections of Aislaby (2025 X 2023) stock at St. Joachim Estate, Ratnapura (1992)]

J - *Pettigala Selections* [Bi-clonal seed selections of Vykumbura (2025 X DN) stock at Pettigala Estate, Balangoda]

K - *LVP 49 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, at St. Joachim Estate, Ratnapura (1991)]

L - *LVP 45 & 46 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, at St. Joachim Estate Ratnapura (1989 & 1990)]

M - Introduction from Assam, India, in 1988

N - *VP 45 Selections* [Seed stocks obtained from the crosses of 1985 using TRI 777, 2024, 2025, 2142, DT 95]

O - *VP 52 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 9, St. Coombs Estate (1990)]

P - *VP 58 Selections* [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 9, St. Coombs Estate (1991)]

Q - LVP 69 Selections [Polyclonal seed selections of Urumiwela and Karandupona stocks, Field No. 2A St. Joachim Estate (1994)]

R- VP 74 Selections [Biclonal seeds selections of El Teb (DN X 2025) and Poly clonal seeds selection from Sapumalkanda S106]

S- Pedro Selections – 2001

T- St. Coombs Selections 2000 Field No. 8

V.Shanmugarajah, K.Gunasekare, M.Ratnayake, M.A.B.Ranatunga, R.Paskarathevan, B.A.Rathnagoda, A.K.Mudalige, J.D.Kottawa Arachch

1.1.3 Phase III trails: Regional testing of clones

Evaluation of TRI 3000 and 4000 series clones in Venture Estate, Norwood

Compared to the first year, during the second year of the second cycle, none of the clones yielded more than the control clone TRI 2025, which showed an increase under organic cultivation conditions. TRI 4071 yielded more than the other clones (Table 4).

TABLE 4 - *Mean yield of clones in the 1st pruning cycle and the first and second years of the 2nd cycle*

Clone	First cycle average (Kg MT ha^{-1})	% yield increase or decrease over control (1st cycle)	2nd Cycle	
			Yield (kg MT ha^{-1}) 1st Year	Yield (kg MT ha^{-1}) 2nd Year
4071	3025	32	3950	2797
3072	2554	11	1489	1083
3018	2329	1	942	687
3016	2329	1	2623	1976
2025	**2298**	**--**	**2462**	**2867**
4063	1900	-17	1437	1111
3069	1893	-18	1507	1185
3073	1770	-23	1679	1080
4052	1634	-29	1973	1227
3015	1409	-39	1694	984
3019	1399	-39	2788	2039
3020	1336	-42	1086	838
4053	1335	-42	1185	864
3017	662	-72	1272	938

Evaluation of TRI 3000 and 4000 series clones in Luckyland Estate, Udapussellawa

The trial was terminated after monitoring the yield for three years. Of the 16 clones evaluated under normal estate conditions, 9 yielded more than the control TRI 2025 (reported last year).

1.1.4 Selection

Cuttings of the 36 outstanding seedling bushes selected at Liddesdale and 24 bushes selected at Labukelle estates were propagated in the nursery at Talawakelle for evaluation.

Project 1. 5 - Screening for quality

The quality ratings given under the above title **last year** were for the selections in Phase II trial **No. VP 80.** Due to an oversight, the trial number and the selection numbers were not given and the numbers given were the serial numbers under which the selections were assessed for quality. The table presented under the title 'Screening for Quality' last year is hereby **corrected as follows** with the correct selection number, giving the corresponding serial number in parenthesis:

High quality	Moderate quality
230 (3)	110 (21)
225 (17)	21 (2)
43 (33)	213 (24)
216 (15)	5 (16)
193 (8)	497 (28)
15 (23)	582 (20)
20 (14)	598 (27)
22 (18)	DN (36)
88 (4)	-

V.Shanmugarajah, M.T.Z.Mohamed*, I.S.B.Abeysinghe**,
R.Paskarathevan and B.A.Rathnagoda
(* Technologist, ** Biochemist)

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

During the first year of the third cycle all the clones yielded more than that of the control clone TRI 2025 (Table 5).

TABLE 5 - *Mean yield of clones in the first and second pruning cycles and the first year yield in the third pruning cycle*

Clone	Yield- 1st cycle Average (kg MT ha^{-1})	% yield increase or decrease over control (1st Cycle)	Yield 2nd cycle average (kg MT ha^{-1})	% yield increase or decrease over control (2nd Cycle)	Yield 3rd cycle 1st year
4046	5922	34	6474	22.2	6882
3018	4918	11	5180	-2.23	5326
4006	4792	8	5326	0.53	5903
2025	**4417**	**0**	**5298**	**0**	**5002**
3015	4369	-1	5646	6.57	5903
4042	4162	-6	4829	-8.85	6468
3013	4247	-4	6437	21.5	6828
3020	3864	-13	5120	-3.36	5396
3014	3849	-13	5305	0.13	5279
4053	3619	-18	5631	6.29	5727
3019	3556	-20	6030	13.82	6992
4047	2583	-42	5714	7.85	6422

V.Shanmugarajah, U.Sritharan, M.Ratnayake

2.1.1 Mutation Breeding *(In vivo)*

Measures were taken to irradiate large number of single nodal cuttings of clone TRI 2025. Gamma dosage used was 4k. Attempts were also made to raise irradiated single nodal cuttings without the mother leaf. To accelerate the root initiation, those cuttings were treated with "Rootone".

T.M.S. Sarathchandra & R. Pieris*
* (Horticultural Research and Development Institute)

Seeds obtained from crosses of TRI 2043 & TRI 2023 were germinated separately and transferred to ploythene bags in the nursery to establish segregating populations for Blister Blight trait assessment.

3. Thrust A 3 - Development of clones for the mid-country semi-dry zone (Uva)

Project 3.1 - Evaluation of clones for the mid-country semi-dry zone

Of the sixty-four genotypes under evaluation in Phase I and Phase II trials, 15 were found promising (Table 6).

TABLE 6- *Clones under evaluation in phase I and II trial in mid-country semi-dry zone (Uva)*

Serial No.	Trial No.	Year of planting	Origin#	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MTha^{-1})	Yield of the control clone
3.1 Phase I Trials								
3.1.1	UVP 10	1998	**F**	Field No. 4 Passara station	40	9	1682- 1258	**2025** -1255
Sub-total					**40**	**9**		
3.2 Phase II Trials								
3.2.1	UVP 9	1998	**D**	Field No. 4 Passara station	24	6	2391 - 2039	**2025** - 2337
Sub-total					**24**	**6**		
Total					**64**	15		

Origin of the clones - Refer page 4

V.Shanmugarajah, J.C.K.Rajasinghe and M.Ratnayake

4. Thrust A 4 - Development of clones for the low-country

Project: 4.1 - Evaluation of clones for the low country

The number of genotypes under Phase I evaluation is 176. These were planted during 2000 and are due for plucking now (Table 7).

After the evaluation over a cycle, all the promising genotypes of LVP 73 were propagated in the low country as well as in the mid country wet zone for Phase II evaluation.

4.1.1 Phase I Trials

TABLE 7 - *Clones under evaluation for the low country*

Serial No.	Trial No.	Year of planting	Origin#	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones	Remarks
4.1.1	LVP 84	September 2000	Q	Field No.1 St. Joachim estate	176	---	----	TRI 2026, 2027, 4042	Due for Plucking

4.1.2 Phase II Trials

Of the 242 genotypes evaluated under Phase II, 33 were found promising (Table 8).

TABLE 8 - *Clones under evaluation for the low country*

Serial No.	Trial No.	Year of planti - ng	Origin#	Location	No. of genotypes tested	No. of promising genotypes	Yield range (kg MT ha^{-1})	Control clones & Yields	Remarks
4.2.1	LVP 74	1997	G	Deniyaya Station	Propagated for the phase III. Cycle Yields in Table 9.				
4.2.2	LVP 75 [I]	1997	D	Field No 1 St. Joachim Estate	Due for pruning and propagation for the Phase III. Cycle Yields in Table 10.				
4.2.3	LVP 75 [II]	1997	H		Due for pruning and propagation for the Phase III. Cycle Yields in Table 10.				
4.2.4	LVP 75 [III]	1997	I		Due for pruning and propagation for the Phase III. Cycle Yields in Table 10.				
4.2.5	LVP 75 [IV]	1997	J		Due for pruning and propagation for the Phase III. Cycle Yields in Table 10.				
4.2.6	LVP 76	1999	H		22	18	3804 - 1853	(2025) 1797	cv 21
4.2.7	LVP 77	1999	L		13	5	3073 - 2489	(2025) 2470	cv 16.8
4.2.8	LVP 78	1999	J		15	9	2863 - 1662	(2025) 1526	cv 45
4.2.9	LVP 79	1999	M		6	1	3010	(2025) 2498	cv 18.6
4.2.10	LVP 80	2000	A		12	---	---	---	Due for plucking
4.2.11	LVP 81	2000	B		15	---	---	---	Due for plucking
4.2.12	LVP 82	2000	C		12	---	---	---	Due for plucking
4.2.13	LVP 83	2000	L		18	---	---	---	Due for plucking
4.2.14	LVP 85	2001	A		20	---	---	---	1st centering done
4.2.15	LVP 86	2002	K	Field No.8 St. Joachim	29	--	--	--	
Total					242	33	---	---	---

Origin of the clones - Refer page 4

TABLE 9 - *First cycle Yield of the genotypes in LVP 74*

Selection Number	First year yield MT.kg /ha/an	Second year yield MT.kg /ha/an	Average
195	4654	4292	4473
01	4281	4067	4174
72	4061	3884	3972
68	3912	3697	3804
122	3907	3394	3650
168	2865	3263	3064
124	3618	3248	3433
278	3265	3161	3213
110	3585	3136	3360
93	4027	3132	3579
2026	**4808**	**5084**	**4946**
CV%	23	29	

TABLE 10 - *First cycle Yield of the genotypes in LVP 75*

	Selection Number	First year yield MT.kg /ha/an	Second year yield MT.kg /ha/an	Third year yield MT.kg /ha/an	Average
LVP75(I)	29	6700	5987	6088	6258
	139	4926	4610	4440	4659
	146	4640	4373	3924	4312
	613	4361	4079	4078	4173
	294	4119	3734	4151	4002
	2025	**3749**	**3833**	**4076**	**3886**
CV%		14		16	
LVP75 (2)	04	4917	4947	4986	4950
	01	4350	4717	5397	4821
	10	4339	4179	4077	4198
	2025	**2714**	**4762**	**4005**	**3827**
CV%		12		31	
LVP75 (3)	12/11	5314	5204	5115	5211
	2025	**4393**	**4553**	**4818**	**4588**
CV%		26		62	
LVP75 (4)	107	8182	7264	6681	7376
	163	5637	6873	6538	6349
	57	5501	5419	5570	5497
	131	5636	5437	5192	5422
	2025	**4189**	**3996**	**3775**	**3986**
CV%		16		18	

P.D.Upali, A.K.M.Jayasena, J.H.N.Piyasundara,
V.Shanmugarajah, M.Ratnayake

5. Thrusts A 5 - A 8 Development of bi-clonal and polyclonal seed cultivars

The performance of the seed stocks in the four field trials established during 2000 in the different regions was monitored with the aim of developing seed cultivars.

Project A 5.1 Development of seed varieties for up country
Evaluation of seed stocks

The plants of the different seed socks were brought into plucking and the yields were monitored. The yield data is being analysed.

R.Paskarathevan, V.Shanmugarajah

Project A 6.1 Development of seed varieties for mid-country

Evaluation of seed stocks

The plants in the trial with different seed stocks were brought into plucking and commenced recording the yield.

Micro seed garden

Majority of the plants in the two micro seed gardens established in the fields of Tea Small-holdings Development Authority, Hantana died due to the prevailing drought last year. Therefore, they were re-established with the same combination of parents (TRI 4053 x N 2 and TRI 4052 x TRI 3017).

U.Sritharan, V.Shanmugarajah, R.Paskarathevan, M.Ratnayake

Project A 7.1 Development of seed varieties for mid-country semi-dry zone

Evaluation of seed stocks

The plants in the trial with different seed stocks are due for plucking in January 2003.

J.C.K.Rajasinghe, R.Paskaratheven, V.Shanmugarajah

Project A 8.1 Development of seed varieties for low-country

Evaluation of seed stocks

Commenced recording the yields of the 11 bi- and poly-clonal seed stocks planted in Field No. 2, St Joachim Estate. The yield of the seed stocks over 43 plucks from January to December is being analysed.

Micro seed garden

A micro-seed garden in the form of crossing block was established at the low country station at Ratnapura and the details are given below:

Location : Field No. 1, St Joachim estate
Combination: TRI 4053 x TRI 4071
No. of plants: 18 each
Date of planting: 10.9.2002

P.D.Upali, A.K.M.Jayasena, and J.HN.Piyasundara

Two micro seed gardens with the following combinations were established at the Regional Station at Kottawa:

Location : Field No. 7
Combinations: TRI 2022 x KEN 16/3
TRI 4049 x TRI 3072
Date of planting: November 2002

K.D.Dahanayake, M.Ratnayake, A.K.Mudalige
R.Paskarathevan, V.Shanmugarajah,

6. Other Experiments

6.1 Polyploid Breeding

A new batch of shoots recovering after pruning in the field was treated with colchicine to induce new polyploids. The clone used was TRI 4056. Thirty apical shoots were treated and another 30 were treated only with distilled water to use as a control. The frequency of recovery of apical buds after colchicine tretment was monitored and none of the treated buds (both treated and control) showed signs of recovery.

Seventeen colchicine treated TRI 2027 plants were planted in the field (Field No. 9) with controls to evaluate their field performances. Those plants were obtained from single nodal cuttings of shoots developed after colchcine treatment (see Annual Report 2001). Some morphological changes were already observed in the newly developed leaves of those plants.

Eleven single nodal cuttings obtained from colchicine treated TRI 4006 apical buds were propagated for further evaluation (see Annual Report 2001).

M.A.B.Ranatunga & K. Gunasekare

6.2 Nursery Trials

6.2.1 Up Country

(a) Effect of different sizes of bags on the growth of cuttings

The aim was to reduce the use of soil as the rooting medium as well. The trial was completed and the data is being analyzed.

(b) Comparison of TRI recommendation with that of Indian practice in the nursery

The trial commenced last year was given up due to unavoidable reasons. However, observations made in a (observation) trial comparing the above two practices, carried out by the Court Lodge Estate showed significant differences between the parameters studied

Parameter	TRI Practice	Indian practice
Height (cm) of plants	20	64
No. of leaves on main stem	10	24
No. of roots	13	7
Length (cm) of longest root	22	26
No. of side shoots	5	2
Length (cm) of side shoots	28	17
No. of leaves on side shoots	71	27
Dry weights (g)		
Main shoot	8	10
Leaves on main stem	1	8
Side shoots	10	3
Side shoot leaves	18	6
Roots	13	8
Total (whole plant)	50	35

Superintendent, Court Lodge Estate,M.Ratnayake, B.A.Rathnagoda, V.Shanmugarajah

6.2.2 Low country

(a) Comparison of shoot and root growth of some TRI 3000 and 4000 series clones in the nursery

This study established to compare the differences in shoot and root growth of some TRI 3000 and 4000 series clones under low country conditions was completed. It was observed that clones TRI 4042, 4049 and 4053 showed better growth. The data is being analysed.

J.Mahindapala*, P.D.Upali and J.H.N.Piyasundara
(* Adivisory Division)

(b) Study on the use of refuse tea as partial soils substitute in Low country nurseries

In collaboration with the Advisory Division, a trial was initiated to study the possibility of using refuse tea as a partial soil substitute in low country nurseries. Growth of the plants in a medium of soil and refuse tea in the ratio of 3: 1 will be compared with the plants grown in soil alone. The pH of the medium will be monitored monthly.

No. of replicates: 3
Clones used: TRI 2025, 2027 and 4042
No. of plants per clone per replicate: 200

(c) Study on the use of easily available agricultural by-products as partial soil substitutes in Low Country tea nurseries where scavenging termites are active in the soil

In collaboration with the Entomology Division, a trial was initiated to study the feasibility of using easily available agricultural by products as partial soil substitutes.

No.	Treatment
T1	Sub soil : Paddy husk 1:1 Mixture
T2	Sub soil : Paddy husk 1:1 Layers
T3	Sub soil : Coir dust [Inland] 1:1 Mixture
T4	Sub soil : Coir dust [Inland] 1:1 Layers
T5	Sub soil : Coir dust [Coastal] 1:1 Mixture
T6	Sub soil : Coir dust [Coastal] 1:1 Layers
T7	Sub soil : Tea waste 1:1 Mixture
T8	Sub soil : Tea waste 1:1 Layers
T9	Sub soil alone [control]

No. of Replicates : 03
No. of cuttings / Treatment / Replicate : 100
Clone: TRI 4042

S. I. Vitarana, V. Shanmugaraja, A. K. Premathunga,
Radly Perera, J.H.N. Piyasundara, P.D. Upali

6.3 Evaluation of the performance of seed stocks planted by the estates –
Aislaby estate

Continued monitoring the yield of the mature seedlings of Aislaby Estate and the data is being processed.

V.Shanmugarajah, R.Paskarathevan, M.Ratnayake.
Superintendent, Aislaby Estate

Kiruwanaganga Estate

A trial to compare the performance of Aislaby seedlings with that of clones planted in the same field was initiated at Kiruwanaganga in Deniyaya. The aim was to recommend a seed cultivar early. For this a plots were marked in mature field of Aislaby seedlings and clonal field of TRI 2026 and commenced monitoring yield.

V Shanmugarajah, R Paskarathevan, M Ratnayake.
Superintendent, Kiruwanaganga Estate

Project D 1 - Use of *in vitro* techniques

7.1 Development of Embryo Rescue Technique

(a) Monitoring of fruit development to aid embryo rescue

Using clone TRI 2016, fruit and embryo development of open pollinated fruits have been completed up to 8 months after pollination. Illustrations were made using anatomical and morphological features of fruit, seed, embryo and endosperm characteristics. This study is being continued to monitor the developmental events till fruit/ seed maturity.

A total number of 185 and 435 open pollinated flowers of clones TRI 2021 and TRI 2025 respectively were tagged for the purpose of comparing their development events.

As there was no enough material left in the trees for further assessments 8 months from pollination, another batch of anthesised flowers were tagged. The number of flowers tagged in each clone is as follows:

Clone	No. of flowers tagged
TRI 2016	660
TRI 2021	90
TRI 2025	500

U.Sritharan, K. Sarathchandra ,H. Jayaweera & K. Gunasekare

(b) Immature embryos culture

Of the 100 immature embryos (approximately 3-4 months old) cultured 60% survived and turned green on the B5 medium supplemented with growth regulators. Another batch (20 x 3 reps) of immature embryos from clone TRI 2023 was cultured on B5 supplemented medium.

Fifteen isolated immature embryos together with a portion of fruit coat (approximately 3-4 months old) were cultured on B5 supplemented medium (B5 + 0.5mg/l ABA + 0.5mg/l BAP). Although these explants turned brown, upon transfer to a fresh medium with the same composition, majority of those turned green and embryo growth seemed to start. These explant grew further upon transfer to same but fresh medium and produced whole plants.

H. Jayaweera, K. Sarathchandra & K. Gunasekare

7.2 Quantification of shoot multiplication rate

(a) Shoots derived from seed material

One hundred cotyledons were cultured on MS medium supplemented with growth regulator, for quantification of shoot multiplication rate per explant. However, on this medium 88% of the explants produced somatic embryos instead of forming plantlet from the zygotic embryo axes. 75% contamination of the previous cultures was observed. This study could not be completed due to high rate of contamination of the explants. Another batch of explants (cotyledon) were cultured on MS medium supplemented with growth regulator, for quantification of shoot multiplication rate per explant.

N. Karunathilaka & K. Gunasekare

(b) Shoots derived from nodal stem explant

Measures were taken to quantify the number of shoots that can be initiated from stem nodal explains and to quantify multiplication rates at each culture passage. Studies did not perform successfully owing to high contamination rate and therefore, multiplication rate could not be worked out.

T.M. Sarathchandra & K. Gunasekare

7.3 Callus Culture

For the study on callus culture, one hundred and twenty stem explants were cultured and 60 per cent of them showed good callus proliferation on the medium containing MS + 2mg/l BAP + 1mg/l 2,4-D. Although mass of callus produced in medium containing higher concentration of 2,4-D (i.e. MS + 2mg/l BAP + 2mg/l 2,4-D) was more, the callus formed was found to be compact and upon transfer to a fresh medium this callus turned brown.

Studies were also initiated to monitor the optimum sub-culture passage for stem derived callus for its better proliferation. It has been found that callus need to be transferred to the fresh medium at 6 week culture passage.

As callus proliferation of stem explants was not sufficient to initiate suspension cultures, cotyledons as well as in vitro leaf materials were selected as explants to obtain profuse callus production as an alternative measure. Cotyledons were cultured on MS medium supplemented with 2mg/l BAP + 1mg/l 2,4-D.

N. Karunathilaka & K. Gunasekare

7.4 Anther Culture

Anthers taken from immature flower buds (size 5mm diameter) of TRI 2023 were cultured on two media :

(1) half MS + 1mg/l 2,4-D + 0.5mg/l Kinetin

(2) half MS + 1mg/l 2,4-D

800 anthers were cultured in above two media and half of the cultures in each medium was maintained in dark and the other half in the light. Anthers maintained in the dark showed very compact and whitish callus whereas anthers in the light formed profuse and friable callus, which may show regeneration capacity. No marked differences were found with regard to callus formation in two different media.

H. Jayaweera & K. Gunasekare

7.5 *In vitro* induction of mutants by gamma rays

A preliminary study was undertaken to measure the effect of physical mutegens (gamma rays) on in vitro shoots derived from seed material of TRI 2023. These microshoots were maintained and sub-cultured on the medium containing MS + 0.02mg/l IBA + 2.5mg/l BAP. Microshoots were irradiated at 1, 3 and 6 Kr and each treatment dosage contained of 10 microshoots . Another 10 microshotos were used as a control.

Irradiated in vitro shoots were monitored continuously for their survival/ death as well as for any morphological changes. Percentage mortality of microshoots was 20, 30 and 50 percent at 2, 3 and 5 Kr treatment respectively and none in the control. Multiple shoot formation was observed only in a single in vitro shoot exposed at 3Kr. This study needs to be repeated for more accuracy of the results.

T.M.Sarathchandra, R. Pieris* & K.Gunasekare
* (Horticultural Research and Development Institute)

8. Issue of cuttings

8.1 Up-country

Major portion of the cuttings of the TRI 3000 and 4000 series was issued to the Tea Development Project funded by the Asisn Development Bank (ADB) and the balance was issued to some estates and smallholders.

8.1.1 (a) Issue of shoots for estates and small holders

Date of issue	Issued to	TRI 3000 Series	No. of shoots	TRI 4000 Series	No. of shoots
14/8/2002	Stellenburg estate	3015 3017 3018	500 500 500	4052	500
30/8/2002	K.N.Deen	3013 3018 3073	500 500 500	4052	250
14/8/2002	North Meddacumbura			4052 4053	500 500
Total			3000		1750
Grand total					**4750**

(b) Issue of shoots for the ADB Mother Bush Project at TSHDA centers

Date of issue	Issued to	TRI 3000 Series	No. of shoots	TRI 4000 Series	No. of shoots
9/4/2002	TSHDA/Haliela	3013 3015 3018 3069	500 500 500 200	4052	500
16/5/2002	TSHDA/ Walahanduwa	3014 3025 3055	230 160 30	4006 4046 4053	130 100 495
20/6/2002	TSHDA/ Walahanduwa	3014 3025	500 25	4006 4042 4046 4052 4053 4054 4055	100 25 75 200 500 500 500
9/7/2002	TSHDA/Gampola	3013 3015 3017 3018	1000 1000 1000 1000	4052 4053	250 1000
10/7/2002	TSHDA/Matara			4052 4053 4054 4055	1000 1000 1000 1000
10/7/2002	TSHDA/Galle			4052	2500

				4053 4055	2500 2500
11/10/2002	TSHDA/Galle			4052	1000
31.12.2002	TSHDA/ Walahanduwa			4042 4046	300 250
Total			10,145		18,675
Grand total					28,820

8.1.2 Summary of issue of shoots for ADB Mother Bush Project at the TRI Stations

Clone	Ratnapura	Kottawa	Hantana	Passara
3013			700	250
3014				
3015				250
3016			325	
3017			150	
3018			1200	300
3019				270
3020			650	
3047				
3052		350		
3055				
3069		350		
3072			1000	
3044				
4006				
4042				50
4043				
4046				300
4052	2000	350		250
4053		350	1000	250
4054	500	350		
4055	1100	350		
4059				
4067				
4071			1175	
4078				
4079				
4085				
Total	3600	2100	6200	1920
Grand total				**13820**

8.2 Low-country

8.2.1. Issue of shoots for estates and small holders

Date of issue	Issued to	TRI 3000 series	No. of Shoots	TRI 4000 series	No. of Shoots	Other Clones	No. of Shoots	Total
03.12.02	Keeragala Estate Kuruwita	3058	200			62/6 62/9	200 100	500
31.12.01	A.M.U. Liyanage, Hiddallana, Ratnapura					2027	100	100
08.01.02	Sampath Peiris, Panadura					2026 2027 62/6	50 650 250	950
10.01.02	T.S.H.D.A, Ratnapura	3058,3065	50each	4049,4059 4004	50 each 25	2027	100	325
21.01.02	A.R.M.Hassim, Mount Moor Estate, Gatahetta					2025 62/1 62/6 62/9	450 200 150 50	850
23.01.02	K.A. Sunil Premathilaka, Nammuniyawatta, Kiriella	3057,3065 3060	125 each 100	4014,4049, 4059	50 each			500
24.01.02	T.S.H.D.A, Ratnapura					2027	300	300
08.02.02	Tamara Gunasekara, Provident Hill Estate, Amithagoda					2027	150	150
08.03.02	C.S.K.Samaraweera Hiddallana, Ratnapura					2027	500	500
13.03.02	A.M.U. Liyanage, Hiddallana, Ratnapura					2027	200	200
22.03.02	Mrs. C.Weragama, Siridola Walluwa Palawala, Ratnapura					2027	200	200
26.09.02	M.M. Mallika C/O A.G.A. Kuruwita, Kithulpe, Kuruwita			4046,4047, 4059	200 each	2027 62/6	200 200	1000
02.10.02	J.M.C. Bandara Kathlana, Pothupitiya Kalawana			4049 4059	250 50	2027	200	500
07.10.02	P.G. Somasiri 507/1, Kagugaswatta Road, Hulladuwa, Gatahatta	3058	200			2027 62/6 62/9	100 100 100	500
17.10.02	Sugath Maddumahewa Galkatiya, Kalawana	3058	200			2027 62/6	100 100	500
01.11.02	M.A.K.E. Mantriratne, No.108 Anghammana Rd. Ratnapura					2027	500	500

06.11.02	H.A. Sirisoma, Patberiya, Parakaduwa					2027	200	200
06.11.02	A.M.D. Alwis, Gullammodera Watte, Panawala, Ehaliyagoda					2027	500	500
17.11.02	G.Siriyawathee, Hiddellana, Ratnapura					2026	100	100
17.11.02	P.Karunawathee Hiddellana, Ratnapura					2026	100	100
27.11.02	Abekoon Bandara, Batugedara, Ratnapura					2027	200	200
02.12.02	T. Wikramasekara, Hanwella, Atigalla					2027	500	500
18.12.02	C. Arabewella, Namaldeniya, Parakaduwa					2026	300	300
	GRAND TOTAL							9475

P.D. Upali, A.K.M. Jayasena, J.H.N. Piyasundara

8.2.2 Summary of issue of shoots for ADB Mother bush Project

Clone	St. Joachim Estate	TRI Hantana	TRI Kottawa	TSHDA Hantana	TSHDA Walahanduwa	TSHDA Mawarella	Total
TRI 2027	250						250
TRI 3014	900				100	500	1500
TRI 3025	500					1000	1500
TRI 3047	150						150
TRI 3055	715				50	1000	1765
TRI 4006	350	250				1000	1600
TRI 4042	2025	250			1800	2000	6075
TRI 4046				300			300
TRI 4047	500			200			700
TRI 4049	225		500				725
TRI 4052				500			500
TRI 4053	1115				75		1190
TRI 4054	100						100
TRI 4055	200						200
TRI 4056	300						300
TRI 4061	1195				175	500	1870
Total No. of Shoots	**8525**	**500**	**500**	**1000**	**2200**	**6000**	**18225**

P.D. Upali, A.K.M. Jayasena, J.H.N. Piyasundara

9. Other Activities

9.1 Other Divisional Activities

After serving as the Commonwealth Consultant to the Division for three years, Dr I.D.Singh returned to India - January 08

Mr. J.H.N. Piyasundara had obtained his B.Sc. Degree in Natural Sciences from the Open University effective from December, 2001.

9.2 Visitors

Staff and students of the -
Faculty of Agriculture, University of Peradeniya – January 09, Agriculture School, Pelvehera – January (last week), Faculty of Agriculture, Sabragamuwa University – February 13, Highlands College, Hatton – February 20, Sabaragamuwa University (Plantation Agriculture) - June 12, Faculty of Agriculture, Jaffna - September 16, Teacher Training College, Palaly - October 22, Wayamba University - November 29, Faculty of Agriculture, Eastern University - December 13

About 15 Middle Level Research Managers (from various countries), the participants of the Regional Training Programme on 'Research Management in Agriculture', sponsored by the Ministry of Foreign Affairs under the Technical Co-operation Programme – March 01

Dr Choudry, Chairman, UPASI and Dr Selvasundaram, Entomologist UPASI Tea Research Foundation had discussion with the staff on matters of mutual interest – April 08

On a familiarization visit -
Five Planter Trainees of the Maskeliya Plantations - June 13, Mr Viduranga Wanigasooriya, a planter trainee from Gouravilla Estate - July 16, About 20 Assistant superintendents of the Udapussellawa Plantations Ltd. - August 21

About 15 Japanese students on a study tour arranged by the Sri Lanka Tea Board visited the divisional nursery - August 28

Four scientists from UPASI, Dr N.Muraleedharan, Director, Mr J.B.Hudson, Assistant Director (Extension), Dr B.Radhakrishnan, Senior Advisory Officer and Dr R.V.J.Elango, Senior Botanist & Head of Divisic had discussion with the staff of the Division - September 13 and 16

Messrs Jim Green and R.S.Jayaratne of the ADB mission on TRI Reforms visited the lab and the field gene bank - November 11

9. 3 Workshops/ Seminars/ Training Programmes/ Meetings attended

Dr I.D.Singh, the Commonwealth Consultant, addressed the members of the Planters Association on 'Towards golden clone for sustained productivity and quality of tea in Sri Lanka', held at the Tea Board Auditorium – January 04

V.Shanmugarajah and M.Ratnayake attended the seminar by Dr I.D.Singh on 'Towards golden clone for sustained productivity and quality of tea in Sri Lanka', held at the Tea Board Auditorium – January 04

B.A.Rathnagoda commenced attending the Advance Certificate Programme in Laboratory Technology at the Open University of Sri Lanka – January 12

M.T.K.Gunasekare attended the workshop on 'Priority research areas in Science and Technology' organised by the Young Scientist of the NASTEC at SLAAS auditorium – March 15

P.D.Upali and J.H.N.Piyasundara participated at the 'Esuru Maga' trade exhibition conducted by the Chamber of Commerce, Ratnapura –March 26 - 30

V.Shanmugarajah attended the International Conference on 'Methyl bromide Substitutes for Tea Plantations in Sri Lanka' – April 05 and 06

J.H.N. Piyasundara participated " Ran dalu Mela" Trade Exhibition conducted by Ministry of Small Holdings – April 6 – 7

M.T.K.Gunasekare was elected a member of the Steering Committee of the Young Scientists Forum of the NASTEC and had attended three meetings.

Ms K.Gunasekare was awarded a fellowship under the Netherlands Fellowships Programme of the Netherlands Minister for Development Co-operation and attended a 10 weeks training programme on 'Biotechnology, Plant Breeding and Seed Technology' commencing April 29. She resumed duties after the fellowship on July 09

Mr. M.A.B. Ranathunga participated in a workshop on "Internet Technologies for Development" conducted by Commonwealth Services Abroad Programme (CSAP) at the Institute of Computer Technologies of the Colombo University - August 19 - 23

Mr. T.M. Sarathchandra was awarded a fellowship from IAEA to follow a three months training on Plant Breeding (Mutation Breeding) commencing from 1st July, 2002 at the National Botanical Research Institute, Lucknow, India. He resumed duties after this training on October 2

Mr P.D.Upali attended the Three moths full time residential Basic Course in Tea Plantation Management at the Kothari Agricultural Management Centre, Coonoor, The Nilgris, India from September to November and resumed duties on December 4

9.4 Publications /Posters

Piyasundara. J.H.N., Upali P.D. and Mahindapala. J (2002). Drought and Low Country Tea Cultivation. " Theae Thathu"- Sinhala, Vol. I (1), pp3

Mahindapala. J and Upali.P.D (2002). Usage of New Tea Clones" Theae Thathu"- Sinhala Vol. I (1), pp1

M.A.B. Ranatunga and M.T.K. Gunasekare (2002). Identification of ploidy markers in tea (*Camellia sinensis*). Proc. 58th Annual Session of SLAAS, 2002, Part I, 38p

K.M. Mewan, J.M.D. Everard, A.C. Liyanage, M.T.K. Gunasekare, T.L.S. Tirimanne & E.H. Karunanayake (2002) A preliminary investigation towards developing molecular markers lnked to blister blight disease resistance in Camellia sinensis L. (tea), Proc. 58th Annual Session of SLAAS, 2002, Part I, 65p.

9.5 Papers submitted

Piyasundara J.H.N (2002). Environmental friendly Tea Cultivation (submitted for publication in "Theae Thathu"- Sinhala]

Singh.I.D., Attanayake.D.P.S.T and Paskaratheven.R (2002). Narrow Genetic Diversity in Cultivated Tea and Rubber and Its Implications in Sri Lanka (submitted for the NIPM Journal)

9.6 Training Programmes conducted

Mrs T.H.Seran, Lecturer, Faculty of Agriculture, Eastern University, commenced her Ph.D programme in the Division under the supervision of Dr (Ms) M.T.K.Gunasekare and Prof. K.Hirimburegama, Dept. of Botany, University of Colombo – April 03

Miss Nayana Krishanthi, NDT trainee of the Hardy Advanced Senior Technical Institute, Ampara, had her 4 months practical training programme from March 11 to July 10

Miss D.M.U.H. Chandramalie Priyangika Dissanayake from the School of Agriculture, Walpita had her one and a half (1 1/2) months practical training in the Division, June 03 - July 11

J.H.N. Piyasundara conducted a training programme on Mother Bush Area Maintenance and Nursery Management in low country for a group of NIPM students - September

Mr Manoj Pushpakumara, National Diploma in Agriculture trainee from the Technical College, Kuliyapitiya had his three months practical training in the division from September 2 - December 2

9.7 Services

Messrs A.K.M. Jayasena, P.D. Upali and J.H.N. Piyasundara had helped in the identification of clones in Hunuwala Estate, Opanayake and Palmgarden Estate, Ratnapura in the low country

Messrs M.Ratnayake and B.A.Rathnagoda had helped in the identification of clones in Montecristo, Nayabedde, Kiruwanaganga and Welimada estates.

9.8 Correspondence

The Division had 156 correspondences with growers and others on various matters.

SOILS AND PLANT NUTRITION DIVISION

L.S.K.Hettiarachchi - Head of Division

APPLIED RESEARCH

Thrust A15 **Development of regional and site specific fertilizer recommendations for improvement of productivity and made tea quality.**

Project A15.1 **Characterization of soils in tea growing areas in Sri Lanka, down to soil series level.**

A detailed description of the work carried out, along with the objectives, tangible outcomes, publications etc. appeared in the Annual Reports 1996 to 2001.

The field activities in the second phase, covering soils in the Intermediate zone, have been completed and the book is in press.

a) Characterization of soils in tea growing estates in mid country.

A detailed description of the work carried out, along with the objective/s, appeared in the Annual Reports 1996 to 2001.

Incorporation of soil physico-chemical parameters to soil series and depth maps is in progress.

W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi
R.M.S.S.Rajapaksa, J.A.M.M.Jayakody

Project A15.2 **Estimating crop response to macro nutrients (N, K, Mg, S and P) at regional level.**

A15.2.1 Fertilization experiments.

a) Effects of application of different rates of N, K and Mg on growth, soil/plant nutrient status and yield.

1) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone PK2, Field No 15B, Court Lodge Estate, Kandapola - (1999)

The yields obtained in the 4th year after pruning are presented in Table 1.

Surprisingly, no significant increase in yield was observed with increasing rates of N even in the 4th year too like 3rd year, although in the 2nd year a significant linear increase was seen. No significant effect was so far seen for increasing rates of K and Mg. There was no interaction between N and K, N and Mg, and K and Mg.

TABLE 1 - *Effects of different rates of N, K and Mg on the yield (3rd year) of tea (MT kg ha^{-1}) – Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	5378	5253	5488	5373	
420	5463	5574	5249	5429	SE 47
600	5416	5477	5317	5404	
Mean	5419	5435	5351	5402	
		SE 47			SE 82

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	5506	5277	5335	5373	
420	5404	5336	5546	5429	SE 47
600	5379	5530	5301	5404	
Mean	5430	5381	5394	5402	SE 82

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	5484	5378	5395	5373	
210	5394	5409	5502	5429	SE 47
300	5411	5357	5286	5404	
					SE 82

Determination made in the 4th year (July 2002) after pruning of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 2, 3 and 4 respectively, while leaf N, K and Mg concentrations are presented in Table 5.

The soil pH levels at 0-15 and 15-30 cm depths, estimated in this year, varied significantly and decreased with increasing rates of N like in the 2nd year. In the 3rd year also, such trends were evident. So far, no variation has been seen either with increasing rates of K or Mg.

Even in 4th year's estimation, it was shown that soil K levels increased significantly with increasing rates of K at both depths. But it was not significantly influenced with increasing rates of N and Mg. Soil Mg levels at both depths did not vary significantly either with increasing rates of N, K, or Mg fertilizers till last year. However, Mg levels estimated in this year from 0-15 cm depth showed that it significantly decreased with increasing rates of N and K while increased with Mg fertiliser rates. This effect was more pronounced with respect to increasing rates of N fertilizer. At 15-30 cm depth, no such variations were found except Mg level being increased with increasing rates of Mg fertilizer.

TABLE 2 - *Effects of different rates of N, K and Mg on the soil pH status - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	4.56	4.32	4.19	0.051
15-30 cm	4.51	4.34	4.25	0.045
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	4.34	4.41	4.32	0.051
15-30 cm	4.37	4.40	4.33	0.045
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	4.38	4.33	4.36	0.051
15-30 cm	4.39	4.35	4.36	0.045

TABLE 3 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	527	502	496	16
15-30 cm	492	482	466	15
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	410	541	574	16
15-30 cm	389	508	542	15
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	517	519	489	16
15-30 cm	477	498	464	15

Leaf N, K and Mg concentrations estimated in the previous year did not vary significantly with either rates of N, K and Mg fertilizers. Leaf N, K, Mg and Ca concentrations estimated in this year showed greater variations. Leaf N significantly increased linearly with N rates but K, Mg and Ca concentrations increased only up to the 2nd rate of N fertilizer and thereafter it decreased. In fact, Mg in soil also decreased with increasing rates of N fertilizer. With respect to K fertiliser rates, N concentration did not vary but K significantly increased while Mg and Ca decreased. In 0-30 cm soil, K increased with K fertilizer rates but Mg did not vary greatly.

TABLE 4 - *Effects of different rates of N, K and Mg on the soil Mg status(mg kg^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	190	160	141	9.8
15-30 cm	162	180	159	8.6

K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	172	175	144	9.8
15-30 cm	166	176	159	8.6
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	144	155	192	9.8
15-30 cm	151	168	182	8.6

TABLE 5 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration – Main effects only*

	N Level (kg ha^{-1} yr^{-1} N)			
Leaf nutrient (%)	240	420	600	SE
N	3.22	3.31	3.37	0.042
K	1.36	1.38	1.33	0.013
Mg	0.23	0.23	0.21	0.004
Ca	0.61	0.64	0.60	0.011
	K level (kg ha^{-1} yr^{-1} K_2O)			
	120	210	300	
N	3.31	3.29	3.31	0.042
K	1.31	1.36	1.39	0.013
Mg	0.23	0.22	0.21	0.004
Ca	0.65	0.62	0.60	0.011
	Mg level (kg ha^{-1} yr^{-1} MgO)			
	60	105	150	
N	3.33	3.29	3.29	0.042
K	1.37	1.34	1.35	0.013
Mg	0.20	0.21	0.24	0.004
Ca	0.62	0.61	0.63	0.011

With increasing rates of Mg fertilizer, only leaf Mg concentration significantly increased but N, K and Ca did not vary. The experiment continues

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2) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2026, Field No. 1, Tokatiyamulla Estate, Galle - (1999)

The yields obtained in the 2nd year (May 2001 to April 2002) are presented in Table 6. So far surprisingly, no significant variation was yet found on yield with increasing rates of N fertiliser and any of other treatments too.

TABLE 6 - *Effects of different rates of N, K and Mg on the yield (1st year) of tea (MT kg ha^{-1}) - Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	*K level (kg ha^{-1} yr^{-1} K_2O)*				
	120	210	300	Mean	
240	5179	4921	5399	5167	
420	5727	4979	4895	5200	SE 119
600	5516	4743	4791	5017	
Mean	5474	4881	5028	5128	
		SE 119			SE 207

N Level (kg ha^{-1} yr^{-1} N)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
240	5107	4998	5394	5167	
420	5449	5140	5011	5200	SE 119
600	4920	5268	4862	5017	
Mean	5159	5135	5089	5128	SE 207

K Level (kg ha^{-1} yr^{-1} K_2O)	*Mg level (kg ha^{-1} yr^{-1} MgO)*				
	60	105	150	Mean	
120	5526	5502	5394	5474	
210	4983	4977	4681	4881	SE 119
300	4966	4926	5192	5028	
					SE 207

Determinations made in May 2002, of soil pH, K and Mg levels from 0-15 and 15-30 cm depths are presented in Tables 7, 8 and 9 respectively, while leaf N, K, Mg and Ca concentrations are presented in Table 10.

TABLE 7 - *Effects of different rates of N, K and Mg on the soil pH status – Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	4.34	4.36	4.47	0.086
15-30 cm	4.29	4.25	4.32	0.048

K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	4.30	4.39	4.47	0.086
15-30 cm	4.33	4.20	4.33	0.048

Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	4.45	4.30	4.42	0.086
15-30 cm	4.33	4.26	4.27	0.048

TABLE 8 - *Effects of different rates of N, K and Mg on the soil K status (mg kg^{-1}) – Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	86	78	77	5.14
15-30 cm	71	66	66	5.82
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	67	82	93	5.14
15-30 cm	55	66	81	5.82
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	76	85	80	5.14
15-30 cm	62	73	68	5.82

No significant variation in soil pH was found with increasing rates of N, K or Mg at both the depths. Generally, pH in soil decrease with increasing rates of N primarily due to acidification caused by nitrification. Like previous year, soil pH levels, estimated in this year also did not show any significant variation at both the depths. This is likely due to continued effect of acidity being neutralized to a greater extent following the application of dolomite in July 2000 at the rate of 2500 kg ha^{-1}. It was partly evident from the grand mean values of soil pH at 0-15

TABLE 9 - *Effects of different rates of N, K and Mg on the soil Mg (mg kg^{-1}) – Main effects only*

N Level (kg ha^{-1} yr^{-1} N)	240	420	600	SE
0-15 cm	142	146	156	13
15-30 cm	116	121	114	9
K level (kg ha^{-1} yr^{-1} K_2O)	120	210	300	
0-15 cm	137	152	154	13
15-30 cm	114	112	125	9
Mg level (kg ha^{-1} yr^{-1} MgO)	60	105	150	
0-15 cm	127	163	154	13
15-30 cm	96	127	128	9

TABLE 10 - *Effects of different rates of N, K and Mg on the leaf nutrient concentration- Main effects only*

Leaf nutrient (%)	*N Level (kg ha^{-1} yr^{-1} N)* 240	420	600	SE
N	3.19	3.28	3.29	0.041
K	0.91	0.92	0.95	0.016
Mg	0.28	0.26	0.25	0.006
Ca	1.17	1.05	1.04	0.030
	K level (kg ha^{-1} yr^{-1} K_2O) 120	210	300	
N	3.20	3.29	3.27	0.041
K	0.88	0.95	0.95	0.016
Mg	0.27	0.26	0.26	0.006
Ca	1.09	1.09	1.09	0.030
	Mg level (kg ha^{-1} yr^{-1} MgO) 60	105	150	
N	3.29	3.22	3.24	0.041
K	0.92	0.92	0.93	0.016
Mg	0.26	0.27	0.27	0.006
Ca	1.05	1.10	1.12	0.030

cm depth, estimated in May 2000, September 2001 and July 2002, and they were 4.07, 4.93 and 4.39 respectively although no differences were found for N fertiliser rates as such.

As previously observed, there was a significant increase in soil K level with increasing rates of K at both depths, but with increasing rates of N, the decreasing trend exist although not significant unlike last year at both the depths. Soil Mg level did not vary significantly with any of the treatments yet, except that there was a trend in increasing level with Mg fertiliser rates. No interactions were found between increasing rates of N and K, N and Mg, and K and Mg.

As observed in the last year's estimation, with increasing rates of N fertilizer, leaf N concentration increased although not quite significant in this year, while Mg and Ca concentrations decreased significantly but K did not vary despite a decrease in available K in the soil. With increasing rates of K and Mg, none of the leaf nutrient concentrations varied significantly, except leaf K being increased with K fertilizer rates. Like in previous years, K in soil also increased with increasing K rates. The experiment continues

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3) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2027, Field No.8, Talgaswela Estate, Galle - (1999)

Fresh pruning weight, base stem circumference and average circumference of secondary branches 2.5 cm below the pruned cuts obtained following pruning in October, fresh weight of shoots following tipping in December 2001 are given in Tables 11, 12 and 13, and 14 respectively.

TABLE 11 - *Effects of different rates of N, K and Mg on the fresh pruning weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	81	90	82	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	84	90	80	3.5
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	83	83	88	
				LSD (0.05) = NS
				CV% 22

TABLE 12 - *Effects of different rates of N, K and Mg on the base circumference (cm) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	19.7	20.0	20.3	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	20.1	19.7	20.2	0.32
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	19.5	20.8	19.9	
				LSD (0.05) = NS
				CV% 8.4

TABLE 13 - *Effects of different rates of N, K and Mg on the average circumference of secondary branches (cm) Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	4.68	4.80	4.81	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	4.73	4.70	4.86	0.057
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	4.73	4.76	4.80	
				LSD (0.05) = NS
				CV% 6.2

TABLE 14 - *Effects of different rates of N, K and Mg on the fresh tipping weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)		1.55	1.49	1.64	
K level		120	210	300	
(kg ha^{-1} yr^{-1} K_2O		1.53	1.56	1.58	0.047
Mg level		60	105	150	
(kg ha^{-1} yr^{-1} MgO)		1.60	1.54	1.52	
					LSD (0.05) = NS
					CV% 16

No significant variations were found on fresh pruning weight, base stem circumference, average circumference of secondary branches and tipping weight with increasing rates of any of the treatments.

Soil and leaf samples obtained in September 2002, and the yield in the 1st year are being statistically analyzed. The experiment continues.

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4) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, Field No.85, Houpe Estate, Kahawatte - (1999)

Fresh pruning weight, base stem circumference and average circumference of secondary branches 2.5 cm below the pruned cuts obtained following pruning in July 2001 are given in Tables 15, 16 and 17 respectively.

TABLE 15 - *Effects of different rates of N, K and Mg on the fresh pruning weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	54	52	53	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	52	55	51	2.2
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	55	50	53	
				LSD (0.05) = NS
				CV% 22

TABLE 16 - *Effects of different rates of N, K and Mg on the base circumference (cm) – Main effects only*

N Level	240	420	600	SE

TABLE 16 - *Effects of different rates of N, K and Mg on the base circumference (cm) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	20.6	21.1	20.9	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	20.7	20.9	21.1	0.39
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	20.9	20.9	20.8	
				LSD (0.05) = NS
				CV% 9.6

TABLE 17 - *Effects of different rates of N, K and Mg on the average circumference of secondary branches (cm) Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	3.99	3.95	3.93	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	3.94	3.99	3.93	0.052
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	3.88	4.03	3.94	
				LSD (0.05) = NS
				CV% 6.9

Even at this experiment, no significant variations were found on fresh pruning weight, base stem circumference and average circumference of secondary branches with increasing rates of any of the treatments.

Soil and leaf samples obtained in April 2002, and the yield in the 1st year are being statistically analyzed. The experiment continues

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5) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2026, Field No. 4B, Lumbini Estate, Deniyaya - (1999)

Fresh pruning weight, base stem circumference and average circumference of secondary branches 2.5 cm below the pruned cuts obtained following pruning in November 2001, fresh weight of shoots following tipping in March 2002 are given in Tables 18, 19 and 20, and 21 respectively.

At this experiment also, no significant variations were found on fresh pruning weight, base stem circumference, average circumference of secondary branches and tipping weight with increasing rates of any of the treatments.

TABLE 18 - *Effects of different rates of N, K and Mg on the fresh pruning weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	97	102	93	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	102	99	91	6.2
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	96	106	89	

LSD (0.05) = NS
CV% 33

TABLE 19 - *Effects of different rates of N, K and Mg on the base circumference (cm) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	20.8	20.2	20.6	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)	21.0	20.3	20.3	0.37
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	20.4	21.0	20.2	

LSD (0.05) = NS
CV% 9.4

TABLE 20 - *Effects of different rates of N, K and Mg on the average circumference of secondary branches (cm) Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	7.25	7.08	7.41	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	7.53	7.12	7.10	0.019
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	7.37	7.31	7.06	

LSD (0.05) = NS
CV% 13.4

TABLE 21 - *Effects of different rates of N, K and Mg on the fresh tipping weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	4.49	4.88	4.70	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	4.53	5.00	4.55	0.266
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	4.76	4.58	4.74	

LSD (0.05) = NS
CV% 29.6

Soil and leaf samples obtained in November 2002, and the yield in the 1st year are being statistically analyzed. The experiment continues

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

6) Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 3019, Field No.2, Ury Estate, Passara - (1999)

Fresh pruning weight, base stem circumference and average circumference of secondary branches 2.5 cm below the pruned cuts obtained following pruning in September, fresh weight of shoots following tipping in December 2001 are given in Tables 22, 23 and 24, and 25 respectively.

At the out set, no significant variations were found on fresh pruning weight and average circumference of secondary branches with increasing rates of any of the treatments. As far as base stem circumference and tipping weight are concerned, indications were such that base stem circumference appeared to widen with increasing rates of N fertilizer while tipping weight decrease with increasing rates of K fertilizer. However, these trends will recur or not, need to be examined at the next pruning time.

TABLE 22 - *Effects of different rates of N, K and Mg on the fresh pruning weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	103	100	105	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	102	101	104	2.7
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	100	105	102	

LSD (0.05) = NS
CV% 14

TABLE 23 - *Effects of different rates of N, K and Mg on the base circumference (cm) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	22.1	21.8	23.0	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O)	22.4	21.8	22.7	0.31
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	22.1	22.4	22.3	

LSD (0.05) = 0.878
CV% 7.2

TABLE 24 - *Effects of different rates of N, K and Mg on the average circumference of secondary branches (cm) Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	6.44	6.27	6.35	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	6.24	6.36	6.46	0.084
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	6.30	6.36	6.40	

LSD (0.05) = NS
CV% 6.8

TABLE 25 - *Effects of different rates of N, K and Mg on the fresh tipping weight (kg plot^{-1}) – Main effects only*

N Level	240	420	600	SE
(kg ha^{-1} yr^{-1} N)	2.70	2.49	2.80	
K level	120	210	300	
(kg ha^{-1} yr^{-1} K_2O	3.01	2.44	2.54	0.161
Mg level	60	105	150	
(kg ha^{-1} yr^{-1} MgO)	2.72	2.59	2.69	

LSD (0.05) = 0.459
CV% 32

Soil and leaf samples obtained in May 2002, and the yield in the 1st year are being statistically analyzed. The experiment continues.

T.C.N.Peries, D.M.B.N. Dissanayake, O.G.K.A.Gunaratne, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

7) **Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Field No. NC New Division,
Rangala Estate, Karaliyadda - (2002)

The experiment appeared in Annual Report 2000 as A15.2.1.15 and in 2001 as A15.2.1 (a) 7 was terminated due its age profile. Instead, a mature tea field planted in 1995 and last pruned in July 2002 was chosen. Thereafter 81 plots, each consisting of 30 plants, were marked and a new experiment commenced in August 2002. Soil and leaf samples were obtained from the plots in September 2002 and are being analyzed for physico-chemical parameters. Dolomite applied at the rate of 1500 kg ha^{-1} as grand mean of pH in soil was 4.3. Stem circumference at 5 cm height from the base and circumference of secondary branches 2.5 cm below the pruned cut were measured. Secondary branches below the pruned cut were labelled for future measurements. The experiment continues.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

8) **Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 210 and 300 kg ha^{-1} yr^{-1} K_2O) and Mg (60, 105 and 150 kg ha^{-1} yr^{-1} MgO) on growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Field No NC5, Midlands Estate, Ratthota - (2000)

Results of soil and leaf samples obtained following treatment applications in May 2002, and the yields recorded during the 4th year (July 2001 to June 2002) are being analyzed for statistical significance. Dolomite applied at the rate of 1500 kg ha^{-1} as grand mean of pH in soil was 4.4. Stem circumference at 5 cm height from the base and circumference of secondary branches 2.5 cm below the pruned cut were measured. Secondary branches below the pruned cut were labelled for future measurements. The experiment continues.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

b) **Effects of application of different rates of N and K (and frequencies) on growth, soil/plant nutrient status and yield.**

1) **Effects of different rates of N (100, 200, 300, 400 and 500 kg ha^{-1} yr^{-1} N) and K (in 100, 300 and 500 kg ha^{-1} yr^{-1} K) on soil/plant nutrient status and yield of tea.**
Clone TRI 2025, St.James Estate, Hali Ela - (1990)

The data collected over the period of January to December 2002 are being analysed for soil physico-chemical properties, plant nutrients and statistical significance. This experiment continues.

R.G.A.Wijayawardhana, D.M.B.N. Dissanayake, O.G.K.A.Gunaratne ,G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) **Effects of split application of N and K fertilizer in mature tea in relation to N/K antagonism.**
Clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years (June 1990 to December 2000) continue as a holistic approach, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) **Effects of different rates of N (240, 420 and 600 kg ha^{-1} yr^{-1} N), K (120, 300 and 480 kg ha^{-1} yr^{-1} K_2O) and frequencies (6, 8 & 12 weekly intervals) on growth, soil/plant nutrient status and yield of tea.**
Clone TC9, Brunswick Estate, Maskeliya - (1998)

All the data collected during the previous cycle (January 1998 to end 2002) have been critically analysed and to be presented at the 206th Experiments Extension forum, to be held on 31st January 2003. This experiment continues.

T.C.N.Peries, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

c) **Effects of application of different rates of K_2O at two levels of N viz. 240 and 360 kg ha^{-1} yr^{-1} as urea and sulphate of ammonia on growth, soil/plant nutrient status and yield.**

1) **Effects of application of 6 levels of potash (60-360 kg $ha^{-1}yr^{-1}$) with 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/plant K and Mg status and yield of tea.**
Clone TRI 2025, Halgolla Estate, Yatiyantota - (1984)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 12 years (October 1984 to March 1996) continue as a holistic approach, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

G.P.Gunaratne, A.K.N.Zoysa, L.S.K. Hettiarachchi

d) **Effects of application of different levels of N with different levels of compost manure on growth, soil/plant nutrient status and yield.**

1) **Effects of seven different levels of N (0 to 720 kg ha^{-1} yr^{-1}) with compost manure (at 0 and 5 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.**
Clone DT1, St.Coombs Estate, Talawakelle - (1992)

The yield obtained during the period August 2001 to July 2002, in the 4th year of the cycle, soil pH, and K levels at 0-15 cm depth, and leaf N and K are given in Tables 26, 27, 28 and 29, and 30 respectively.

As observed during most of the years, yield in the 4th year of the cycle also showed a significant increase in diminishing returns with increasing rates of N, towards 450 and then flattening out like previously, except in the 2nd year's linear pattern. So far, compost had no significant overall effect, nor was there an interaction. However, unlike earlier observations, in last two years data did not show the widening pattern of yield between compost and no compost application.

TABLE 26 - *Effect of different levels of nitrogen with and without compost on yield of tea*

Treatments	*Yield (MT kg ha^{-1})*			
N level				
	Compost			
	Nil	5t	Mean	
N				
0	1693	1715	1704	
120	2024	2074	2049	
240	1987	2072	2030	
360	2116	2038	2077	SE 57
480	2054	2127	2091	LSD (0.05) 174
600	2187	2009	2098	
720	2092	1985	2038	
Mean	2022	2003	2012	
	SE 31			SE 81
LSD (0.05)	NS			NS
CV% 5.7				

TABLE 27 - *Effect of different levels of nitrogen with and without compost on soil pH*

Treatments	*Soil pH*			
N level				
	Compost			
	Nil	5t	Mean	
N				
0	4.95	5.23	5.09	
120	4.62	4.72	4.67	
240	4.35	4.52	4.44	
360	4.31	4.37	4.34	SE 0.109
480	4.39	4.30	4.34	LSD (0.05) 0.332
600	4.09	4.64	4.37	
720	4.18	4.76	4.47	
Mean	4.41	4.65	4.53	
	SE 0.058	SE 0.153		
	LSD (0.05) 0.177			
CV% 4.8				

Although the pH determinations made in November 2000 and July 2001 did not clearly show variation with increasing N rates, this year's estimation showed that the level clearly decreased with increasing rates of N like the determinations made in 1999. This is despite having applied dolomitic-limestone at rate of 1500 kg ha^{-1} in August 1998.

TABLE 28 - *Effect of different levels of nitrogen with and without compost on soil exchangeable K*

Treatments	*Soil ex. K (mg kg^{-1})*			
N level				
	Compost			
	Nil	5t	Mean	
N				
0	166	180	173	
120	213	246	229	
240	220	188	204	
360	240	230	235	SE 22
480	223	270	246	
600	203	311	257	
720	233	226	229	
Mean	214	236	225	
	SE 12			SE 31
				LSD (0.05) NS
				CV% 20

TABLE 29 - *Effect of different levels of nitrogen with and without compost on leaf N concentration*

Treatments	*Leaf N (%)*			
N level				
	Compost			
	Nil	5t	Mean	
N				
0	3.41	3.36	3.38	
120	3.29	3.02	3.15	
240	3.22	3.40	3.31	
360	3.15	2.86	3.00	SE 0.103
480	3.07	3.39	3.23	
600	3.22	3.36	3.29	
720	3.47	3.26	3.36	
Mean	3.26	3.23	3.25	
	SE 0.055			SE 0.145
				LSD (0.05) NS
				CV% 6.3

Soil K levels, in general, are expected to drop when excessive nitrogen is applied to soil, but at this site, so far no such trends have been observed. The quantity of potash supplied for plots was 180 kg ha^{-1} except for nil N plots. Soil K levels in the nil N plots were, therefore, considerably lower compared to other treatments. As far as leaf N and K concentrations are concerned, no significant influences have so far been found with increasing rates of N fertilizer or compost application.

TABLE 30 - *Effect of different levels of nitrogen with and without compost on leaf K concentration*

Treatments *N level*	*Leaf K (%)*			
	Compost			
	Nil	5t	Mean	
N				
0	1.45	1.51	1.48	
120	1.31	1.50	1.40	
240	1.40	1.36	1.38	
360	1.26	1.35	1.30	SE 0.042
480	1.34	1.31	1.32	
600	1.38	1.41	1.39	
720	1.45	1.32	1.39	
Mean	1.37	1.39	1.38	
	SE 0.022			SE 0.059
				LSD (0.05) NS
				CV% 6.1

This experiment continues.

R.G.A.Wijayawardhana, D.M.B.N. Dissanayake, O.G.K.A.Gunaratne G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of three different levels of N (200, 400 and 600 kg ha^{-1} yr^{-1}) with different levels of compost manure (at 0, 10, 20 and 30 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, Baddegama Estate, Baddegama - (2000)

This experiment appeared in the Annual Report 2000 as A15.2.1.14 and in 2001 as A15.2.1 (d) 2. With heavy horsehair blight infestation and its age profile, treatment effects appeared to have been overshadowed, therefore it is to be terminated soon.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of three different levels of N (200, 400 and 600 kg ha^{-1} yr^{-1}) with different levels of compost manure (at 0, 10, 20 and 30 t ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2026, Anninkande Estate, Deniyaya - (2001)

Data collected before and after imposing treatments, during the period January 2001 to end December 2002, have been analyzed statistically and kept as base information. The experiment continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

e) Effects of application of different rates and proportions of urea and sulphate of ammonia on growth, soil/plant nutrient status and yield.

The following trials, vide 1 to 7, are being carried out as part of a post-graduate study on S nutrition with specific objectives too, and the detailed investigations are therefore underway.

1) Effects of application of different rates of N as urea and sulphate of ammonia (240 and 360 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, St. Coombs Estate, Talawakelle (May 1979)

The yield obtained during the 2nd year of the 6th cycle is given in Table 31.

TABLE 31 - *Effect of different proportions of Urea:S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

	Level of N (kg ha^{-1} yr^{-1})			
Proportions (%) Urea:S/A	240	360	Mean	
100:0	2958	3075	3017	
75:25	2765	3076	2920	
50:50	2885	3266	3075	SE 125
25:75	2870	3007	2938	
0:100	2839	3495	3167	
Mean	2863	3184	3024	
	SE 79			SE 177 (18 df) CV 10 %

On the average, application of N at 360 kg ha^{-1} yr^{-1} gave 321 kg more crop than the 240 kg ha^{-1} yr^{-1}, which was in fact significantly different unlike the last year. During 1st and 2nd years of the previous cycle also, application of N at the higher rate gave more crop than the lower rate and this difference became significant only in the 3rd and 4th years. During this year as well, the effects of Urea:S/A proportions and its interaction on yield were not significant.

The effect of application of Urea and S/A on soil pH and sulphate sulphur levels (at 0-15 and 15-30 cm), and leaf sulphur concentrations are given in Tables 32, 33, 34 and 35 respectively.

TABLE 32 - *Effect of application of different proportions of Urea:S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on soil pH at 0-15 cm depth*

	Level of N (kg ha^{-1} yr^{-1})		
Proportions (%) Urea:S/A	240	360	Mean
100:0	4.38	4.11	4.25
75:25	4.51	4.22	4.36

50:50	3.99	3.97	3.98	SE 0.144
25:75	3.90	4.02	3.96	
0:100	4.14	3.64	3.89	
Mean	4.18	3.99	4.09	
	SE 0.091		SE 0.204 (18 df) CV 8.6%	

TABLE 33 - *Effect of application of different proportions of Urea:S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on soil pH at 15-30 cm depth*

Proportions (%)	*Level of N (kg ha^{-1} yr^{-1})*			
Urea:S/A	240	360	Mean	
100:0	4.54	4.10	4.32	
75:25	4.62	4.28	4.48	
50:50	4.15	4.06	4.11	SE 0.158
25:75	3.95	3.97	3.96	
0:100	4.20	3.73	3.96	
Mean	4.29	4.03	4.16	
	SE 0.099		SE 0.223(18 df) CV 9.3%	

TABLE 34 - *Effect of application of different proportions of Urea and S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on soil sulphate sulphur levels at the 0-15 and 15-30 cm depths*

Proportions(%)	*$(SO_4)^{2-}$-S (mg kg^{-1})*	
Urea:S/A	*0-15 cm*	*15-30 cm*
100:0	114	130
75:25	172	213
50:50	282	321
25:75	274	364
0:100	309	401
SE	32	47
Level of N (kg ha^{-1} yr^{-1})		
240	238	288
360	221	284
SE	20	30
LSD (0.05)	NS	NS
CV %	34	40

TABLE 36 - *Effect of different proportions of Urea:S/A at 200, 300, 400 and 500 N (kg ha^{-1} yr^{-1}) on fresh pruning weight (kg plot^{-1})*

Proportion Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 200	300	400	500	Mean	
100:0	76	82	75	76	77	
75:25	101	70	77	136	96	
50:50	98	81	86	68	83	SE 7.3
25:75	104	55	119	107	95	
0:100	95	92	82	119	97	
Mean	95	76	88	101	90	
			SE 6.5			SE 14.5 (38 df)
						CV 28 %

TABLE 37 - *Effect of different proportions of Urea:S/A at 200, 300, 400 and 500 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

Proportion Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 200	300	400	500	Mean	
100:0	4279	4008	3896	3907	4022	
75:25	4018	3995	4108	3923	4011	
50:50	4037	4024	3913	3846	3955	SE 50
25:75	3966	4018	3913	3941	3960	
0:100	4086	3997	4049	3908	4010	
Mean	4077	4008	3976	3905	3992	
			SE 45			SE 100 (38 df)
						CV 4.3 %

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga
G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300 and 400 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 3018, Field No.2, Ury Estate, Passara - (1999)

TABLE 35 - *Effect of application of different proportions of Urea and S/A at 240 and 360 N (kg ha^{-1} yr^{-1}) on total Leaf S concentration*

Proportions(%) Urea:S/A	*(Total S) (%)*
100:0	0.32
75:25	0.29
50:50	0.31
25:75	0.29
0:100	0.31
SE	0.020
Level of N (kg ha^{-1} yr^{-1})	
240	0.31
360	0.30
SE	0.012
LSD (0.05)	NS
CV %	16.4

After applying dolomite at the rate of 1500 kg ha^{-1}, at the time of pruning soil pH levels determined in the 2nd year, at both depths where N was applied at the rate of 360 kg ha^{-1} yr^{-1}, was lower compared to 240 N although not significant. This was in spite of the difference in the 1st year become significant. A trend in decreasing soil pH levels was observed even in this year like in the initial phase of the previous cycle at both depths, as the proportion of S/A increased in Urea + S/A combinations although it was not statistically different. Determination made in the 1st year showed that it was significant particularly at the 0-15 cm depth.

As has been observed, there was a significant linear reduction in soil sulphate sulphur as the proportion of urea increased in the combinations, at both depths. However, leaf sulphur concentrations were not yet affected either due to Urea + S/A combinations or N rates, as can be seen from Table 42. This experiment continues as a long-term trial.

S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2027, Field No.8, Talgaswela Estate, Galle - (1999)

Fresh pruning weight and the yield obtained during the 1st year (October 2001 to September 2002) of the cycle is given in Tables 36 and 37 respectively.

Following pruning, neither the fresh pruning weight nor the yield significantly vary with the increasing rates of N and application of N in different proportions of Urea:S/A. The experiment continues.

The yield obtained during the 3rd year (August 2001 to July 2002) of the cycle is given in Tables 40.

Surprisingly although the yields are extremely high in magnitude, yield did not significantly vary even with the increasing rates of N and experiment continues.

TABLE 40 - *Effect of different proportions of Urea:S/A at 200, 300, 400 and 500 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

	Level of N (kg ha^{-1} yr^{-1})					
Proportion Urea:S/A	200	300	400	500	Mean	
100:0	7670	7847	8192	7196	7726	
75:25	8479	8159	8360	8708	8427	
50:50	8867	7650	7929	7190	7910	SE 218
25:75	8571	7126	8441	7969	8027	
0:100	7954	7981	7816	7810	7890	
Mean	8308	7753	8148	7775	7996	
			SE 195			SE 436 (38 df)
						CV 9.4 %

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

5) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2026, Field No.7, St. Francis Division,
Millakande Estate, Horana - (2001)

Yield collected before and after imposing treatments, during the period October 2001 to end December 2002, have been analyzed statistically and kept as base information. The experiment continues.

T.C.N.Peries, D.M.B.N.Dissanayake, O.G.K.A.Gunaratne, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa and L.S.K.Hettiarachchi

6) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2026, Field No.13, B Division,
Kiriwangange Estate, Deniyaya - (2001)

Yield collected before and after imposing treatments, during the period February 2002 to end December 2002, have been analyzed statistically and kept as base information. The experiment continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

TABLE 38 - *Effect of different proportions of Urea:S/A at 200, 300 and 400 N (kg ha^{-1} yr^{-1}) on fresh pruning weight (kg plot^{-1})*

Proportions Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 200	300	400	Mean	
100:0	112	110	96	106	
75:25	89	92	97	92	
50:50	97	108	109	104	SE 5.2
25:75	116	107	108	110	
0:100	108	110	83	100	
Mean	104	105	98	103	
			SE 4.1		SE 9.1 (42 df)
					CV 17.7 %

Fresh pruning weight and the yield obtained during the 1st year (October 2001 to September 2002) of the cycle is given in Tables 38 and 39 respectively.

TABLE 39 - *Effect of different proportions of Urea:S/A at 200, 300 and 400 N (kg ha^{-1} yr^{-1}) on yield (kg MT ha^{-1} yr^{-1}) of mature tea*

Proportions Urea:S/A	*Level of N (kg ha^{-1} yr^{-1})* 200	300	400	Mean	
100:0	1462	1595	1372	1477	
75:25	1424	1465	1652	1514	
50:50	1449	1596	1591	1545	SE 66
25:75	1683	1422	1497	1534	
0:100	1372	1547	1861	1593	
Mean	1478	1525	1595	1532	
			SE 51		SE 115 (42 df)
					CV 15.0%

Even at this site, neither the fresh pruning weight nor the yield significantly vary with the increasing rates of N and application of N in different proportions of Urea:S/A. The experiment continues.

T.C.N.Peries, D.M.B.N.Dissanayake, O.G.K.A.Gunaratne, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

4) Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2023, Field No.3, Upper Division,
Mahaousa Estate, Madulkelle - (2001)

7) **Effects of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha^{-1} yr^{-1}) and their proportions (Urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Field No.3A, Lower Abbotsford Division,
Dessford Estate, Nanu-oya - (2001)

Yields are being collected during the immature phase and the experiment continues.

T.C.N.Peries, O.G.K.A.Gunaratne, S.Ananthacumaraswamy, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

g) Effects of application of different sources of organic manure on improvement of soil organic matter, growth, soil/plant nutrient status and yield.

1) **Effects of application of different sources of organic manure on improvement of soil organic matter, growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Bearwell Estate, Talawakelle - (1990)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years (December 1990 to April 2001) continue as a holistic approach, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

h) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures on growth, soil/plant nutrient status and yield.

1) **Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Kiruwanaganga Estate, Deniyaya - (1993)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 06 years (June 1993 to August 1999) continue, with a view to understand the overall effects and to draw final conclusions collectively with other investigations where sul-po-mag, is being tested. Analytical work continues.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) **Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 300 kg N ha^{-1} yr^{-1}, with and without dolomitic-limestone on growth, soil/plant nutrient status and yield of tea.**
Clone TRI 2025, Hopton Estate, Passara - (1993)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 08 years (October 1993 to April 2001) continue, with a view to understand the overall effects and to draw final conclusions collectively with other investigations where sul-po-mag, is being tested. Analytical work continues.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) Effects of application of sul-po-mag and kieserite along with some of commonly used fertilizer mixtures at 2 levels of N (240 and 360 kg ha^{-1} yr^{-1}) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, Waltrim Estate, Talawakelle - (1994)

Yield obtained in the 4^{th} year of the last cycle of testing treatments following commencement, is presented in Table 41.

Apparently, 4^{th} year yield in the last cycle, did not significantly vary with respect to application of N levels, despite having a significant difference in the last year. A notable difference yet exists between the two levels. In the 2^{nd} year of this cycle also, there was a notable difference present. But in the 1^{st} year it was marginal like in both the 1^{st} and 2^{nd} years of the previous cycle. In the 3^{rd} and 4^{th} years of the previous cycle, yields obtained for the application of N at 360kg ha^{-1} yr^{-1} were significantly higher compared to 240. There were no significant differences between the other fertilizer treatments.

TABLE 41 - *Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite on yield (kg MT ha^{-1} yr^{-1}) of tea.*

Treatments	*Level of Nitrogen (kg ha^{-1} yr^{-1})* 240	360	Mean	
U 709 (Urea)	3534	3691	3612	
U 709 + Kieserite	3513	3804	3659	
U 750 Sul-Po-Mag	3339	3665	3502	SE 86
UT Mix. (Urea & S/A)	3605	3553	3579	
T 1130 (S/A)	3641	3485	3563	
Mean	3526	3640	3583	
	SE 54		SE 122	
				LSD (0.05) NS
				CV % 5.9

Plants (40 per plot) in the experimental plots were pruned in September 2002 and fresh pruning weights taken are given in Table 42.

TABLE 42 - *Effect of application of potassium and/or magnesium from Sul-Po-Mag and kieserite on fresh pruning weight (kg $plot^{-1}$)*

Treatments	*Level of Nitrogen (kg ha^{-1} yr^{-1})* 240	360	Mean	
U 709 (Urea)	162	168	165	
U 709 + Kieserite	182	178	180	
U 750 Sul-Po-Mag	182	197	189	SE 11
UT Mix. (Urea & S/A)	177	192	184	
T 1130 (S/A)	165	160	163	
Mean	173	179	176	
	SE 7			SE 16

LSD (0.05) NS
CV % 16

No significant differences were observed in the pruning weight following the applications of treatments over 8-year period.

Investigations in this experiment are to be concluded with the completion of two pruning cycles following recording tipping weight in January 2003. The data collected over 2 pruning cycles are to be analyzed in detail for overall findings and also collectively with other investigations vide A15.2.1 (h) 1 and 2 above, where sul-po-mag, is being tested.

S.M.Dissanayake, A.K.N.Zoysa, L.S.K.Hettiarachchi

i) Effects of application of different rates of K and/or Mg on growth, soil/plant nutrient status and yield.

1) Effects of application of increasing rates of kieserite (0 to 75 kg MgO ha^{-1} yr^{-1} at 15 kg increments) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years (December 1990 to November 2001) continue as a holistic approach, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of 6 levels of potash (48 to 480 kg ha^{-1} yr^{-1} K_2O) and 2 levels of Mg (0 and 60 kg ha^{-1} yr^{-1} MgO) at 240 kg N ha^{-1} yr^{-1}, on growth, soil/plant K/Mg status and yield of tea.
Clone TRI 2025, Glenanore Estate, Haputale - (1990)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years (July 1990 to May 2001) continue as a holistic approach, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

j) Effects of application of different rates of P fertilizer on growth, soil/plant nutrient status and yield.

1) Effects of application of increasing rates of P as ERP fertilizer (0 to 120 kg P_2O_5 ha^{-1} yr^{-1} at 20 kg increments) on growth, soil/plant nutrient status and yield of tea.
Clone TRI 2025, St.Coombs Estate, Talawakelle - (1989)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years (mid 1989 to April 1999) continue, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

A.K.N.Zoysa, L.S.K.Hettiarachchi

2) **Effects of increasing rates of P as ERP fertilizer with two methods of application (Broadcast and Incorporated) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Walahanduwa Estate, Galle - (1994)**

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 06 years (April 1994 to February 2001) continue, with a view to understand the overall effects and to draw final conclusions. Analytical work continues.

A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.3 Estimating crop response to micro nutrients (Zn, B, Mn etc.) at regional level

Five trials were laid down to compare the efficacy of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with commonly used foliar spray formulations.

1) **Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea. Clone TRI 2025 Field No.3B, St Coombs Estate, Talawakelle - (1999)**

Basal soil fertilizations along with foliar fertilizations are being carried out. The rates of N and K_2O supplied are 300 and 150 kg ha^{-1} yr^{-1} respectively. The yield obtained in the 4th year is given in Table 43.

TABLE 43 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations on yield*

Foliar Fertilization Formulation	*Yield (MT kg ha^{-1} yr^{-1})*	
Water (control)	2704	a
Kiecite	2852	ab
Zinc sulphate	2912	bc
Zinc sulphate + CES	2945	bc
Multiplex	3016	c
SE	50.3	
LSD (0.05)	155	
CV %	3.5	

Multiplex treated plots gave significantly higher yields when compared to the control. Both zinc sulphate and zinc sulphate along with commercial Epsom salt also gave significantly higher yields. Experiment will continue.

T.C.N.Peries, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) **Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea.**
Clone TRI 2025 Field No.3, Baddegama Estate, Baddegama - (2000)

Investigation in this experiment was concluded with the completion of present cycle owing to death of plants. The data collected over period of March 2000 to end March 2002, following commencement, have been analyzed statistically. No meaningful conclusions were made.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

3) **Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea.**
Clone TRI 2025 Field No.9, Madulkelle Estate, Madulkelle - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rate of N supplied is 320 kg ha^{-1} yr^{-1} from U709. The yield obtained in the 4th year is given in Table 44.

TABLE 44 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations on yield*

Foliar Fertilization Formulation	*Yield (MT kg ha^{-1} yr^{-1})*
Water (control)	5124
Zinc sulphate	5168
Zinc sulphate + CES	5110
Zinc sulphate + CES + Urea	5079
Multiplex	5535
Kiecite	4858
SE 336.2	
LSD (0.05) NS	
CV % 6.5	

So far, no significant variation in yield was found with foliar fertilisation treatments. Experiment will continue.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

4) **Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea.**
Clone TRI 2025 Field No.3B, Greenwood Estate, Nawalapitiya - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rate of N supplied is 320 kg ha^{-1} yr^{-1} from U709. The yield obtained in the 3rd year is given in Table 45.

TABLE 45 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with two commonly used foliar spray formulations on yield*

Foliar Fertilization Formulation	*Yield (MT kg ha^{-1} yr^{-1})*
Water (control)	3739
Zinc sulphate	4119
Zinc sulphate + CES	4054
Zinc sulphate + CES + Urea	3845
Multiplex	3899
Kiecite	3701
SE 174.9	
LSD (0.05) NS	
CV % 9.0	

So far, no significant variation in yield was found with foliar fertilisation treatments. Experiment will continue.

W.M.S.Wijayatunga, P.L.K.Tennakoon, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

5) Effects of application of micro nutrient foliar feeds such as Multiplex and Kiecite along with 2 conventional zinc sulphate solution combinations (11kg Zn ha^{-1} yr^{-1}) on growth, soil/plant nutrient status, quality and yield of tea.
Clone TRI 2025, Field No.3, Upper Division,
Indola Estate, Deniyaya - (2000)

Basal soil fertilizations along with foliar fertilizations are being carried out. The rates of N and K_2O supplied are 320 and 100 kg ha^{-1} yr^{-1} respectively. The yield obtained in the 3rd year is given in Table 46.

No significant variation in yield has so far been found with foliar fertilisation of the different formulations. The experiment will also continue.

TABLE 46 - *Effect of conventional zinc sulphate and/or commercial Epsom salt foliar spray solutions with commonly used foliar spray formulations on yield* of tea.

Foliar Fertilization Formulation	*Yield (MT kg ha^{-1} yr^{-1})*
Water (control)	3731
Zinc sulphate	3867
Zinc sulphate + CES	3883
Multiplex	3895
Kiecite	3805

SE 146.8
LSD (0.05) NS
CV % 7.7

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, R.P.Kulatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.4 Evaluating effects of macro and micro nutrients on colour and strength of tea liquor

1) Effects of foliar application of phosphorus (0, 1, 2, 3 and 4% DAP and TSP) on plant P status, quality (biochemical parameters) and yield of tea Clones DT 1 and CY9, St.Coombs Estate, Talawakelle - (1992)

The optimum quantities of nutrients have been given by soil fertilisation. However, following the inclusion of TRI2025 clone, no attempt was made during last year also for assessing made tea quality. Yield records were maintained and soil and plant nutrient status assessed with a view to undertaking quality assessments. This experiment continues.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of foliar application of muriate of potash (MOP) and sulphate of potash (SOP) fertilizers at 2, 3 and 4% concentrations, along with a control on K-status, quality, growth and yield of tea.

a) Clone TRI 2025, Field No. 5, St.Coombs Estate, Talawakelle - (1999)
b) Clone PK2, Field No. 13, Pedro Estate, Nuwara-Eliya - (2000)

The above two trials concluded as the results of investigations showed that wider variation in some of measurable parameters present, over shadowing the treatment effects.

P.S.Munasinghe, T.C.N.Peries, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Project A15.6 An islandwide survey on identifying factors affecting response to potash, K (and S).

Data have been collected from 19, 28, 4, 1, 2, 3, 2, 9, 7, 8 fields in the estates under WU1, WU2, WU3, WM1, WM3, WL1, WL4, IU1, IU2 and IM2 agro-ecological regions respectively. Collected soil and leaf samples are being analyzed for nutrient status, and other data are being organized for statistical analysis.

G.P.Gunaratne, S.M Dissanayake, W.M.S Wijayatunga, L.S.K.Hettiarachchi

Thrust A16 Development of regional and site specific dolomitic limestone recommendations, for ameliorating soil acidity and enhancing soil productivity.

Project A16.4 Establishing dolomitic limestone requirements for better growth of mature plants in different tea growing regions at soil-series levels.

1) Effects of application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & yearly basis) on growth, soil/plant nutrient status and yield of tea. Clone TC 9, Field No.4, St.Coombs Estate, Talawakelle - (1989)

The yield obtained in the 3rd year of the cycle is given in Table 47.

As observed previously, virtually same results were found in yield variations. There was no significant effect in this year as well on yield for the frequency of dolomitic limestone application, but it varied significantly with increasing rates of dolomitic-limestone, the pattern of decrease being linear, and yields dropping sharply beyond 2500 kg ha^{-1} application. No interaction was found between rates and frequencies of application. But, when considering the rates of application and frequency, considerably lower yields were recorded at 10,000 kg ha^{-1} rate applied on cycle and mid-cycle frequencies, and 5000 kg ha^{-1} rate applied on cycle, mid-cycle and yearly frequencies, compared to nil dolomitic-limestone application. However, no substantial differences were found where dolomitic-limestone was applied at 1250 and 2500 kg ha^{-1} on any frequency compared to nil dolomitic-limestone application.

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years continue, with a view to understand the overall effects. This experiment is in progress.

TABLE 47 - *Effect of increasing level of dolomitic-limestone application on yield (kg MT ha^{-1} yr^{-1}) of tea.*

Rate of dolomite (kg ha^{-1} pruning cycle^{-1})	*Frequency of dolomite application*				
	Cycle	*Mid-cycle*	*Yearly*	Mean	
Control	2684	-	-	-	
1250	2545	2709	2528	2594	
2500	2509	2580	2594	2561	SE 53
5000	2139	2328	2361	2276	
10000	2069	2147	-	2108	SE 65
Mean	2316	2441	2494		
SE	46	46	53		SE 93 (44 df)
CV % 6.9					

R.G.A.Wijayawardhana,G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

2) Effects of application of increasing levels of dolomitic-limestone at three frequencies (Cycle, Mid & Yearly basis) on growth, soil/plant nutrient status and yield of tea. Clone TRI 2025, Field No.2, Moragolla Estate, Imaduwa - (1990)

Total nutrient analysis of the pruned branches and, some soil and leaf samples collected over 10 years continue, with a view to understand the overall effects along with the St Coombs trial vide A16.4 (1) and also to draw final conclusions collectively. Analytical work continues.

J.R.Y.Abeywardane, W.T.B.D.Priyantha, M.A.Wijedasa, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Friction angle (on different surfaces), repose angle and shear strength that intervened with the free flowing of fresh samples have been determined for the different tea fertilizer mixtures and their ingredients and given in Table 48.

TABLE 48 - Friction and repose angles and shear-strength of samples over different surfaces

Fertilizer	Average friction angles				Average Repose angle	Average Shear strength (kg m x m)
	Metal sheet (Iron)	Al sheet	Perspex	Stainless Steel		
Urea	28	27	26	25	42	6.99
MOP	43	40	40	38	48	11.85
ERP	47	45	43	40	48	10.6
Dolomite	31	30	32	30	44	14.35
U709	35	42	43	40	47	12.23
T750	27	26	25	25	40	16.0
VP/UM	29	27	26	26	45	12.5

As the existing mechanisms in the imported applicators failed, several possible mechanisms for smooth release of fertilizers have been evaluated viz. vibrating mechanism, auger mechanism, scraping mechanism. At the same time different shapes of hoppers have also been evaluated. Modifications continue.

C.S.K.A.Ratnayake, N.P.S.N.Bandara,W.M.S.Wijayatunga, B.F.A.Basnayake, S.M Hulangamuwa, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

BASIC RESEARCH

1) Fate of long term application of ERP fertiliser in acid tea soils

Soil samples were collected from a long-term (40 years) on-going field trail using NPK fertilizer located at St. Coombs, Talawekelle. The treatments are 3 levels of NPK in factorial combination. Representative soil and leaf samples were analyzed to understand the fate of long term application of Eppawela Phosphate Rock (ERP) in soil.

Increasing rates of N had increased the acidification of soil. Irrespective of the level of N applied to the soil, the application of increasing levels EPR fertiliser has increased the soil pH. The consumption of soil acidity for the dissolution of phosphate rock should be the reason for increase in soil pH.

The P-fractionation revealed that increasing levels of long-term ERP application had increased resin–P, NaOH-P_i and NaOH-P_o in the soil. Majority of applied ERP was recovered as NaOH-P_I and NaOH-P_o in the soil. The concentration of resin-P and residual-P fractions were low compared to the other P fractions. The H_2SO_4-P fraction was rather undetectable. This proved that there was sufficient acidity to make the applied EPR dissolve completely in the soil.

S N Liyanagama and A K N Zoysa

3) **Effects of different particle sizes of applied dolomitic-limestone fertilizer on soil pH, soil/plant Mg status and yield of tea.**

a) Clone TRI 2023, Mattakelle Estate, Talawakelle - (1991)
b) Clone TRI 2025, Talangaha Estate, Nakiyadeniya - (1991)

Two 10-year field trials testing different particle sizes of dolomitic limestone on amelioration of soil pH, showed no difference in yield, pH and the available Mg levels in soil for different size.

R.G.A.Wijayawardhana, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A17 Development of fertilizer and/or dolomite applicators for improving broadcasting efficacy and to overcome labour shortage

Project A17.1 Evaluating and improving the efficiency of fertilizer applicators

Shortcomings and inefficiencies in manual fertilizer application in tea fields have been identified as uneven distribution of fertilizers and dolomite over the surface of ground in mature tea fields and inability of dosing required amount of fertilizer (T200 and T750) for immature fields.

Imported Swiss Max hand operated applicator and Kaaz motorized applicator have been tested and evaluated for the suitability to use them for tea industry in Sri Lanka. Uneven distribution of fertilizer, inability to dose required amount by hand operated applicator and high rate of fertilizer release, high rate of airflow in the motorized applicator have been identified as problems. Creation of typical dome and clogging specially with urea based tea fertilizer mixtures were the common problems in both the applicators. The reason for uneven release to the discharging tube is primarily due to the obstruction for fertilizer granules above the opening by forming a dome.

E.g. Amounts released following continued stroking of the hand-operated applicator with a complete load of 13 to 14 kg are given below.

Weight (g) of SA based fertilizer (T750) per stroke
22.1, 17.5, 17.5, 21.8, 24.5, 21.8, 26.9, 22.5, 21.2 and 28.1

However, with the urea based fertilizer mixtures, widely different amounts were released and at times hardly any release too. In the motorized Kaaz applicator, the problems were higher rate of release (10 to 16 kg per minute), and as a result crushed fertilizers such as ERP and dolomite forms in to clouds, and eject particles with high momentum due to high airflow rates and at the same times with dome creation particularly when urea based mixtures are used, leading to irregular discharge.

In the hand-operated applicator, a moving flap governs discharge over the opening. But when an extra flap is fixed to the bottom of the opening and moved them together by stroking reciprocally, the amounts confined are given below:

Weight (g) of SA based fertilizer (T750) per stroke
14.9, 15.4, 14.9, 14.9, 14.9, 15.0, 15.2, 15.2, 15.4 and 15.7

The above results indicated the generation of accurate doses when two flaps are operated (Top and Bottom).

2) Effect of mixing compost on the dissolution ERP in organic tea soils

The application of Eppawela rock phosphate rock (ERP) and compost as natural sources of nutrients is usual practice in organic tea growing. However the work on ERP dissolution in organic tea soils in the presence is not studied adequately. Therefore this study is to understand the fate of ERP in organic tea soils.

Soil were collected from Stassen Bio Tea Project at Haputale and treated with ERP at 0, 15, 30 and 45 kg P ha^{-1} and compost at 0, 10, 20 and 30 mt ha^{-1}. The treatments were replicated 4 times and arranged in complete randomized design in a glasshouse at the TRI, Talawakelle.

The study showed that the application of ERP and compost increased soil pH. The concentration of Ex. Ca and Mg in the soil increased in the soil with time due to mineralization of organic matter in compost and release of Ca in the dissolution of EPR in the soil. The P-fractionation revealed that the applied P was recovered as rein-P, NaOH-P_i and NaOH-P_o and H_2SO_4-P.

M G N Rupasinghe, A K N Zoysa and S M Dissanayake

3) Use of dolomite for amelioration of soil acidity in tea nursery soil

Soil reaction (pH) plays a dominant role on the performance of growth in nursery plants. The scarcity of soil with suitable pH is a problem in Sri Lanka to produce planting materials of good quality. The quantity of dolomite to be mixed with soil depends on many factors, however no work is reported to this effect.

An incubation study was conducted at TRI laboratory, Walahanduwa using soils collected from a tea estate at Galle. Dolomite was applied at increasing rates to the soil. A control treatment was also included and replicated 5 times. The soil pH reached a maximum at the rate of 5 g of dolomite kg^{-1} of soil. The addition of dolomite application beyond 5 g kg^{-1} of soil increased soil pH beyond the desirable range for tea plants. The increasing rates of dolomite also increased Ex. Ca and Mg in the soil. The increasing rates of dolomite decreased the borax extractable P in the soil. However the validity of the results lies with in the limits of the trial. Further investigations needed using different types of soils.

H S Weeratunga, A K N Zoysa, S M Wijedasa and K D Dahanayake

4) Evaluating soil test methods for assessing bioavailability of sulphur.

A glasshouse experiment was commenced in June using 6 soils representing different soil series under different agro-ecological regions viz WU1, WM3, WL1, WL2, WM1 and IU3 and locations Dessford, Mahaousa, Talgaswela, Millakande, Kiriwanagange and Ury estates. The six soils were sieved through a 6.4 riddle and weighed 4kg of moist soil and treated with wettable S at different rates viz 0, 20, 40, 60, 80 & 100 kg S ha^{-1}. Wettable S treated soils were put into pots of 5 L volume and replicated 6 times. Thereafter, 04-month old VP tea plant (TRI 4052) was transplanted per pot in June. Applications of basal nutrients containing NPK and Mg were made. First batch of 108 pots, were dismantled in December and fresh and dry weight of shoots and roots were recorded. Soils and leaf samples are being analysed for necessary parameters, and work continues.

G.P.Gunaratne

B15 Environmental studies

B15.1 Impact of variation of weather conditions on crop environment and productivity of tea: Assessment of the effects of wet and dry depositions from the atmosphere.

Rainwater quality monitoring continued in collaboration with the meteorological centers of the TRI stations at Talawakelle, Ratnapura, Hantane, Passara, Kottawa and Deniyaya. Parameters such as rainfall, in situ pH, NO_3-N, SO_4-S, Mg and Ca are being monitored.

The data collected during March 1999 to April 2002 have been analysed for variance and its interpretation and work continue.

P.L.K.Tennakoon, S.M.Dissanayake, O.G.K.A.Gunatratne, W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi, S.L.D.Amaratunge, P.B.Ekanayake, S.T.Yatawatte,K.D.Dahanayake, J.A.S.K.V.Jayasinghe, J.C.K.Rajasinghe.

SUPPORTIVE PROJECTS

1) Adaptive fertilizer trials

a) TRI and TSHDA collaboration

Detailed descriptions of the trials along with the objective/s and some of important findings have been given in the Annual Reports 1996 to 1999. The results obtained from the trials collected over a period of about 4 to 6 years, are being analyzed in detail collectively in order to draw final conclusions. Operations of some of these trials still continue.

S.M.Dissanayake, W.M.S.Wijayatunga, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi, S.L.D.Amarathunge, P.B.Ekanayake, S.T.Yatawatte, K.D.Dahanayake, J.A.S.K.V.Jayasinghe, S.Wimaladharma

b) TRI, and Balangoda and Madulsima Plantations collaboration - 2002

High (U877) and low potash (U709) mixtures on the soil/plant nutrient status, growth and yield in seedling and clonal tea (Eltab, Mahadowa, Wewessa, Telbedde, Kew, Kirkoswald, Cecilton, Balangoda estates and Gonakelle Estate, Passara

Either a single or two mature tea field/s was chosen from each estate and thereafter 4 to 24 plots, each consisting of 50 plants having a minimum of two replicate, were marked during the period of May to September 2002. Soil and leaf samples were obtained from each of these trials and analyzed for required physico-chemical parameters. Pretreatment yield was recorded for a period of 2 to 3 months except for Mahadowa estate, where a pruned field was chosen. Thereafter, fertilizer treatments, having ratio of N: K_2O, 1:1 and 2:1 have been carried out. Regularly harvested crop yields are being recorded. These experiments continue.

P.S.Munasinghe, G.P.Gunaratne, A.K.N.Zoysa, L.S.K.Hettiarachchi

Thrust A18 Development of regional analytical laboratories for soil, plant and fertilizer analysis.

1) Analytical laboratory service

The mean, minimum and maximum values along with the number of some routinely carried out tests at Talawakelle, Walahanduwa and Hantane laboratories are given in Table 49 and 50 respectively.

2) Analytical laboratory accreditation

The analytical laboratory at Talawakelle participated with the international laboratory evaluating programmes on chemical analysis of soil (International Soil-Analytical exchange-ISE) and plants (International Plant-Analytical Exchange-IPE). Sixteen each soil and plant samples were received for this year. They were subjected to the test methods such as pH (water, $CaCl_2$ solution), % C (Walkley and Black), E.C, Na, K, Mg and Ca in soil and Cu, Fe, Mn, Zn, Ca, K, Mg, Na, P, and Cd in plant samples. The results were submitted to the Wageningen University for evaluation.

TABLE 49 - Soil Analysis

AER	pH				C %				P ppm				K ppm				Mg ppm			
	Count	Max	Min	Mean	Count	Max	Min	Mean	Count	Max	Min	Mean	Count	Max	Min	Mean	Count	Max	Min	Mean
WU1	479	6.9	3.7	4.8	153	4.3	0.92	2.15	108	202	5	28	21	230	75	147	46	60	11	22
WU2	1567	7.4	3.8	4.7	1317	10.8	0.40	2.45	642	350	1	30	1200	850	13	160	581	400	9	85
IU1	8	4.8	3.5	4.1	11	2.1	0.83	1.67	-	-	-	-	-	-	-	-	-	-	-	-
IU2	389	6.7	3.4	4.7	376	5.7	0.53	2.25	114	96	5	41	86	440	25	143	43	300	10	74
IU3	152	6.0	4.0	4.7	80	6.6	0.40	2.05	116	98	2	38	92	500	65	177	33	223	7	75
WM1	65	7.1	4.1	4.9	58	1.5	0.25	0.91	22	96	5	40	22	180	40	78	-	-	-	-
WM2	20	5.4	4.3	4.9	20	4.5	0.76	1.60	-	-	-	-	-	-	-	-	-	-	-	-
WM3	214	6.8	3.9	4.7	212	4.9	0.30	1.48	96	76	1	16	96	425	42	122	94	186	8	56
IM2	126	6.6	3.9	4.6	89	4.9	0.91	2.40	83	40	1	22	65	441	67	263	83	300	13	57
IM3	45	5.9	3.8	4.7	106	3.8	0.85	2.15	-	-	-	-	-	-	-	-	-	-	-	-
WL1	65	5.9	3.8	4.6	39	2.3	0.65	1.35	19	21	8	39	19	250	30	134	5	42	23	30
WL2	65	7.7	3.8	5.3	10	2.8	1.00	2.00	24	20	22	2	70	75	75	75	2	48	28	38
WL4	12	5.3	3.7	5.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

WU1 Up country wet zone 1
WU2 Up country wet zone 2
IU1 Up country intermediate zone 1
IU2 Up country intermediate zone
IU3 Up country intermediate zone 1
WM1 Mid country wet zone 1
WM2 Mid country wet zone 2
WM3 Mid country wet zone 3
IM2 Mid country intermediate zone 2
IM3 Mid country intermediate zone 3
WL1 Low country wet zone 1
WL2 Low country wet zone 2
WL4 Low country wet zone 4

TABLE 50 - Leaf Analysis

AER	N %				P %				K %				Mg %			
	Count	Max	Min	Mean	Count	Max	Min	Mean	Count	Max	Min	Mean	Count	Max	Min	Mean
WU1	8	3.5	2.5	3.0	8	0.25	0.18	0.15	8	1.82	1.34	1.67	8	0.26	0.21	0.24
WU2	50	3.6	2.5	3.1	68	0.50	0.10	0.18	68	2.00	0.65	1.39	44	0.31	0.16	0.21
IU1	1	3.0	3.0	3.0	1	0.15	0.15	0.15	1	1.25	1.25	1.25	1	0.41	0.41	0.41
IU2	29	4.2	2.7	3.2	29	0.30	0.13	0.20	29	1.81	1.10	1.34	29	0.26	0.17	0.22
WM3	25	3.7	2.3	3.2	25	0.22	0.14	0.19	25	2.1	1.10	1.52	25	0.31	0.10	0.24
IM3	16	3.5	2.8	3.2	-	-	-	-	-	-	-	-	16	0.28	0.18	0.24
WL1	12	3.7	3.1	3.4	12	0.22	0.15	0.18	12	1.50	.085	1.21	12	0.25	0.12	0.19

O.G.K.A.Gunaratne, D.M.B.N.Dissanayake, T.C.N. Peries, S.M. Disssanayake,
R.G.A.Wijayawardhana, M.A.Wijedasa, J.R.Y.Abeywardane, B.D.Priyantha. R.P.Kulatunga,
W.M.S.Wijayatunga, P.L.K.Tennakoon, P.S.Munasinghe,
S.Ananthacumraswamy,G.P.Gunaratne,A.K.N. Zoysa, L.S.K.Hettiarachchi

PUBLICATIONS

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9. Zoysa A K N 2002 Some aspects of dolomite use in tea cultivation. (Accepted for publication in Tea Bulletin Tea Research Institute of Sri Lanka).

10. Hettiarachchi L S K Zoysa A K N Gunaratne G P and Ananthacumaraswamy S 2002 Fertilisation of tea in Sri Lanka: A historical review. (Accepted for publication in the Jubilee commemorative volume of the Tea Research Institute of Sri Lanka.

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THESIS

Nil

GENERAL

Mr R G A Wijayawardhana has successfully completed course work in Environmental Science at PGIS, University of Peradeniya. in October.

Dr L.S.K.Hettiarachchi served as:

a) A member of the Working Group on Fertilizer to the Sri Lanka Standards Institute
b) A member of the Technical Committee on Organic Fertilizer to the Sri Lanka Standards Institute

Dr.A.K.N.Zoysa served as:

a) A member of the Executive Committee of the Soil Science Society of Sri Lanka
b) A member of the Publication panel of the TRI

Meetings and seminars

Drs L S K Hettiarachchi and A K N Zoysa, and Messrs G P Gunaratne, P S Munasinghe and Mrs S Ananthacumraswamy attended the 204th and 205th E & E meeting, held at TRI Auditorium, Talawakelle on 1st and 26th February and July respectively.

Dr L.S.K.Hettiarachchi attended the RSC V (Kelani Valley Region) meeting, held at the Salika In, Kegalle on 8th March 2002.

Drs L S K Hettiarachchi and A K N Zoysa, and Messrs G P Gunaratne, P S Munasinghe and Mrs S Ananthacumraswamy attended the 9th and 10th E & E (Sinhala) meeting, held at TRI Auditorium, Talawakelle on 10th and 11th May and October respectively.

Drs L S K Hettiarachchi and A K N Zoysa attended the RSC VII (Galle/Deniyaya) meeting, where Dr A K N Zoysa presented a paper entitled "Eppawela phosphate rock as a source of P in tea" held at Sun Shine Inn Hotel. Unawatuna. on 17th May.

Dr L S K Hettiarachchi attended the RSC (Kandy) 1st and 2nd meeting, where at the 2nd meeting Dr L S K Hettiarachchi delivered a lecture on "Fertilization of tea with special reference to nutrient deficiencies and corrective measures for mid grown tea" held at the In-Service Centre, Gannoruwa and Hotel Tourmaline, Kandy on 5th and 29th June and November respectively.

Dr. A K N Zoysa attended an International conference on 14th IFORM Organic World Congress on "Cultivating Communities" conducted by Canadian Organic Growers, where he presented a paper entitled "Comparison of soil fertility status in organic and conventional tea (*Camellia sinensis L*): Growing system in Sri Lanka held in Victoria conference center. Canada. during 12th to 24th August.

Dr L S K Hettiarachchi attended the RSC III (Uva) meeting, held at Uva Management Training Centre, Passara, on 3rd September.

Training programmes and workshops

Mr. P S Munasinghe participated a workshop on "Rocks and Minerals", conducted by the PGIS and Geological Survey and Mines Bureau held at the PGIS Auditorium, Peradeniya from 25th to 27th January.

Dr A K N Zoysa attended a workshop on "Organic Tea Plantation" conducted by Gami Seva Sevana, held at the Gami Seva Sevana Ltd. Kandy, on 27th February 2002.

Dr A K N Zoysa attended a meeting on " A G M of Loam", conducted by the Lanka Organic Agricultural Movement Interim Committee Secretariat, held at the Devon Restaurant, Kandy on 1st June.

Dr A K N Zoysa attended a meeting on " Lanka Organic Agricultural Movement, First Executive Committee Meeting", conducted by the Lanka Organic Agricultural Movement Secretariat, held at the Board Room, Post Graduate Institute of Agriculture, Peradeniya on 7th July.

Mr G P Gunaratne and Mr. P S Munasinghe attended a workshop on " A Systematic Approach to Formulate Site-Specific Fertilizer Recommendations" conducted by Soil Science Society of Sri Lanka in collaboration with Phosphate and Potash Institute of Canada held at Post Graduate Institute of Agriculture, auditorium during 26th to 31st August 2002.

Mr. P S Munasinghe attended a seminar on "Research Methodologies", conducted by the Sri Lanka Association for the Advancement of Science Section E2 (Chemical Sciences) and National Science and Technology Commission – Young Scientists Forum in collaboration with University of Kelaniya and Industrial Technology Institute, held at the Auditorium, Industrial Technology Institute, Colombo on 9th August.

Dr L.S.K.Hettiarachchi attended Executive Committee Meeting on "Metrology Services at SLSI", conducted by the Sri Lanka Association of Testing Laboratories, held at the Metrology Laboratory, Colombo on 2nd August.

Dr A K N Zoysa attended a meeting on " Lanka Organic Agricultural Movement, Forth Executive Committee Meeting", conducted by the Lanka Organic Agricultural Movement Secretariat, held at the Dambadeniya Development Foundation, Narammala, on 3rd November.

Mr. P S Munasinghe attended a one day workshop on "Recent Advances in Soil Science Research in Sri Lanka", conducted by the Soil Science Society of Sri Lanka and SRICANSOL, held at the In-service Training Centre Auditorium, Gannoruwa on 15th November.

Trainees

Trainee Assistant Superintendents from Talawakelle, Maskeliya, Horana and Udapussellawa Plantations Ltd. underwent "Familiarizing programmes on some aspects of soil fertility and tea plant nutrition" on 16th, 17th, 18th and 7th January, June, July and August respectively.

Ms G N Rupasinghe, S N Liyanagama. H S Weeratunga and T N Mathew final year Agricultural degree undergraduate students from University of Ruhunu successfully completed their 06 months research projects in October.

Visitors

About 15 middle level officers from Bhutan, Cambodia, Iran, Laos, Maldives, Myanmar, Vietnam and Sri Lanka visited the division in order to disseminate the on going SPND research projects on 1st March.

Three officers from Tea Promotion Division of S.L.T.B. visited the division on order to familiarize themselves on soil fertility and tea plant nutritional aspects on 7th May.

Fifteen delegates from 8 countries visited the division on order to familiarize themselves on soil fertility and tea plant nutritional aspects on 15th June

Mr.D.Medawala, (CEO) and Mr N. Wickremasinghe (DGM) of Udapussellawa plantations Ltd visited SPND and discussed about challenges in soil fertilizer improvements and plant nutritional aspects in tea on 12th August.

A team of scientists consists of Drs N.Muralitharan, Director UPASI, J B Hudson, Assistant Director, UPASI, R.P.K.Hango, Senior Botanist and B.Rathakrishnan, Senior Advisory Officer for UPASI, India had discussion with SPND staff regarding the on going projects and future needs on 16th September.

A group of students from Technical College, Dambulla, University of Jaffna, Wayamba University and Eastern University visited the division in order to familiarize themselves on soil fertility and tea plant nutritional aspects on 3rd August, 16th September, 28th November and 12th December respectively.

TECHNOLOGY DIVISION

M T Ziyad Mohamed - Deputy Director Research (Technology)

Computer model for drawing a rolling program

The staff developed a simple computer model to select rolling programs in black tea processing during the year 2001. Application of this model in tea factories was demonstrated at the Experiments and Extension Forum held in February. The Tea Research Board granted officers involved in developing this model two merit increments in recognition of their contribution. The Tea Research Board also decided to make this model available to the end users free of charge, as it is expected to improve the quality of tea produced.

Introduction of this model to tea factories was selected as an activity under the **"Hundred day - Revolutionary Program"** proposed by the new Government for implementation in year 2002. As such the entire staff strength was deployed in installing this program in many factories as possible, during the first four months of the year. In factories where there were no computers, information on machinery was requested through a questionnaire, and appropriate rolling programs were drawn and posted. The progress on this activity could be summarized as follows:

No. of factories visited	- 125
No. of factories where the program was installed	- 106
No of questionnaires posted	- 400
No. of replies received	- 131
No. of factories to which rolling programs were posted	- 131

Subsequently, this program was distributed in compact disks for use by the stakeholders. Adopting this program will ensure made tea quality and the efficient use of machinery.

M T Ziyad Mohamed, D L D H Dahanayaka and L Jayasinghe

1. Applied Projects

Thrust No 25:

Project A 25.1 - Reduction of cost of electrical energy in withering using speed controllers

Monitoring the performance of the speed controllers installed to 100' trough continued. During the trials, the relative humidity of the air supplied and the dry bulb temperature were maintained at comparable levels in both troughs, as far as possible.

Statistical analysis of data indicates a saving of about 39% on energy consumed due to speed controllers. Variation in moisture content of withered leaf was not significant in the experimental trough compared to control. Results were presented at the Experiment and Extension Forum held on 31 July. However, during the experiment harmonics in power supply was observed. Hence it is compulsory to use harmonic filters with speed controllers to prevent/minimize damage to the capacitors/capacitor banks.

In addition to this, several variable speed drives, supplied by different firms were tested in commercial bought leaf factories. Some of these units gave similar results compared to the unit tested by TRI, where as the performance of some other units was poor.

During the period under review, four units consisting of light-weight fans and lesser horse-power motors with speed controllers were fitted to four 60' length troughs at St Coombs factory, and their performances were monitored.

M T Ziyad Mohamed, G L C Galahitiyawa, U Marapana

Thrust No: 26
Project A 26.1 - Developing and evaluating solar energy techniques for tea drying

During the year under review, data could not be collected due to breakdown of the booster fan, coupled to this system.

M T.Ziyad Mohamed, S Koneswaramoorthy, G L C Galahitiyawa, U Marapana

Thrust No: 27
Project A 27.1 - Evaluating new type of paper sacks

The aim of this project is to recommend new packing materials with good moisture barrier properties and without any foreign odour. During the period under review, paper sacks from a new manufacturer was received for testing. The experiment is in progress.

Thrust No 28:
Project A 28.1 - Optimum condition for best grade mix in Hatton District
Project A 28.2 - Optimum condition for best grade mix in Uva

Although there is no demand for ortho-CTC tea from Hatton district, there is enthusiasm from plantations in Uva district to improve the grade mix during the off-season, as the teas produced during this season do not fetch good prices. As such, some preliminary work was carried out at TRI to establish optimum conditions, such as ideal wither percentage, gap setting etc. Environmentally Controlled Miniature manufacturing unit procured from Tea craft (UK) Ltd., was used in these trials. El-Teb estate from Uva district has been identified to carry out trials in that area. Trials will commence in January 2003

M T Ziyad Mohamed, W S Botheju, S Koneswaramoorthy,
S H Priyanthi, A M M V.Abeykoon

2. Basic Projects
B 41 - Identification of TRI 3000 and 4000 series clones for better CTC manufacture
No new clones were tested during the period under review.

B 48 - Designing a Dust Collector

At tea factories, dust coming out during drying operation creates an unpleasant environment for the officers and workers inside the factory premises. In addition to that installation of electronic items such as humidity sensors was found to be difficult inside the factories. It is therefore, intended to design dust-collecting system in order to remove dust from the factory. The systems that are already installed at factories are not promising. It is decided to improve the system through proper design.

Through a collaborative project with University of Moratuwa, fair amount of data on particle size distribution in the blow out from the drier, density of such particles, velocity of the exhaust air etc was collected. Using these data, a pilot scale unit was fabricated and tested. This unit will be tested for its performance and design improved for commercialization.

M.T.Ziyad Mohamed, K Raveendran and S Koneswaramoorthy

3. Divisional Projects

D 31 - Computer Aided Tea Manufacture

A project was initiated to check the feasibility of using load cells to monitor the withering process. A specially designed metal basket with 4 ft^2 area was placed on middle of a trough, with a view to monitoring the loss of moisture during withering, at St.Coombs factory. Another four sided cage, to prevent leaf from outside touching the basket, was installed. A load cell with digital display to indicate the instantaneous weight of the leaf inside the basket, coupled to an un-interrupted power supply (UPS), was also installed.

The basket was fixed to the load cell in such a way as to record only the weight of the leaf in the basket. The following problems were encountered with preliminary trials:

(i) Due to the up lift of the airflow from the fan, the load cell indicated a lower figure than actual.
(ii) There was a severe air leak between the basket wall and the outside cage.

Initial trials showed that the leaf inside the basket was under-withered compared to leaf outside the basket, mainly due to air pockets created as described above. Attempts to seal the air leaks between the inner basket and the cage were not very successful and as such even withers could not be achieved. Thus it was concluded that load cells could not be used to control the withers and the project was terminated.

M T Ziyad Mohamed, S Koneswaramoorthy, D L D H Dahanyake,
L Jayasinghe, A M M V Abeykoon, U D Alagiyawadu

Testing new moisture meters

A compact, new type of moisture meter working on capacitance principle, was received for testing during the latter part of the year.

In addition to this, moisture meters from the following estates were calibrated:

Estate	Meter
Mattakelle Estate	Infra Red Moisture Meter
Nayapana Estate	Infra Red Moisture Meter
Logie Estate	Infra Red Moisture Meter
Radella Estate	Infra Red Moisture Meter
Great Western Estate	Infra Red Moisture Meter
Yuillefield Estate	Kett PM 600 (Capacitance) Moisture Meter
Troup Estate	Infra Red Moisture Meter
Eildon Hall Estate	Infra Red Moisture Meter
Moray Estate	Kett PM 600(Capacitance) Moisture Meter

Though moisture determination by Infra Red Bulb method is very popular in tea factories. However, calibration of this meter is cumbersome and the readings are not reliable when there is voltage fluctuation in the power supply.

Development of a moisture meter based on capacitance principle

Moisture meters based on the capacitance principle are used in the tea industry. However, with such meters, reproducibility is very poor. Through work carried out at the TRI in the past, a theoretical model for moisture measurement by the capacitance method was established.

But designing an instrument to measure the moisture content in all grades using this model was difficult, as the bulk density varies from one tea grade to another and one factory to another. Therefore, currently experiments are carried out, to device a mechanism to make the equation independent of bulk density, by compressing a known weight of sample in a fixed volume. Although promising results were obtained for broken (small) grades, the results with leafy grades are not very encouraging. This is in progress.

M T Ziyad Mohamed, D L D H Dahanayaka, L Jayasinghe,
A M M V Abeykoon & U D Alagiyawadu.

Effect of type of manufacture on quality of tea produced

It is reported that the teas produced in Up country do not have adequate flavour, compared to what was produced a decade ago. Out of many reasons for decline in such quality, certainly the type of processing carried out too plays a major role. It is known that, since of late, the tea leaf is subjected to severe maceration in 8" diameter rotorvanes compared to gentle rolling in orthodox rollers. The objective of this study is to compare the effect of different types of rolling on made tea quality, with special emphasis on flavour.

The clone selected for the study was DT1. Field No.3 and Field No.5 of St.Coombs Estate have been reserved and the required quantity of leaves were obtained for the experiment. The leaves were plucked, transported carefully to the factory and manufactured using pure orthodox and orthodox -rotorvane types of manufacture. The made tea samples were tested for quality parameters, including flavour profile. Made tea samples were also sent to professional tea tasters for organoleptic evaluation. Six replicates were conducted during the year. More replicates will be conducted in the coming year.

Outturn Made tea to green leaf in up-country region:

Keegel in 1955 suggested an average nett out-turn of made tea to green leaf of 22.22% through out the year. Monitoring the nett outturn recorded daily at St.Coombs factory, over a period of one year mostly using seedling leaf, arrived at this figure. Since the 1960s,tea production in the country has increased mainly due to the proliferation of small-holdings and planting of vegetatively propagated tea.

Commercial scale experiments were carried out using estate leaf to determine the nett outturn achievable in Up-country and a correlation between nett outturn of made tea to green leaf and moisture content in green leaf, was established as follows:

$$NOT = 111.75 - 1.17 \times MC.$$

Where: NOT – Nett outturn of made tea/green leaf, MC – Moisture content in green leaf

These results were presented at the 205th Experiments and Extension forum held in July and also at the Uva Regional Scientific Committee meeting in September. Validity of the results is being checked using actual data obtained at St.Coombs and Mattakelle tea factories.

Results of the Outturn trial carried out at Mattakelle Estate

Trial No	GL wt (kg)	GL mc%	LS%	MT wt (kg) at 3% MC	GOT %	GT wt (kg) at 5% MC	RT %	NOT %	Predicted NOT %
1	13199.5	75.38	52.48	3336.97	25.27	2878.2	9.32	21.81	23.56
2	11454.7	76.90	52.86	2566.44	22.40	2402.8	9.34	20.97	21.77
3	14192.9	76.91	49.77	3282.50	23.12	2916.6	9.30	20.55	21.76
4	9331.6	76.87	42.00	1989.90	21.32	1966.1	10.83	21.06	21.81
5	8673.9	73.95	56.60	2049.12	23.62	1384.4	17.29	25.96	25.22

Shear plucking Vs Hand plucking Experiment at St Clair Estate

The effect of using TRI Selective Harvester was tested on yield and made tea quality was studied. Experiments were conducted at St.Clair estate and Technology division. Plots were demarcated for two popular clones TRI 2025 and K145 and seedling teas. Shear and manual plucking were carried out in randomly selected plots. Yield data from the plots were recorded. The leaves harvested were transported to TRI, manufactured and made tea samples were tested for quality parameters. Tea samples were also sent to professional tasters for organoleptic evaluation. Results from 21 replicates indicate that there is neither significant yield differences nor significant variation in quality parameters between the two treatments.

Results of chemical analysis for made tea quality parameters and organoleptic evaluation

					Tasters scores for BOP			Tasters scores for BOPF		
Clone	Treatment	TF%	TR%	TF:TR	Forbes	A/Siyaka	J/Keels	Forbes	A/Siyaka	J/Keels
Seedling	Manual	0.8329	15.5855	19	14	10	16	14	10	15
	Shear	0.8413	15.6528	19	14	10	16	14	10	16
K145	Manual	0.8131	12.1574	16	14	11	16	14	10	15
	Shear	0.8216	12.5176	16	14	10	14	14	10	14
TRI 2025	Manual	0.7144	14.9642	21	14	11	16	15	11	16
	Shear	0.7155	14.2250	20	14	10	16	14	11	16

Total yield obtained from two different clones and seedling teas

		2025	K145	Seedling
Hand	Plot1 *	63	64	50
	Plot2	63	55	48

Shear	Plot1	69	54	53
	Plot2	48	56	45

* Each plot contains 400 tea bushes

W.S.Botheju, K.Raveendran, S.H.Priyanthi, A.M.M.V.Abeykoon,
U.D.Alagiyawadu, L Jayasinghe and M T Ziyad Mohamed

ISO 9002 certification for tea processing at St.Coombs tea factory

St.Coombs tea factory was awarded the ISO 9002 certification for tea processing by SLSI. The effective date of certification is 20th of May 2002. Under this programme several internal audit programs were carried out by the staff at St.Coombs factory. The officers from the Division and the factory followed several training programmes related to ISO 9000 Quality System, Hazard Analysis and Critical Control Points (HACCP), 5 'S' etc conducted by SLSI and assisted the factory staff in implementing the ISO 9002 certification system.

Development of a Sand Separator

As reported in last three years the cleaning of sand/grit from tea is satisfactory. However, during the year under review, frequent breakdown of this machine was observed, due to poor quality raw material (such as aluminum pulley) used. It was decided to fabricate a commercial scale unit using good quality raw materials.

ISO 11286 Tea - Classification of leafy grades by particle size analysis

Based on a recommendation adopted last year, more true to type samples from St Joachim Estate are being analyzed. The work is in progress.

Determination moisture content and weight percentages of tea leaves part vice

Objective of this experiment is to check the impact of different parts of the shoots on made tea to green leaf outturn. Shoots from different clones were harvested and the weight percentage and the moisture content of each part of the plucked shoots were determined separately during wet and dry days. This is in progress.

Results of the moisture content in different parts of shoots of separate clones

	Moisture Content (%)											
CLONS	Bud	1st Stem	1st Leaf	2nd Stem	2nd Leaf	3rd Stem	3rd Leaf	4th Stem	4th Leaf	5th Stem	5th Leaf	Total
NAY3	25.30	19.69	24.35	15.63	23.00	13.18	12.81	15.51	24.81	18.49	26.85	19.05
777	28.59	24.53	26.94	18.31	23.85	15.16	23.76	16.91	28.01	20.02	29.58	24.55
DT1	26.02	21.63	24.75	17.35	23.51	13.85	22.55	36.88	23.73	16.11	25.45	23.77
CY9	26.92	24.39	26.35	17.58	25.22	14.94	25.98	15.52	26.82	19.02	29.59	24.13
2025	27.06	23.08	26.85	16.79	26.77	14.66	27.45	14.47	28.54	16.96	30.43	24.64

Shear plucking Vs Hand plucking Experiment at St Joachim Estate

No trials were carried out under this project as the miniature/experimental rollers were sent for repairs/modifications. Furthermore Superintendent St Joachim Estate was not keen in using TSTH on the estate fields.

G L C Galahitiyawa,, M A Chamindra, M T Ziyad Mohamed,
and M A Wijeratna (Agronomy Division)

Collaborative projects with National Engineering Research and Development (NERD) Center

The staff had few discussions with officials from National Engineering and Development Centre (NERD) with a view to identifying collaborative projects. Areas for collaboration identified are as follows:

i. Micro-controller application in tea withering process
ii. Generation of Biogas and bio-fertilizer manufacture from refuse tea
iii. Design and development of efficient cost effective waste heat recovery system

1. **Micro controller application in tea withering process**

Withering process is the first unit operation in tea manufacture. The control of wither in leaves received at different hours every day is a difficult task in most of the factories and as a result fair amount of energy is wasted. It was decided to incorporate control system to withering trough in order to facilitate better control of wither and to reduce the energy consumption in this process.

The details of the process and the possible control system to withering trough have been discussed with the Engineers attached to National Engineering Research and Development (NERD) center, with a view to commencing a collaborative project. NERD has made arrangements to purchase auxiliary items required for the project and develop software for the system.

2. **Biogas and Bio-fertilizer manufacture from refuse tea.**

The refuse tea produced in tea factories are decomposed and applied as fertilizer in the tea fields. These teas could be used to produce bio gas and converted as a fertilizer by **anaerobic digestion**. This process can be made as a cottage industry, where the estate people could be given the task of producing bio-gas for their cooking and lighting purposes in their households. Initially to demonstrate viability of such a system, preliminary trials are carried out using refuse tea from St Coombs at NERD with the digesters already prepared. On successful completion of the trials, the system could be used in estates. It is to be noted that the results from past research on biogas production conducted by TRI using **aerobic digestion** were not very successful.

3. **Design and development of efficient, cost effective waste heat recovery system**
Thermal energy is required to produce hot air for drying and withering processes in tea factories. In the production of hot air, considerable energy is lost in the flue gas from furnace/ heat exchangers. Some of this heat could be recovered and thereby fuel consumption in the processes could be reduced. Although several design of waste heat recovery units were suggested, the installation of such units did not gain momentum primarily due to high capital cost.

A gravity assisted heat pipe heat exchanger has been designed. This unit will be fabricated and developed to recover the heat.

4. Energy Audit

The staff was also involved in an energy audit (thermal and electrical) carried out by NERD officials at St Joachim factory, Ratnapura. Several areas for improvement were identified. Action has been taken to improve those areas and to repeat the audit again to work out the savings.

Identified improvement at St Joachim Tea Factory

Identified Improvement	Present Consumption	Expected Consumption After The Improvement.	Saving After The Improvement
Efficiency improvement of 5 pass Diesel fired Furnace	180000 liters of diesel	132000 liters of Diesel	48000 liters
Efficiency improvement of 3 pass wood fired furnace	2200 yards firewood	2050 yards	150 yards
Maintaining the hot air temperature at constant Range	2200 Yards of Firewood	2050 Yards	150 Yards
Avoid use of oversized motors	Some motors are utilized with less efficiency. Motor capacity could be reduced to improve the efficiency	Depends on the motor replaced.	Depends on the motor replaced
Optimum use of compressed air in Colour Separator	12588 kWh	7788 kWh	4800 kWh
Application of variable Speed drives for withering trough blowers	126720 kWh	76032 kWh	50688 kWh
Avoid idling operation of exhaust fans at Grading and Packing room	19836 kWh	16536 kWh	3300 kWh
Switch off the unnecessary bulbs	65364 kWh	60164 kWh	5200 kWh

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% good leaf (on count basis) or 80% on weight basis, as per recommendation of the Institute. The standard of green leaves coming to St. Coombs factory was monitored twice a week. Leaves were obtained from two Divisions, St. Coombs and Lamilliere, and the leaf samples were tested according to the following method:

After spreading the leaf, samples of approximately 100g of leaves were collected at every 10 feet length along the trough randomly, after spreading the leaves on the trough separately. The respective samples were bulked and 250g samples taken to monitor the leaf standard. The leaves were divided as standard and sub-standard leaf.

TABLE *10 - Average standard of good leaf brought to St. Coombs Factory.*

	St Coombs		Lamilere	
	Count %	Weight %	Count %	Weight %
January	73	70	64	64
February	54	65	67	75
March	62	70	63	72
April	60	64	66	73
May	44	49	50	56
June	55	59	55	60
July	57	58	61	63
August	66	66	59	64
October	62	60	55	54
November	53	51	52	54
December	51	57	62	64

The acceptable standard of leaf should be about 65% (minimum) good leaf (on count basis) or 80% on weight basis, to produce good quality tea. However, the standard of leaf from St Coombs as well as Lamiliere was very poor, on weight basis, throughout the year.

M T Ziyad Mohamed, S H Priyanthi, L Jayasinghe,
A M M V Abeykoon, U DAlagiyawadu

4.0 General

Dr. Ziyad Mohamed served as :

- A member of panel of teachers/examiners of the Post Graduate Institute of Science(PGIS) University of Peradeniya.
- A member of the Technical Committee appointed by Chairman, Sri Lanka Tea Board, to advice on Tea Factory Development Subsidy Schemes for Orthodox Factories.
- A member of the panel of the Professional Examination in Tea Manufacture and Factory Practices, appointed by the Director, National Institute of Plantation Management.
- The Chairman of the Technical Committee on Tea, appointed by the Sri Lanka Standard Institute.
- A member of the Academic Committee of NIPM
- The Convenor/Secretary of the 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 Achievements:

The collaborative study on "Conservation of electrical energy in trough withering" won the Sri Lanka Energy Managers Association (SLEMA) Award as the best energy related study during the year 2002. The award was received by Dr M T Ziyad Mohamed and Mr G Galahitiyawa, the two officers from TRI involved in this project, along with collaborating scientists from Energy Conservation Fund.

4.2 Brain storming session on quality of tea produced

A brain storming session on "quality of tea produced in Sri Lanka" was organized on 14 November. Based on deliberations a concept paper on quality of tea produced with a view to preparing a policy document on tea processing was prepared and circulated to all stakeholders.

4.3 Publications/ Paper presentations:

1. D L D H Dhahnayake, L Jayasinghe and M T Ziyad Mohamed (2002) A simple computer model for selecting a rolling program in black tea processing, Sri Lanka Journal of Tea Science Vol 67, Parts (1/2), Pp 32 - 36.
2. U Daranagama, H A W Nadeera, B A J Kitsiri, D Weerakody, G Galahitiyawa and M T Ziyad Mohamed (2002) Conservation of electrical energy in trough withering. Sri Lanka Journal of Tea Science Vol 67, Parts (1/2), Pp 37 - 46
3. M T Ziyad Mohamed (2002) Problems in "bought leaf" processing - an Analysis". Tea Bulletin, Tea Research Institute of Sri Lanka, Vol 17 (1 & 2), Pp 12 - 17
4. D L D H Dahanayaka and M T Ziyad Mohamed (2002). A leaflet titled "Tea Leaf to the Cup". Tea Research Institute of Sri Lanka
5. M T Ziyad Mohamed, G Galahitiyawa & S Koneswaramoorthy (2002) Solar energy for tea processing in Sri Lanka. Techwatch Lanka, Vol 1, No 3, Pp 11
6. S. Koneswaramoorthy, W. S Botheju and M T Ziyad Mohamed (2002) Direct fired heaters for tea drying. TRI Update, Vol 7, No 1,June 2002, Pp 3
7. A C Liyange, P A N Punyasiri, U B S Bandara, H N L Pradeepa, L Jayasinghe and M T Ziyad Mohamed (2002) Microwave drying of tea. TRI Update, Vol 7, No 1,June 2002, Pp 5
8. J W K K Jayasundara, A Balasuriya, K Raveendran and M T Ziyad Mohamed (2002) Microbial populations in black tea during storage. TRI Update, Vol 7, No 1,June 2002, Pp 6
9. S. Koneswaramoorthy, M T Ziyad Mohamed and W. S Botheju (2002) Electrical energy losses in withering due to inappropriate ducting. TRI Update, Vol 7, No 2, December 2002, Pp 1
10. W. S Botheju and M T Ziyad Mohamed (2002) Minimum quality standards of tea for export. "Thea Tahthu" (Newsletter in Sinhala), January - June 2002, Vol 1 No 2.

4.4 Advisory Reports

During the period under review, the members of the Technology Division at Talawakelle and Ratnapura made 60 (names of the estates/ factories given below) and 53 advisory visits respectively. These exclude the seminars and the Factory Officer training programs conducted and coordinated by NIPM.

Number of samples received for moisture determination from estates/factories was 484.
Divisional staff calibrated nine moisture meters received from commercial factories.

Date	Estate	Purpose of Visit
03/01/2002	Halgolla Estate	Drier Test
10/012002	AnnField Estate	Drier Test
17/01/2002	Pitakanda Estate	Drier Test
22/01/2002	Hapugastenne Estate	Drier Test
24/01/2002	Kataboola Estate	Drier Test
29/01/2002	Mount Vernon	Drier Test
31/01/2002	Brunswick Estate	Drier Test
07/02/2002	Fernlands Estate	Drier test
18/02/2002	Tillyrie Estate	Drier Test
01/03/2002	Mocha Estate	Drier Test
05/03/2002	May field Estate	Drier Test
08/03/2002	Kelaniya Estate	Drier Test
02/04/2002	Theresia Estate	Drier Test
18/04/2002	Kirkoswald Estate	Drier Test
22/04/2002	Sheen Estate	Drier Test
01/05/2002	New Peacock Estate	Drier Test
10/05/2002	Waltrim Estate	Drier Test

09/05/2002	Hellbodde Estate	Manufacture
16/05/2002	Westhall Estate	Drier Test
20/05/2002	Vellaioya Estate	Drier Test
23/05/2002	Nayapana Estate	Drier Test
10/06/2002	Gartmore Estate	Drier Test
13/06/2002	Shanon Estate	Drier Test
20/06/2002	Ancoombura Estate	Drier Test
01/07/2002	Nayabedde Estate	Drier Test
04/07/2002	Meddecombra Estate	Drier Test
08/07/2002	Ohiya Estate	Drier Test
11/07/2002	Diyagama East Estate	Drier Test
15/07/2002	Park Estate	Air Flow Test
18/07/2002	Ingestre Estate	Drier Test
30/07/2002	Logie Estate	Drier Test
30/07/2002	Kew Estate	Drier Test
08/08/2002	Great Western Estate	Drier Test
08/08/2002	Madulkelle Estate	Drier Test
19/08/2002	Fordyce Estate	Drier Test
26/08/2002	Stockholm Estate	Drier Test
02/09/2002	Tillyrie Estate	Drier Test
05/09/2002	Great Western Estate	Drier Test
05/09/2002	Halgolla Estate	Drier Test
12/09/2002	Invery Estate	Drier Test
23/09/2002	Kirkoswald Estate	Drier Test
26/09/2002	El-Teb Estate	Drier Test
03/10/2002	Theresia Estate	Drier Test
07/10/2002	Robgill Estate	Drier Test
10/10/2002	Carolina Estate	Drier Test
17/10/2002	Galloola Estate	Drier Test
21/10/2002	Mayfield Estate	Drier Test
24/10/2002	Pedro Estate	Drier Test
28/10/2002	Hunnasgiriya Estate	Drier Test
29/10/2002	Battawatte Estate	Drier Test
10/11/2002	Talawakelle Estate	Drier Test
11/11/2002	Waverly Estate	Manufacture
21/11/2002	Midlands Estate	Drier Test
25/11/2002	Mahadowa Estate	Drier Test
28/11/2002	Frotoft Estate	Drier Test
02/12/2002	Bearwell Estate	Drier Test
04/12/2002	Mousakelle Estate	Drier Test
10/12/2002	Radella Estate	Drier Test
09/12/2002	Verrallapatana Estate	Drier Test
13/12/2002	Theresia Estate	Drier Test
16/12/2002	Gouravilla Estate	Drier Test
23/12/2002	Carolina Estate	Drier Test
30/12/2002	Holyrood Estate	Drier Test

AGRICULTURAL ECONOMICS DIVISION

J A A M Jayakody – Officer in Charge

1. Applied Research

Thrust A 31. Identification of appropriate labour use pattern to improve profitability in plantations.

This thrust was revised to study the problem of labour scarcity in all tea growing regions and it was decided to study the situation in Uva, Mid country and Kalutara, Ratnapura & Kegalle districts of the Low country. Due to inadequacy of staff, this study was not continued and it is planned to continue this study in the year 2003.

Thrust A 35. Development of Financial Support System for Soil Rehabilitation and Conservation in tea estates.

A research proposal has been forwarded to South Asian Network for Development and Environmental Economics (SANDEE) for their comments and consideration for funding.

Thrust A 36. Assessment of Vulnerability, Impacts and Adaptation to Climate Change in the Tea Industry of Sri Lanka

In the divisional research programe, it was proposed to undertake a study to assess the drought damage in tea using GIS and Remote Sensing techniques. This was integrated with climatic change impact assessment study of the Tea Research Institute, which is undertaken in collaboration with the Sri Lanka Association for Advancement of Science (SLAAS), Meteorological Department of Sri Lanka and the Coconut Research Institute.

Project objectives in relation to the socio-economic aspects are follows.

a. To develop socio-economic scenarios of tea plantations with and without climatic change.
b. Assessment of socio-economics impacts and adaptation measures in tea plantations

Agricultural Economics Division undertakes the assessment of socio-economic impacts and the adaptation measures in tea sector.

Tasks performed: Literature survey was started in the second quarter of the year.
Started historic data collection from selected tea plantations in order to develop socio-economic scenarios. The Inter-governmental Panel on Climate Change (IPCC) period has decided base line 30 years from 1960. A sample of tea estates was selected to represent all tea growing Agro Ecological Regions (AER) and data collection was started from the up county. A summary of primary data collected from selected estates is given n below in the Table 1.

Table 1 Socio- Economic Data collected from selected estates in the Up & mid country

AER						
Type of Data	E 1	E 2	E 3	E 4	E 5	E 6
Rain fall	1970 – 1975 1982 - 2001	1978 - 2001	1986 - 2001	1966 - 2001	1963 - 2001	1978 - 2001
Sun Shine hrs	1994- 1998			1988 - 2000	1992 - 2001	
Wet Days	1970 – 1975 1982 - 2001	1978 - 2001	1986 - 2001		1970 - 2001	1978 - 2001
Land Use	1980 – 2001		1986 - 2001	1985 - 2001		
Green Leaf	1970 – 1975 1982 - 2001	1967 - 2001	1986 - 2001	1966 - 2001	1977 - 2001	1978 - 2001
Bought leaf			1986- 2001	1966 - 2001	1977 - 2001	
Made tea	1970 – 1975 1982 - 2001	1978 - 2001	1986 - 2001	1966 - 2001	1970 -2001	1978 - 2001
Gross Outturn	1970 – 1972 1982-1998		1986 - 2001	1966 - 2001	1977 - 2001	1983 -2001
Net Outturn			1986 - 2001	1966 - 2001	1977 - 2001	1983 -2001
C.O.P	1984 - 2001	1995 - 2001	1986 - 2001	1983 -2001	1981 - 2001	1978 - 2001
N.S.A	1984 - 2001	1995 - 2001	1986 - 2001	1983 -2001	1981 - 2001	1978 - 2001
Refuse Tea	1970- 1975 1982 - 2001		1986 - 2001	1966 - 2001		1978 - 2001
Made tea - Grades	1970- 1975 1982 - 2001		1986 - 2001	1966 - 2001		1978 - 2001
Agro-Chemical use			1994 - 2001	1977 - 2000	1992 - 2001	1978 - 2001
Fertilizer Use			1994 - 2001	1977 - 2000	1992 - 2001	1978 - 2001
Annual work force			1987 - 2001			1980 - 2001

Non-availability of old estate records in many places is found to be a major limiting factor in data collection.

Data analysis is to be carried out in order to develop socio-economic scenarios of the base period and to compare with the present. Future Scenarios are to be developed using the relationships established in these analysis and the prediction of crop response to expected climate in future. Future climate predictions and the crop response data would be obtained from the results of the Agronomic and Climate data analysis undertaken by Agronomists and climate scientists.

A stakeholder survey was carried out in the same sample of estates to gather their experience on climatic change impact on tea cultivation and production. In the up country seasonal quality tea production has been affected over the last five years. Producers of some special quality tea trademarks have been seriously affected due to inability of supplying adequate quantities of particular trademarks to meet buyers demand. Impact on national economy is to be estimated.

Basic Research:

Project B1 Establishment and maintenance of micro level tea information system in Geographic Information System (GIS)

Activity 1: Development of a tea area overview map in GIS

Computing estate information was continued in collaboration with the Council for Agricultural Research Policy.

Activity 2: Estate mapping for GIS:

Two undergraduate student of Surveying Department, University of Sabaragamuwa started a project to develop GIS Maps using Global Positioning System (GPS). The objective of this project is to estimate the cost and time requirement for developing an estate map in GIS. Suitable area is selected in St.Coombs estate to undertake mapping. Necessary steps have been taken to purchase a suitable GPS instrument for the Institute.

Project B 56. Estimating the variation of yield according to elevation, slope and aspects in tea fields .

Project B 57 . Estimating tea canopy characteristic using spectral analysis

Both of the above projects were not undertaken due to lack of staff. The staff member who was trained on GIS technology has left the service of the Institute and all GIS related project activities were affected. Capital expenditure estimated for the above two projects were also not utilized due to the same reason.

B 5 Estimation of cost of tea cultivation

Agricultural Economics Division took part in the work programe of the TRI under the 100 days revolution programe of the Government conducted in the first quarter of the year. A manual on " Cost of tea cultivation; from nursery to the field " was written and published under this programe. This manual contains the cost of all agricultural operations, when tea is cultivated adhering to all technical recommendations of the Institute.

Writing some manual in sinhala, incorporating smallholder sector information was started.

Divisional Projects / Activities

D 35.1 Tea Information

National and International tea data collection and computation was continued. National and International statistics of tea industry was provided to publish in the diary of the Tea Research Institute, year 2003.

An article on "Distribution of tea extents according to age in the estate sector" was written and submitted to publish in the TRI update, with the objective of updating the age profile information of tea cultivation. (This was not accepted for publication).

D 35 .2 Project Monitoring Activities

1. In September 2002, Agriculture Economics Division was given the responsibility of coordinating the INFORM Database for the National Agricultural System. Annual information on research projects and scientists were collected and computed. Ms. H.W.Shyamalie participated for the two days workshop held by the CARP for this purpose.

2. A format was prepared to report the Tea Research Board on progress of research programs.

3. Annual reviewing system for Applied Research Thrusts was initiated and a schedule was prepared to complete the exercise within the first two months of the year 2003.

D 35.3 Tea Policy Document

A concept paper on tea cultivation aspects was compiled for "The Tea Policy Document" is to be prepared by the Ministry of Plantation Industries (MPI) and the concept paper was discussed at the Tea sector Review meeting held in the MPI in November 2002. A concept paper on tea processing and marketing aspects was also complied jointly with the Deputy Director Research (Technology). The first draft is completed and circulated among the scientists and stakeholders for comments.

Staff Changes:

1. Mr W S B Ariyapala joined the division in January as research assistant of the Climate Change Impact Assessment Project.

2. Ms R M S S Rajapaksa resigned from the TRI service in August.

3. Mr D P B Herath never returned after completing his post-graduate studies at the University of Guelph, Canada. This programe was started in October 1996.

Seminar Meetings and Training programs

Mrs J A A M Jayakody presented a paper on "Economics Analysis of Tea and Rubber Intercropping" at the 204th E & E meeting held at on 1st February, at TRI Talawakelle.

Ms R M S S Rajapaksa presented a paper on "Some Applications of Geographic Information System (GIS) and Remote sensing for the Tea Industry" at the 204th E & E meeting held at on 1st February at TRI Talawakelle

Mrs J A A M Jayakody attended to the RSC seminar held at the Tea Research Institute, Ratnapura, on 22nd February.

Mrs J A A M Jayakody and Mr W S B Ariyapala attended for the first stakeholder seminar on " Assessment of the impacts an adaptation to Climate Change in the plantation Sector of Sri Lanka" held at the auditorium of SLAAS in Colombo on 9th April and Mrs. Jayakody presented a paper on " Climate Change and Socio-Economic Impact on Tea sector".

Mrs J A A M Jayakody and Mr W S B Ariyapala attended for Climate Change project review meeting held on 25th June at the TRI, Ratnapura.

Mrs J A A M Jayakody and Mr. W S B Ariyapala attended for Climate Change project review meeting held on 21st July at the CRI, Lunuwila.

Mrs J A A M Jayakody attended for a meeting called by the National Operation Room of the Ministry of Policy Development and Implementation, held on 31st July at the NOR, Ministry of Policy Development and Implementation, Central Bank, Colombo.

Mrs J A A M Jayakody attended for a meeting of "Agricultural Sector Monitoring Committee" of the National Operation Room of the Ministry of Policy Development and Implementation held on 8th August at the NOR, Ministry of Policy Development and Implementation, Central Bank, Colombo.

Mrs J A A M Jayakody attended for a meeting of " Plantation and Small holder sub committee of the Agricultural Sector Monitoring Committee" of the National Operation Room of the Ministry of Policy Development and Implementation held on 11th September at the NOR, Ministry of Policy Development and Implementation, Central Bank, Colombo.

Mrs J A A M Jayakody participated to a training programe on Geographic Information System under AIACC project, conducted by the staff of EMSO Ltd, on 23rd, 24th, 25th, 28th and 29th October at EMSO Ltd, Colombo 02.

Mrs H W Shyamalie attended to the Advisory –Research linkage meeting held in the Auditorium at Tea Research Institute, Talawakelle on 29th October.

Mrs J A A M Jayakody participated to a discussion on Tea Policy Document of Tea Research Institute held at Ministry of Plantation Industries on 1st November.

Mrs H W Shyamalie participated to the committee meeting of National Committee on Socio-Economics and Policy Analysts held at CARP on 1st November.

Mrs J A A M Jayakody and H.W.Shyamalie participated to a discussion of manual on cost of tea cultivation from nursery to the field at the Tea Research Board meeting held at Tea Research Board on 8th November.

Mrs H W Shyamalie attended to two days workshop on INFORM-R conducted by CARP at Post Graduate Institute of Agriculture, University of Peradeniya on 25th and 26th November.

Mrs J A A M Jayakody attended to a discussion with Kegalle Plantation Ltd held in the auditorium at Tea Research Institute, Talawakelle on 26th November.

Mrs J A A M Jayakody presented a paper on "Economics of reviving fertilizer subsidies at the RSC meeting held at Kandy on 29th November.

Mrs J A A M Jayakody and Mr. Sayuru Ariyapala attended to five - day workshop organized by AIACC project held in Colombo from 16th – 20th December.

Overseas Training

Mrs J A A M Jayakody participated to a training programe on "Assessment of Vulnerability, Impacts and Adaptation to Climate Change" conducted by the AIACC and the third world Academy of Science in Italy, from 2nd to 14th June.

Mr G Ganewatte requested for further study leave until March 2003 to complete his PhD program at the University of Latrobe, Australia.

Mrs. J A A M Jayakody participated for a training workshop on Econometrics for Environmental Economists organized by South Asian Network for Development and Environmental Economics at BCDM Center, Rajendrapur, Bangladesh from 9th –14th December.

Other

Mr T L Dammalage and Mr T S M Jinasingha, final year students of Department Surveying Sciences, University of Sabaragamuwa started their industrial training programe in the Agricultural Economics Division, TRI in November.

Undergraduate students of the faculty of Agriculture, Eastern University visited Agricultural Economics Division in December.

Publications

J A A M Jayakody and H.W Shyamalie, **"Cost of Tea Cultivation; from Nursery to the Field"**, April 2002, Tea Research Institute, Talawakelle, Sri Lanka.

J A A M Jayakody, **" Shortage of workers – a Major Constraint to Tea Cultivation in Sri Lanka"**, Agricultural Research News, Vol. 3 No. 3, Oct- Dec 2002, Council for Agricultural Research Policy, Colombo, Sri Lanka.

ADVISORY & EXTENSION SERVICES

S Wimaladharma - Senior Advisory Officer,
Head, Advisory & Extension Services

1. General

The activities carried out by the Advisory & Extension Services through its centres at Talawakele, Ratnapura, Hantane, Passara, Kottawa and Deniyaya are summarized below.

The staff position remained unchanged with two vacancies. The supporting services were carried out by casual employees at some stations.

Mr. B. A. D. Samansiri followed a one week training programme on Web designing at ICT, Colombo.

Mr. V. S. Sithakaran, Advisory Officer followed a training programme on "Development Oriented Research in Agriculture", at Wageningam, Netherlands from 12th January to 26th July 2002.

Messers Suranjan Fernando, Janaka Mahindapala, S. P. Ratnayake, K. R. W. B. Kahandawa, K. K. P. Katulanda, R. M. A. C. Rajakaruna and Neville Ekanayake attended a one weeks training programme on script writing, video filming and editing at the Audio Visual Centre, Department of Agriculture, Peradeniya in November 2002.

Mr. R. Rajendrakumar (Clerk/Typist) "s service was terminated from the TRI with effect from 26th June.

Mrs.I Jayawickrama, Clerk/Typist was transferred to the division with effect from 16th September 2002.

Messers T.G.N.Mahinda , R.M.A.C.Rajakaruna, M. A. J. S. Fernando and K.K.P.Katulanda followed a Training of Trainers Programme conducted by the NIPM in February 2002.

Mr. K. D. Dahanayake continued to overlook the field activities at Walahanduwa unit.

Two Advisory & Research Linkage sessions were held during the year to discuss the extension and research needs based on the feed back information received from the growers.

The Head of the Advisory & Extension Services served 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 TDP.
Co-ordinating Committee Meeting of the TDP.
Plantation Reform Project Committee on the production of AV materials
Estate Affairs meeting of the TRI
TRI/TSHDA Interaction Meeting

The ADB funded Clonal Mother Bush Project activities were coordinated by the Head of the Advisory & Extension Services.

The Advisory/Extension staff continued to assist the Scientific Divisions in conducting their regional research activities.

Mr.S.L.D.Amarathunga followed the AIACC Project workshop on Developing Integrated Models for Examining the effect of climate change and variability in the Tea and Coconut sectors in Sri Lanka held at Colombo from 16th to 20th December.

The Advisory staff participated in two Exhibitions 'Isurumaga' and 'Randalumela' held at Ratnapura.

Mr. S. Wimaladharma continued to serve as a resource person to the NIPM and conducted 61 training programmes for Superintendents, Assistant Superintendents Field Staff and other workers on Nursery skills training, Plucking and other agricultural practices.

Mr. S.Wimaladharma was also associated with the following activities:

- Preparation of Video Programmes on Shade Management and Weed Management, with funds from the Plantation Reform Project.
- Preparation and release of twelve video programmes produced to CD format for the benefit of the growers.
- Co-ordinated the Clonal Mother bush Programme of the ADB to establish 54 ha, of Mother bushes in six TRI stations.
- Participated at the RSC Seminars held in all the regions during the year.
- Revision of the Sinhala Advisory leaflets and production of Nursery and Fertiliser leaflets.
- Preparation of Advisory booklets on Nursery Management, Plucking and Pruning under the 100 days Programme.

2. Land Use Information of Regional Stations

TYPE OF LAND USE	HANTANE	PASSARA	KOTTAWA	DENIYAYA
Seedling tea (ha)	2.00			
VP tea –mature (ha)	6.00	3.44	10.0	6.41
VP tea –young (ha)	1.75	0.30	1.0	0.38
Mother bushes (ha)	2.00	1.15	4.0	0.50
Tea Nursery (ha)	0.20		1.0	0.46
Tea Seed Garden (ha)			1.0	
Under Grasses (ha)	2.25			
Fruit trees (ha or Nos.)	0.40		1.5	
Coconut and Paddy (ha.)	0.81			0.13
Forestry (ha)	1.20	6.85	7.3	0.42
Marshy land (ha)	0.62			0.50
Buildings, Gardens, Roads	5.77	0.50	9.8	1.44
Pepper (ha)				0.05
Encroachment (ha)				0.36
Uncultivated area) ha)				0.57
Grass Clearing (ADB Funded)		2.06		1.50
Total Extent (ha)	**23.00**	**14.30**	**35.6**	**13.22**

ADVISORY & EXTENSION ACTIVITIES

	T"kelle	Ra"pura	Hantane	Passara	Kottawa	Deniyaya
Advisory correspondences	596	851	242	130	290	281
Advisory visits	136	64	125	24	68	40
Extension visits	14	55	20	10		04
Visitors to the Division						
-Estate management & small holders	586	422	222	209	1108	216
-University/Diploma students & others	2679	638		46	06	145
Advisory & Extension Programmes (Total)		121				
Skill training for nursery management	35			03		
Seminars			02	30	16	04
field days		04	04		1	
Educational Programs for University Student			02		05	03
Educational Programs for Diploma/Te' Student	12	06				
Educational Programs for school children			03	02	17	
Awareness programs	18	01	04	03	23	42
Diploma NAITA Trainees Training Programs						
Familiarisation Programs for planter trainees		01				
NIPM Programs	10	30		03		
Informal discussion		107		80	07	79
Video programs	36	22	01		16	
RSC Seminars		01			01	
Meetings Attended	37	76	15	29	22	22
Commercial nursery Inspections	06	18	71	146	31	30
Advisory Publications distributed	1003	1914			777	410
Plucking materials distributed						
Soil samples tested for PH		188	515	1132	323	120
Soil samples tested for carbon				427		
Exhibitions		02				
Method demonstrations & field days	14	39	15	05		03
Other activities attended by Head/Ad & Ex..		185				
VP Shoots/Cuttings issues		9475		16750		
VP Shoots/Mother bush Project	18225					
Sale of planting materials				16750		220950

ADVISORY & EXTENSION SERVICES -TALAWAKELLE

B A D Samansiri - Senior Advisory Officer
Actg Officer -in-Charge.

General

(1) Advisory Correspondence:
596 Letters were sent on routine advisory matters and preparation of development plans.

(2) Visits made by the staff

2. a Advisory Visits:
136 number of Advisory visits were made to Company Estates, Private estates and small holdings pertaining to the following subjects:

Problem solving
Preparing Development Programme
Land selection for Re planting
Survey on Potash application

2.b Extension Visits:
14 Extension visits have been made to the estates and small holdings to carry out demonstrations on shear harvesting. Fertilizer/dolomite/Zn usage in small holdings fields, monitor the fertilizer trials and shear plucking demonstrations.

2.c Commercial Nursery Inspection visits -
Involved in 06 commercial nursery inspections.

2.2 **Training Programmes:**

I Estate - 32
II Small Holding - 03

2.3 Video Programmes:
Video programmes shown 36

2.4 Training Programmes conducted with the NIPM
10 NIPM training programmes were conducted by the Advisory staff.

3. Visitors to the Station

586 Visitors including estate management personal, small holders and proprietary planters visited TRI stations seeking advise on problems on nursery failures, pest damage, root diseases, drought casualties, labour shortage, productivity decline and for preparing pruning programmes etc.

1706 Students from universities, technical colleges and schools visited the stations to obtain information on tea husbandry.

Foreigners - 87
Others - 886

4. Advisory & Extension Programmes conducted

4.1 Regional Scientific Activities: Nil

4.2 Method Demonstrations and Field days:

14 demonstrations/field days were conducted to small holders in the region

4.2 Educational Programmes -

12 Special Educational programmes were conducted for students of Universities, Agricultural Colleges and Technical Colleges.

4.4 Awareness Programmes for Staff/Workers and Smal Holders

18 Awareness Programmes were conducted for tea growers and Plantations staff on general agricultural practices in tea

4.5 Informal Discussions with Individuals and Groups:

Many informal discussions with individuals and groups were done with the growers

4.6 Exhibitions: Nil

4.5 Meetings attended by the Advisroy Staff:

The advisory staff attended all regional scientific conducted by RSC's.

The staff attended a total of 37 meetings on Advisory Research and Administrative matters.

5. Soil analysis for Carbon, texture/PH: Nil

6. Advisory Publications:

1003 free publications were issued during the year

7. Activities under the Forward Extension Programme - TRI Co-operate plan 1999/2003

7.1 Project 01 - Adaptive Demonstration Trial

Nil

7.2 Project 02 - Information Desk

Web site on TRI information is being prepared

7.3 Project 03 - Upgrading Tea Museum and 'AV' Saloons

Tea Museum has been upgrading work in progress.

Relief model of tea growing regions with relevant information has been completed.

'AV' Saloons - CD Video program has been prepared on Tea Rolling Programme

7.4 Project 04 - Establishment of Clonal Mother Bushes

Not relevant

7.5 Project 05 - Monitoring the Agricultural Practices of the plantations & Small holdings

Information is being gathered from several estates to assess the agricultural performance of estates.

7.6 Project 06 - Production of Extension Materials for the Effective Dissemination of Research Findings

Wall poster on pest management is nearing completion
Preparation of Video film on Tea Research Institute and its activities is in progress
Preparation of a pamphlet on sampling for analysing in relation to tea cultivation is in Progress

(8) Sale of Planting Materials (Clonal Cuttings): Not relevant

(9) Production of Leaflets and other Publications:

Booklets on Nursery Management, Pruning, Plucking, Shear Harvesting have been Printed and released.

(10) Presentation of Research/Extension papers: Nil

(11) Special Assignments/problems:

Islandwide surveys conducted on use high potash fertilizer on Potash application and its Effects on tea production
Five Advisory Circulars on Protection of tea from red root disease, protection of tea from Blister blight, Control of Nematodes in young tea , white grubs on tea lands and their control, Suitability of tea clones for the different region were revised and released

New advisory circular on Guidelines on land suitability classification for tea was released
Translation of newly released TRI Advisory Circulars into Sinhala language has been commenced
Information gathering have been completed from 50 estates in the co-operate sector
Data has been gathered from St.Coombs Estate daily on plucking standard
Under the 100 days programme 21 demonstration programs were conducted on Shear plucking
Establishment of a field demonstration plot is in progress.

ADVISORY AND EXTENSION SERVICES, LOW COUNTRY STATION, RATNAPURA

S Wimaladharma - Senior Advisory Officer
Head, Advisory & Extension Services

1. Advisory Correspondences

- 851 letters were sent on routine Advisory matters, and preparation of development plans.
- Approximately 350 telephonic requests and 335 letters pertaining to the advisory matters were received and the necessary advises have been given.

2. Visits made by the staff

2.1 Advisory visits,

64 number of Advisory visits were made to Company Estates, Private estates and small holdings pertaining to the following subjects:

- Land suitability assessment for new planting and replanting of tea.
- Land suitability assessment for establishment of mother bushes.
- Adversities related to the Nursery management.
- Yield decline studies and productivity assessment.
- Problems related to the water logging condition, drought etc.
- Preparation of pruning and development programmes.
- Monitoring of shade trees and wind belts.
- Preparation of Manuring programs.
- Identification of problem related to the pests and diseases.

2.2 Extension visits

55 Extension visits have been made to the estates and small holdings to carry out the surveys on Shear harvesting, fertiliser/ dolomite/ Zn usage in small holding fields, monitor the fertiliser trials and shear plucking demonstrations.

2.3. Commercial Nursery Inspection visits

18 Commercial nurseries, which consist of 348,556 plants, have been inspected and only 13 of them had satisfactory plants (212,834 Plants) which fulfilled the basic requirements specified in the commercial nursery agreement. Rest of the inspected nurseries (5) had an inferior or poor quality plants and those plants could not be recommended for planting.

3. Visitors to the Low Country Station

- 422 visitors including estate management personnel (107), small (222) and private estate holders (93) have visited the station seeking advise pertaining to the problems such as nursery failure, poor recovery after pruning, information on inter cropping of tea & rubber, pests and root diseases problem, drought casualties, labour shortage, productivity decline of tea lands and for formulating programmes of pruning, fertilizer and development etc.

- 638 students, including 10 University Students, 29 Diploma Students, 599 School Children came to the station in order to get technical know-how and information on tea cultivation.

4. Advisory & Extension programs conducted

- The Advisory staff in collaboration with scientific staff conducted a total of 121 Advisory and Extension programs. Some of the special programmes are given below.

4.1 Regional Scientific committee Seminars

a. RSC –VI Activities-Ratnapura Region and Kalutara region

- The RSC committee VI for Ratnapura Region 2002 with the TRI representative, continued to co-ordinate all the scientific and estate sector affairs pertaining to the tea plantations in the

above region. The seminar has been successfully organised for the tea planting community in estate sector in Ratnapura region in collaboration with the Advisory and Extension Services, Low Country Station. It was held on the 22nd February 2002 at TRI Sports Club, Low Country Station, and Ratnapura. In this event more than 60 planters belongs to plantation companies from Ratnapura region (four PMCs) and Kalutara region (two PMCs) and proprietary planters participated in the technical session. Four presentations were made on the following themes. (Co-ordinated by Mr. S. L. D. A).

Theme	Presenters
Effective Harvesting System for enhancing Quality and Productivity of tea.	Dr. A Ananthacumaraswamy
Introduction of TRI Mechanical Hand Pruner	Dr. M.A. Wijerana
Refresher Programme on Tea Manufacture with special emphasis on Problem relating to Low grown Tea Manufacture.	Mr. G. Galahitiyawa
Computer Model to draw Rolling Programme	Mr. D.L.D.H.Dahanayake

b. RSC – VII Activities- for Kalani-welly Region (Kegalle, Avissawella, Daraniyagalla and Yatiyantota)

- New committee RSC VII for Kalani-welly Region (Kegalle, Avissawella, Daraniyagalla and Yatiyantota) 2002 with the TRI representative, was appointed and co-ordinated the activities. The 1st RSC seminar was organised for the tea planting community in estate sector in Kelani-valley Region and was held on 8th March 2002 at the Shalika Inn, Kegalle. In this event more than 50 planters belongs to plantation companies from Kalani-welly Region and proprietary planters participated in the technical session. Four presentations as indicated in the RSC VI were delivered by same resource persons except Dr. M.T.Z.Mohamed who has delivered presentation on Refresher programme on Tea Manufacture instead of Mr. G. Galahitiyawa. (Co-ordinated by Mr. S. L. D. A).

The Senior Advisory officer and Advisory officer participated at the RSC seminar held in Galle, Passara and Kandy for the planters in the respective districts.

4.2. Method Demonstrations and Field Days under 100 days programmes:

- 39 Demonstration, Field days under 100 days programmes were conducted by TRI-LC Advisory and Extension division for Executive staff and field officers and workers of estates in the corporate sector and small holders on plucking, introduction of TRI-selective tea harvester and Plucking Basket,

4.3. Educational programme

- 6 Educational programmes were conducted by Advisory and Extension staff for students from School of Agriculture, Universities and Government Schools on tea cultivation.

4.4. Empowering Small holder through Awareness Programs:

- 4 field days and seminars were conducted to empower the small holders and field staff of proprietary and company estates, nursery management, pruning. fertilizer application.

4.5. Familiarization Programme

- Advisory officer conducted an awareness programs on tea cultivation for members of the Agri-Business Crop Association in Asia pacific region (Group of Foreigners) on 20/08/2002

- Advisory staff conducted the familiarization programme for the Scientists of UPASI Tea Research institute, India on field practices and tea manufacture of low grown tea by organizing the Field and factory visits in both small holding and corporate sector tea lands and factories on 11/9/2002.

4.6. Training Programmes in collaboration with NIPM

Advisory staff participated as a recourse personnel for following training programmes conducted by NIPM.

- Mr S Wimaladharma, Head/ Advisory and Extension services conducted 30 NIPM training programmes for Superindentents, Assistant Superindentdents, and Field staff on nursery practices, plucking, other cultural practices etc.

- Mr. T.G.N. Mahinda has made a presentation on tea cultivation for NIPM-Students on 5th October, 2002.

4.7. Training Programmes for Students of Agriculture & Technical collage

- Four Diploma Students from the School of Agriculture, Hardy, Niwala, Kuliyapitiya under went four months in-plant training programme on tea cultivation.

- One student from the Technical collage, Ratnapura under went training programme on stenography and data Entry for a period of six months.

4.8. Informal discussion with Individuals or Group

- 107 informal discussions with individuals or group (for Management and field staff of company or proprietary Estates, and small holders, and students) were held at TRI, Low Country Station or at their properties on Development Programme, pruning Program, Manuring, Nursery failures, Plucking, control of canker, Wood rot. Termite and shot-hole borer, water logging, drought mitigation etc.

4.9. Video Programme

- 22 video programmes were shown on land selection, nursery, plucking, use of TRISTH and plucking basket etc, for the proprietary planters and their field staff and small holders.

4.10. Exhibition (2) & Mobile Tea Advisory Services (1)

- Participated for two Exhibitions; "Isrumaga 2002" held at the Newtown Ground, Ratnapura from 26th to 30th March 2002 and "Randalumela- TSHDA" held at Batugedara Maha Vidyalaya, Ratnapura on 6th and 7th April 2002.
- Participated for the Mobile Tea Advisory Services for small holdings organized by the Tea shakthi programme/ TSHDA-Ratnapura held at Sevali Collage, Ratnapura on 31st April.

5. Meetings attended by the Advisory Staff.

- About 76 meeting related to the Research and Advisory matters, Planter Association, RSC-matters, Circulars matters, Clonal Matters, District Agricultural development Committee meeting, E & E Preview, TRI-TSHDA-interaction, Research and Advisory linkage meeting, Advisory officers forum and Administration and finance matters etc. organised by TRI and other organisations (Tea sector committee, Ministry, TSHDA). have been attended by Head advisory and Extension Services, Advisory Officer, and Extension Officers

- **Other activities attended by Head/ Advisory and Extension Services and Advisory staff. - 185**

  Over looking Advisory centres (6 six), Advisory & Extension matters with Plantation reform project, discussion with Survey Department, Open University etc..

6. Soil pH analysis

- 188 soil samples were tested for soil pH and suitability for use of nursery

7. Advisory Publications Distributed - 1914

- A advisory Leaflets (free issued) - 1226
  Priced Publications - 688

8. VP Shoots issued

- Estate and small holdings - 9475
- ADB-mother bush project - 18225

9. Activities involving under Forward Extension Program - Corporate Plan 1999/2003

Project 1

a) Adaptive Demonstration Trial

- ***Adaptive research trials on fertilizer***:- Five trials conducted in 5 locations at Kalawana, Horana, Palawatte and Daraniyagala. were terminated due to successfully completion of 2 pruning cycles. Beside the assessment of the fertilizer performance, these trials served as centres for dissemination of various agricultural skills /practices such as plucking, pruning and bush management, control of pests and diseases to surrounding small holders.

b) Basic studies/Observational Trial conducted by Advisory staff in collaboration with research staff as suggested by Advisory & Research Forum (coordinated by SLDA)

- **Comparison study of VP/LC-880 v/s U-709**

  Observational trial on comparison study of VP/LC-880 v/s U-709 was commenced with three replicates at the Field No 1, St. Joachim Estate, TRI, Ratnapura in collaboration with SPND and St. Joachim Estate on 24th December 2002.

- **Study on rooting / Growing medium**

  A trial was started to study assess the nursery performance of clones TRI 2025,2027 and 4042 in the refuse tea mixed soil media at Plant Breeding nursery, TRI. Ratnapura. 100 plants of each clones were planted in 3 replicates. (Duration- March-2002 to January 2003) (TGN,PDU, JHNP)

- **Study on seasonal effect the growth of nursery plant**

  A Nursery trial to determine the seasonal effect to the growth of nursery plant under low country condition is in progress. 1st phase of this trial will be completed in January 2003 and 2nd phase has been commenced in November 2002. (JPM/PDU}

- **Comparison study of the root and shoot growth of 3000/4000 clones**

  A Nursery trial on comparison study of the root growth and shoot growth of some selected 3000/4000 clones (TRI 3014, 3025, 3055, 4006, 4042, 4049, 4053, 4061; TRI 2026/2027 used as control) was completed in July 2002. Results revealed that TRI 4042, 4049, 4053 have shown higher root and shoot growth with compared to the other studied clones. Statistical analysis is being carried out. (JPM/PDU/JHNP)

- **Clonal Popularization Programme**

  The Clonal block which consists of 18 clones (3000 and 4000 series) in two replicates, was established in the Millakanda Estate, Bulathsinhala under Clonal Popularization Programme in collaboration with Plant breeding unit (SLD/TGN/PDU).

Project 2: Information Desks

Arrangements have been made to equip the Information Desk with following:-

- Data base for tea estates in the low country is in progress and Estate data such as weather, yield and other field information are being analysed.
- Ready- reckoner is in progress.
- Display materials on salient points on nursery practices have been displayed in the new building of plant breeding at nursery site.
- Statistical Information on Tea Industry was prepared in Microsoft power-point presentation form for easy reference.
- A Hot-line telephone service (045-28748) to facilitate the small holders, planters and other interested person to have access directly to the Advisory & Extension Services for their required information or advice.

Project 3: Upgrading Tea Museum and "AV" saloons.

- Expanding and upgrading the tea museum is being carried out at new hall..
- *"AV" saloons*-Arrangements have been made to start the AV saloons at new hall to provide services for tea growers.

Project 4: Establishment of Mother Bush areas

Establishment of Mother Bush Areas under ADB Project in the low country station is being carried out in the St. Joachim Estate.

Project 5: Monitoring the agricultural performance of tea plantation & Small holding.

- Several routing Advisory visit to the Estates sector as well as & small holding sector have been done to monitor the agricultural practices adopted by them and collect the field information to produce data base.

Project 6: Production of extension materials

- Completed Video programmes on Shade management organized Tea Reform Project with the assistance of. Advisory and scientific staff.

- **Collection of Photographs on tea related information**

  Photographs were taken collected on tea related information to produce extension materials and upgrade the Museum

- **Leaflets Booklet & News letters**

  - The booklet *on "Control of Stem and Branch canker in low country and Uva region"* - Arrangement is made to printing. *(Produced by SLD)*
  - *Tea Information* - has been Printed *(Produced by JPM and SLD)*
  - A Sinhala version of Tea Information with the current figures was submitted to the PPP for make necessary arrangement for publishing. *(Produced by JPM)*
  - Leaflet on pruning (Sinhala Medium) was completed and submitted to PPP for make necessary arrangement for publishing. (TGN & SW)
  - Booklet on *weed identification:* The final editing work is being done by Dr. B. Marambe, weed scientist Faculty of agriculture University of Peradeniya and will be completed in end of January 2003 (Produced by LDS, JCKR & JM).

  - Articles to ***Tea Thathu*** and TRI Update written by Advisory & Extension Staff
    Use of new clonal cutting issued by T.R.I.(based on a survey. (JPM &PDU)
    Drought and law country tea (JHNP,PDU & JPM)
    Canker problem in young tea (SLD)
    Some important points to increase the yield (TGN)
    Some observation on shear harvesting in low- country small holding (JPM/SLD)

10. Presentation of Research papers:

Full paper of "Impact of variation of soil properties on the Bush stand and productivity of tea lands in Sri Lanka" produced by Mr. M.K.S.L.D. Amarathunga and Dr. M.A.Wijeratna *was accepted for publication of the Journal of SLAAS in the last volume - 2002.*

11. Survey on small holding land

The following Extension surveys have been conducted in small holding lands

a. The survey on $Znso_4$ usage in smallholdings in Dehiowita TI region has been completed with the assistance of a diploma student from Agriculture school, Karapincha. The results of the survey revealed that the Usage of $Znso_4$ in the small holding tea lands was found to be low due to various reasons such as lack of proper knowledge, unavailability of material in remote areas where tea small holdings are located and financial difficulties etc. (JPM/SLD)

b. A survey on Assessment of Termite damage in sample estates in the low country tea estate was commenced (SLDA/TGN).

c. Commenced collection of weather and yield data from tea estates in the low country for the study on adaptation to climate change in the Plantation Sector (Tea) in collaboration with Agronomy and Economic division/TRI and SLAAS, Met. Department under Project of Assessment of Impact and Adaptation to climate Change (IACC Project) (SLDA/MAW).

12 Workshop attended by advisory staff

- Mr. T.G.N. Mahinda attended the trainers training programme conducted by the National Institute of Plantation Management, Athurugiriya on 30/01 to 03/02/2002

- Mr. K.G.J.P. Mahindapala attended the 5 day workshop on Script writing and Video filming conducted by the Audio Visual Training Center/Dept. of Agriculture, Peradeniya on November 2002.

- Mr. S. L. D. Amarathunga attended the AIACC Project Workshop on Developing integrated Models for Examining the effect of climate change and variability in the Tea and Coconut Sectors in Sri Lanka held at Hotel Renuka,. Colombo from 16th to 20th December.

13. Special Problem encountered

- Numbers of white root incidences were reported in small holding Sector due to direct conversion of rubber lands in to tea plantation without adopting soil rehabilitation procedure and proper land perpetration.

ADVISORY DIVISION, MID COUNTRY

S T Yatawatta - Advisory Officer

There were no changes in the staff position. Mr W B Kahandawa Extension Officer underwent a five day Audio Visual training programme at Audio Visual Centre of the Department of Agriculture.

General

1. **Advisory Correspondence** – 242 letters were sent to Estates and Small holders during the year.

2. **Advisory and Extension Services**

2.1 Routine Services

a) Advisory Visits	125
b) Extension Visits	20
c) Commercial Nursery Inspections	71

2.2 Training Programmes

Productions of Extension and teaching materials

2.3 Video Programmes

Video programme was prepared with the collaboration of Agriculture Faculty University of Peradeniya, on the use of T.R.I Harvesting Shear.

2.4 Training Programmes conducted with the N. I. P. M

Advisory Officer served as a resource person in the training programmes organised by the N.I.P.M. for planter trainees and Diploma course conducted by the N.I.P.M.

3. Visitors to the centre

75 Planters and 147 Small holders visited the centre during the year.

4. Advisory and Extension Programmes conducted

4.1 2 Seminars were organised with the RSC for Superintendents, Assistant Superintendents and Private Estate owners during the year.

4.2 Method Demonstrations and Field days

15 programmes was organized for estates in mid country area on the correct use of T.R.I. harvester.

Field days were conducted on the Nursery practices for Small holders.

4.3 Educational Programmes.

Educational programme was conducted for a group of 120 students from Ananda Balika Maha Vidyalaya, Colombo.

Similar programme was conducted for a group of students from Wariyapola Sri Sumangala Vidyalaya, Kandy.

Programme was conducted for students from Hemamali Balika Vidyalaya, Kandy on tea cultivation practices.

2 Groups of students visited the centre for practical training on all aspects of tea cultivation from Rajarata University, Puliyankulama.

Group of students from Agriculture School Wariyapola visited the centre for practical training on tea cultivation.

4.4 Awareness Programmes for staff/Workers and Samll holders.

Four programmes were conducted on the use of hand pruner introduced by the TRI

4.5 Informal discussions with Individuals and Groups.

Several planters and small holders visited the centre to discuss about various aspects of tea cultivations

4.6 Advisory Officer participated in an Exhibition held at Ratnapura

4.7 Meeting attended

Attended a RSC Seminar held at Kegalla
Attended Advisory officers' forum held in Kalawana
Attended 2 E & E Meetings organised for CEOs held at Talawakelle
Attended 2 E & E Meetings organized for Small holders held at Talawakelle

Attended the Seminar held in connection with alternate materials for Me.Br held in Colombo
Attended 2 RSC Seminars held at Galle
Attended 2 RSC Seminars held at Uva
Attended Advisory Officers' Forum held at Deniyaya
Attended Research and Advisory linkage meetings held at Talawakelle
Attended TRI/TSHDA Linkage Meeting held at Talawakelle
Attended the Quarterly PA Meeting and Annual General Meeting of Kandy District PA

5 Soil analysis for texture and pH
515 soil samples were tested for Ph and Texture

6 Advisory Publications
Joint publication on "worker shortage and declining productivity of tea estate- A case study - Doteloya Estate Dolosbage" was made with the Agriculture Economics Unit of TRI.

7 Activities under the Forward Extension Programme

7.1 **Project 1** Adaptive trial on use of fertilizer U709 and VP/UM was started at TRI Mid Country Centre.

7.2 **Project 2**. Collection of relevant tea data on mid country was started

7.3 **Project 3** Upgrading the existing museum was started

7.4 **Project 4** Clonal mother bushes of new TRI clones 3000 and 4000 series was started at the TRI MC and necessary assistants were provided to the OIC. in this connection.

7.5 **Project 5** Started a survey on Small Holders who collects cuttings from the Mid country centre with the objective of providing them correct cultural practices and to asses their current practices

7.6 **Project 6** Started a trail on growing nursery plants at different Ph levels

A set of nursery plants were raised in order to prepare a growth index

7 -

8 -

9 -

10 Advisory officer served as joint external supervisor for a final year student from Agriculture Faculty, University of Peradeniya on a project on "Different Plucking Baskets used in Tea Estates".

Advisory Officer inspected and prepared reports on Clonal Mother Bush areas planted at TRI and TSHDA centres and also inspected and submitted a report on land selected for planting Mother Bushes in Private Estates.

Advisory Officer served as Convenor/Secretary for Advisory Officers Forum and E & E forum (Small Holder) Sector.

MID COUNTRY RESEARCH, ADVISORY & EXTENSION CENTRE, KANDY

P B Ekanayake - Officer-in-Charge

1.General:

Mrs.P.Marapana, Stenographer and Mrs.W.R.D.P.de Silva, Typist/Clerk were transferred to Hantane from Talawakele in July.

2.CROP

Green leaf harvested (kg)

Month	Crop harvested	Crop sold	Rate paid/kg	Total Rs. Cts
January	2422	2413	14.33	34578.29
February	1533	1529	17.46	26696.34
March	1247	1245	17.46	21737.70
April	2471	2456	19.26	47302.56
May	1874	1868	19.26	35977.68
June	1196	1181	17.19	20301.39
July	975	969	14.61	14157.08
August	794	786	12.66	9950.76
September	1299	1287	12.79	16460.73
October	1287	1287	14.29	18391.23
November	1436	1436	14.29	20520.44
December	2029	2029	15.41	31266.89
Total	**18563**	**18486**		**297,341.09**

3.Income

No. of cuttings sold	785,645
Income from sale of cuttings	Rs.196,411.25
No:of VP plants sold	20
Income from sale of plants	Rs. 100.00
Total crop harvested (kg)	18486 kg
Income from sale of green leaf	Rs.297,341.09
Guest House occupation charges	Rs. 22,325.00
Soil testing (pH) charges	Rs. 15,390.00
Sale of TRI publications	Rs. 6,770.00
Miscellaneous (Sale of pepper,cloves & trees)	Rs. 13,550.00
Total income	**Rs. 551,887.34**

4.Special Scientific Visitors

1.Mr.Kingsely de Alwis in April
2.Mr.R.K.Nathaniel in April
3.Ms.S.Feriyal UNDP in April
4.Ms Dorthe Jokgensen UNDP in April
5.Mr.H.Smits in June
6.Mr.David Leask in June
7.Mr.Auner Barazari, Israel n August
8.Ms.Naoka Yoshida, Japan in September
9.Ms.Loli Ai Tee, ADB in September
10.Ms.Victoria , ADB in September
11.Dr.N.Muraleedharan, UPASI, India in September
12.Dr.B.Radhakrishnana, UPSAI, India in September
13.Mr.J.B.Hudson, UPASI< India in September
14.Dr.R.V.J.Ilango, UPASI, India in September
15.Dr.V.S.Pandit, India in November
16.Mr.A.Assiriyage in November
17. Mr.Ronie Weerakoon, Chairman, Sri Lanka Tea Board in December
18.Mr.S.B.Herath, SLSPC, in December

ADVISORY AND EXTENSION CENTRE, PASSARA

J C K Rajasinghe -Advisory Officer
Acting Officer- in-Charge:

1. **General:**

- Mr. BM Gunadasa, Guest house Keeper was retired from the TRI service in August 2002.
- New Director, TRI, Dr. SSBDG. Jayawardena visited the Station on 3rd September 2002.
- Mr. R. Nandasena, Station Assistant was transferred from TRI Low Country Station, Ratnapura on 2nd September 2002.

1.1 Infrastructure Development and capital items

- Construction work of new water storage tank was completed during the year.
- Extent of 1.5ha was planted with mother buses of clones TRI 3000 and 4000 series.
- TRI name boards were repainted during the year.
- A weighing balance was purchased under capital budget to weigh green leaf of experimental plots.

1.2 Special assignments

- Two Trainees form the Agriculture School Kundasale, conducted three surveys with the assistance of TSHDA officials, under the guidance of Advisory staff of the station. Survey titles are as follows

1. Evaluation of Commercial Nurseries in Uva .
2. Investigation of sources of technical information for tea smallholders.
3. Evaluating the adoption rate of TRI recommendations and their contribution to the productivity of smallholdings in Pelgahatenna Tea Inspector range.

2 Staff

3 Advisory and Extension Activities

➢ Advisory letters issues	-	130
➢ Advisory visits made to estates and small holdings in Uva	-	69
➢ Seminars/field days/training programmes held for estates/small holders/school children	-	29
➢ Regional seminars held in collaboration with Uva RSC.	-	01
➢ Visitors, including planters / small holders to the Centre	-	255
➢ Soil samples tested for pH	-	1132
➢ Soil samples tested for Organic Carbon content.	-	427
➢ VP cuttings issued	-	16750

4 Crop

Green leaf sold in 2002

Month	Sold (Kg)	Price SL. Rs./Kg.	Income Rs.
January	1188	20.97	24912.36
February	1181	21.39	25261.59
Arch	1853	23.00	42619.00
April	2638	21.00	55398.00
May	2361	19.44	45897.84
June	1739	18.10	31475.90
July	1351	17.22	23264.22
August	727	17.16	12475.32
September	1534	16.40	25157.60
October	2775	20.37	56526.75
November	1881	20.29	38165.49
December	3043	19.21	58456.03
Total Revenue	**22271**		**381154.07**

The total amount paid as transport charges was Rs15589.70 and, the net income realized from the sale of green leaf for the year was Rs 365564.37.

5. Income

Income from sale of VP cuttings	Rs. 4187.50
Income from sale of VP Plants	Nil
Income from green leaf	Rs 381154.07
Soil Analytical charges	Rs 80930.00
Sale of publications	Rs. 6430.00
Guest house accommodation charges	Rs. 6300.00
Other income	Rs. -
TOTAL INCOME	**Rs. 479001.57**

6. Check-roll workers (as at 31st December 2002)

No. of check-roll workers	- *24*
Out turn (Women)	- *36.1%*
Out turn (Men)	- *47.3%*

7. Field Trials

- 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 smallholdings.
- Monitoring activities of clonal observation trial 2/VP37/UVA are continued.
- The Field trial on evaluation of seed varieties is being monitored by the Plant Propagation and Breeding Division.

- Field trial was laid down by Plant Propagation and Breeding Division at the station to evaluate the different sizes of nursery bags.
- Drip Irrigation trial at Dammeria Estate was being monitored jointly with Agronomy Division.
- SPND division started a field trial in parallel to ongoing estate trials in the region to evaluate the high levels of potash fertilizer.
- A trial was initiated at the station under Methyl Bromide project to evaluate newly recommended clones for Uva for their tolerance to nematodes(*P loosi* and *R similis*).

8 Special Uva Problems

- Canker (collar and branch) infestations were frequently reported among smallholdings in the area mainly due to the poor soil management practices adapted by them.
- Sulphur deficiency symptom were observed in few smallholdings in Tea Inspector Ranges of Passara and Pelgahatenna during the year and indications are such that this would become common among smallholdings who do not use zinc sulphate for mature tea.
- Widespread incidents of Shot-Hole Borer infestations causing damage to bush frame and tea crop was reported from many plantations especially in Haputale - Koslanda area.

ADVISORY & EXTENSION CENTRE – DENIYAYA

J A S K V Jayasinghe - Advisory Officer
Acting Officer in-charge

General

(1) Advisory Correspondence

281 letters on regular advisory matters and problems

(2) Advisory & Extension Services

2.1 a. Advisory Visits: 40 visits for company estates, proprietary Plantations and smallholding sector
b. Extension Visits: 4 visits
c. Commercial Nursery Inspections: 30

(3) Visitors to the Station:

I. Plantation staff: 17
II. Small Holders: 199
III. Students/ School Children: 145

(4) Advisory and Extension programme conducted

4.1Regional Scientific Activities: 4 Seminars attended by OIC

4.2Method demonstration and field days:

2 Shear harvesting programmes for small holders
1 Plucking demonstration for Company estate

4.3 Educational programmes:

3 Days programme for students of university of Sabaragamuwa
2 six months programmes for agricultural diploma students

4.4 Awareness programmes & Training programmes:

1 programme for proprietary planters
3 programmes for Superintendents and Asst. Superintendents on shear harvesting
13 programmes on Installation of Computer model for rolling
19 programmes for small holders (shear harvesting, cultivation practices and quality plucking)
2 programmes for students (cultivation and agronomic practices)
2 programmes for *Samurdhi* and *Gramaseva Niladari* (cultivation and agronomic practices)
2 programmes for *Seva Lanka* foundation (cultivation and agronomic practices)

4.5 Informal discussions:

75 with small holders
3 with planters
1 with student

4.6 Meetings attended by the advisory staff:

- 2 Advisory officers' forums
- 4 E & E meetings
- International conference on phasing out of MeBr at Hotel Oberoi
- Forestry and environmental symposium at Hikkaduwa
- Others: 14 (circular, research- advisory linkage, TSHDA- TRI Interaction, ADB mother bush project and TSHDA mobile service)

- Extension officer attended Two Training programmes in Meteorological Department in Colombo and Audio Visual Division Agriculture Department in Peradeniyaya

5. Soil analysis for pH: 120 samples

6. Advisory publications: 410

7. Activities under the forward extension programme – TRI co-operate plan 1999/2003:

8. Sale of planting materials: 220,950

9. Production of leaflets and other publications: nil

10. Presentation of Research/ Extension papers: nil

11. Special assignments/problems:

Further investigations are in progress on 'gradual bush debilitation' in Deniyaya region

ADVISORY AND EXTENSION CENTRE, KOTTAWA, TALGAMPOLA

K D Dahanayake - Advisory Officer
Officer-in –charge

1. General

Repairs to workers' cottages & colour- washing staff quarters C1,C3 were completed.
Electricity supply to workers' cottages completed.

1.1 Mother Bush Project

Construction works for the expansion of nursery was completed and laid 46740 cuttings.
02 ha. land preparation and planting Gautemala was completed.
Another 02 ha land area was cleared and prepared for planting tea under the same project
Special Assignments
Mr.K.D.Dahanayake shared the responsibilities of inspection of tea fields of Walahanduwa TRI in addition to his normal duties.

2. Labour force -

Number on check-roll		65
Outturn	55	average

3. Land Use Information -

VP tea mature (ha)	10.0
VP tea young - ADB (ha)	1.0
Mother bushes other -ADB (ha)	4.0
Nursery (tea)	1.0
Seed garden (tea)	1.0
Coconut, Fruit trees and Germplasm (ha)	1.5
Forestry (ha)	7.3
Buildings, gardens, roads	9.8
Total extent (ha)	**35.6**

4. **Crop -**
Green leaf harvested - 2002

Month	Harvested Kg	Sold kg	Rate paid/kg Rs. Cts.	Total income Rs. Cts.
January	7429	7429	26.47.7	196697.63
February	5530	5530	26.32.3	145566.19
March	6548	6548	26.00	170248.00
April	3562	3562	25.30	90118.60
May	5003	5003	25.83.6	129257.51
June	4721	4721	24.80.2	117090.24
July	4828	4828	24.61.9	118835.91
August	4940	4940	25.17.3	124354.62
September	3741	3741	26.02	97340.82
October	6465	6465	25.72.9	166337.99
November	6541	6541	25.26.3	165245.28
December	7668	7668	25.00	191700.00 appr.
	66975	66975	1712792.79	

Total rainfall - 2161.1 mm.

No. of wet days - 162

5. Income from supply of VP shoots - Rs.14135.00

6. Miscellaneous income - Rs. 38645.00

7. Total income -

Income from sale of green leaf	-	Rs. 1712792.79
Income from sale of VP shoots	-	Rs. 14135.00
Miscellaneous income	-	Rs. 38645.00
		Rs 1765572.79 approx

8. **Advisory & Extension Services - 2002**

8.1 Advisory correspondences

290 Advisory correspondences were made by the Advisory and Extension staff for the year 2001.

8.2. Advisory and Extension Services

8.2.1 Routine services

a) Advisory Visits

The total number of advisory visits made by the Advisory and Extension staff was Sixty four (68) which included routing visits to the estates and the smallholdings visited.

b) Commercial nursery inspections

Mr.K.D.Dahanayke had involved in 31 commercial nursery inspections.

8.2.2 Training programmes

a) Seminars

Mr.K.D.Dahanayake and Mr.S.P.Rathnayake conducted 16 seminars at Kottawa station and outside in collaboration with Central Bank of Sri-Lanka, Forest department, Ministry of Indigenous Medicine and Tea Commissioners division. The target groups were tea smallholders, green leaf suppliers and Factory owners.

8.2.3 Video programmes

Sixteen (16) video shows were presented on plucking, land preparation and soil conservation of tea in and outside Kottawa station.

8.3. Visitors to the station

The number who visited the station personally seeking advice and collecting VP shoots.

8.3.1 Estate management and Smallholders - 1108

8.3.2 University/Diploma students and others - 06

a) One student of Wayaba University commenced a survey on Horse Hair Blight disease spread in low country under supervision of Dr.A.Balasooriya/Pathology division and attached to kottawa station

b) Two students from University of Kelaniya successfully completed their research projects on current trends in tea market and production under the supervision of Mr.S.P.Rathnayake.

c) A student of University of Ruhuna was educated and furnished with a set of Agro –met data by Mr.S.P.Rathnayake.

d)One project of Agriculture diploma student from School of Agriculture, Angunakolapalassa relating to tea nursery management was carried out at Kottawa under the supervision of Mr.S.P.Rathnayake.

e) One Advance level student gained information and completed the project report under the supervision of Mr.S.P.Rathnayake.

8.4. Advisory and Extension programmes conducted

8.4.1 RSC activities

One RSC seminar was organized and held at Unawatuna Sun-Shine hotel.

Mr.Godfry Tissera chaired the seminar and Dr.W.W.D Modder made the keynote address. Dr.A Anandacoomaraswamy and Dr A K N Zoysa were the two presenters of Ergonomics of tea harvesting and Eppawala Phosphate rock as a source of P in tea respectively.

8.4.2 Method demonstrations and field days

Fourteen (14) field days had with Superintendents, Assistant Superintendents, participants from AgStar Company and Smallholders on demonstrations relating to nursery works, weed management, plucking, pruning and pest/diseases control methods.

8.4.3 Educational programmes

Seventeen (17) Educational programmes related to identification of new clones, new fertilizer policy recommended for low country and shear harvesting and new plucking basket were conducted by the Advisory and Extension staff

8.4.4 Awareness programmes for staff/workers and smallholders

Twenty three (23) awareness programmes were organized by the Advisory and Extension staff.

8.4.5 Informal discussions

Seven (07) informal discussions were held in finding solutions for various problems such as labour shortage, pest/diseases control which encountering in tea industry.

8.4.6 Meetings attended

Mr.K.D.Dahanayake and Mr.S.P.Rathnayake attended 22 meetings including HOD, Advisory Officers' forums, Grade I-V, E&E meetings, Advisory Circular Revision meetings, DDC meetings and Advisory & Research Linkage meetings.

8.5. No. of soil samples tested for pH - 323

8.6. Advisory publications distributed

777 nos. of Advisory and extension publications have been distributed.

8.7. Activities under the forward Extension programme – TRI Cooperate plan 1999/2003

8.7.1 Adaptive demonstration trials

Two (02) Adaptive demonstration trials were conducted at Akuressa and Elpitiya

8.7.2 Upgrading Tea Museum and AV Saloons

Upgrading the Tea museum was commenced.

8.7.3 Establishment of Clonal Mother Bushes

Bringing into bearing was done in 01 ha ADB site and Expansion of the nursery to accommodate 50000 plants was completed.

8.8 Sale of Planting materials (Clonal Cuttings)

70675 nos. cuttings were distributed (TRI 2022,2025,2027)

8.9 Experiments & Observations

01 The effect of different mulches on microbial activity of tea lands
02 The effect on burial of prunings
03 Shear plucking observation block
04 Hedge planting observation block
05 4000 series observation block
06 Calliandra plants block
07 200 plants Cinnamon in boundaries (Intercropping)
08 Growth performance of Gravellia – reported by Talawakelle & Ratnapura
09 Growth performance of young tea - reported by Ratnapura
10 Lopping high shade - Albizzia
11 Clonal Mother Bush Project - 3000 & 4000 clones
12 Adaptive research trials (U-709 and T-1130) at Akuressa and Alpitiya
13 Seed Garden trial at field no: 07
14 Fertilizer demonstration trial at Field no: 04 (VP/LC 880 and U 709)

8.10. Special problems observed in the tea industry of southern province

The rate of spreading of Horse hair blight disease was noticed in Nagoda, Hiniduma and Baddegama, Akuressa areas and reported to the TRI Pathology division and started an experimental trial at Nagoda.

9. Staff

MID COUNTRY RESEARCH, ADVISORY & EXTENSION CENTRE
KANDY

P B Ekanayake- Officer in Charge

1.General:

Mrs.P.Marapana, Stenographer and Mrs.W.R.D.P.de Silva, Typist/Clerk were transferred to Hantane from Talawakele in July.

2.Hectarage as at 31st December 2002

Type of land use	ha
Seedling tea	2.00
VP tea (mature)	6.00
VP (young)	1.75
Mother bush	2.00
Nursery (tea)	0.20
Under mana grass	2.25
Fruit trees	0.40
Coconut	0.81
Forestry	1.20
Marshy land	0.62
Buildings, gardens, paths & roads	5.77
Total	**23.00**

3.CROP hrvested (kg)

Month	Crop harvested	Crop sold	Rate paid/kg Rs.cts	Total Rs.cts
January	2422	2413	14.33	34578.29
February	1533	1529	17.46	26696.34
March	1247	1245	17.46	21737.70
April	2471	2456	19.26	47302.56
May	1874	1868	19.26	35977.68
June	1196	1181	17.19	20301.39
July	975	969	14.61	14157.08
August	794	786	12.66	9950.76
September	1299	1287	12.79	16460.73
October	1287	1287	14.29	18391.23
November	1436	1436	14.29	20520.44
December	2029	2029	15.41	31266.89
Total	**18563**	**18486**		**297,341.09**

4.Income

No:of cuttings sold	785,645
Income from sale of cuttings	Rs.196,411.25
No:of VP plants sold	20
Income from sale of plants	Rs. 100.00
Total crop harvested (kg)	18486 kg
Income from sale of green leaf	Rs.297,341.09.
Guest House occupation charges	Rs. 22,325.00
Soil testing (pH) charges	Rs. 15,390.00
Sale of TRI publications	Rs. 6,770.00
Miscellaneous (Sale of pepper,cloves & trees)	Rs. 13,550.00
Total income	**Rs.551,887.34**

5. Special Scientific Visitors

1. Mr Kingsely de Alwil in April
2. Mr R K Nathaniel in April
3. Ms S Feriyal UNDP in April
4. Ms Dorthe Jokgensen UNDP in April
5. Mr H Smits in June
6. Mr David Leask in June
7. Mr Auner Barazari, Israel in August
8. Ms Naoka Yoshida, Japan in September
9. Ms Loli Ai Tee, ADB in September
10. Ms Victoria, ADB in September
11. Dr N Muraleedharan, UPASI, India in September
12. Dr B Radhakrishna, UPASI, India in September
13. Mr J B Hudson, UPASI, India in September
14. Dr R V J Ilango, UPASI, India in September
15. Dr V S Pandit, India in November
16. Mr A Assiriyage in November
17. Mr Ronie Weerakoon, Chairman, Sri Lanka Tea Board in December
18. Mr S B Herath, SLSPC, in December

TRI RESEARCH, ADVISORY AND EXTENSION CENTRE
RATNAPURA

Sushila I Vitarana-Officer in Charge

General

There were 25 technical and 17 administration staff based at this Station. They conducted research in agronomy, entomology, plant breeding and technology. Technical staff assisted staff of the Advisory and Extension Division at transferring technology to the plantation sector. Other research activities in the low country were serviced by staff from the head office.

Detailed reports of research, advisory and extension activities conducted by the staff of the station have been reported under the individual reports of the Agronomy, Entomology, Plant Breeding, Technology and Advisory and Extension Divisions.

Appointments, transfers, retirements and resignations

Mr.S.Wimaladharma, Head Advisory and Extension Services Division, retired from the services of the TRI with effect from 16th January 2002. He was reempl;oyed on on contractual basis to serve in the same capacity and was based at this station. Mr.Muditha Jayathilaka, Technical Assistant, Entomology Division, and Mrs.H.K.Seetha, Accounts Clerk were transferred from Talawakelle and assumed duties at this station with .effect.from 10th June and 12th August, respectively. Mr.R.Nandasena, Station Assistant was transferred out, to TRI Advisory and Extension Centre, Passara w.e.f. 2nd September. Mr. K.W.K.Chaminda Driver, was transferred to TRI Advisory & Extension Centre, Deniyaya w.e.f. 03rd Jume and Mr. P.Rnaweera, Driver from head office took his place w.e.f. 08th April.

Training and Attending Conferences, Symposia

Miss.S.M.Samarasinghe, Research Officer, was granted permission to register at the PGIA to undertake a post-graduate study programmme leading to a PhD Degree.

Mr.J.S.K.de Silva, Electrician attended a short training in electrical maintenance conducted by the ICTAD, Colombo.

Seven apprentice trainees from Hardy Technical College, Ampera and School of Agriculture, Naiwala underwent on-the-job training in extension, agronomy and entomology, as part fulfillment of the requirements for the National Diploma in Technology (Agriculture).

Four apprenticec commenced training in English Stenography, Accountancy and General Clerical work and one completed the training by the end of the year.

Mrs S.I.Vitarana participated at an International conference held Thailand, to discuss the progress of research conducted on alternatives to methyl bromide used in the agricultural sector..

Meteorological Station

Mr.A.K.Prematunga, Experimental Officer, Entomology Division, maintained the weather records and the meteorological station under the supervision of Dr. M. A. Wijetatne, Agronomist at the Station. Weather Record have been published elsewhere, in this report.

TRI Low Country Station Expansion

Construction work on improvements to the Administration Block was completed, in November. Construction work on the new Hostel Complex was nearing completion. Soil survey was carried out and location identified for new deep well to supply the hostel complex.

Designing, drawings and tender documents were completed by Sri Lanka State Engineering Corporation, the construction consultants, for the proposed D-type Quarters, Circuit-bungalow, and a building complex to accommodate an Auditorium, Plant-
Breeding Lab, hardware stores and the workshops for the electrician and the works supervisor.

Authority was granted by the United Nations Overseas Project Services to construct one Glass House, using funds of the Methyl Bromide Project and the tender document for this purpose was being prepared by the Resident Engineer, TRI.

Maintenance of Buildings, Roads and Water Supply

Renovation of the C-16 quarters and the Mechanical Workshop of the Technology Division were completed. Repairing the roof and gutters of C-1 was completed. Complete colour washing of B-1 and C-15 and roof painting of Technology Division, D-7 and D-8 ware completed. Painting of the roof of the office and laboratory premises, replacement of gutters, down pipes and repairs of the roof of the office and lab complex were completed. Repairs of main beams and pavements of D1,D2,D3 and D4 quarters were completed.

Replacing barbed wire fence around the boundaries of the TRI and new fencing around residential quarters was in progress.

Re-tarring of all internal roads commenced in December and was in progress.

Laying down of pipe lines to supply water to the administration building was completed.

The day to day maintenance of the buildings, roads etc was satisfactorily carried out.

Transport - Major Repairs

Tinkering and re-painting of Mitsubishi Pajero (32/3468) were completed. An engine overhaul of vehicle Mitsubishi Pajero ((32/1808) was in progress. Day-to-day maintenance of vehicles was carried out satisfactorily.

Electrical

Lay down of Aerial bundle-cable and re-wiring of mechanical workshop after renovations were completed. The day-to-day maintenance of electrical work was satisfactory.

Security Service

As pointed out on several occasions in the performance reports submitted to head office, the services rendered by the security force was very unsatisfactory. This has been so, even though there were sufficient security guards to cover the security points.

Constraints

As indicated in several performance review reports the staff strength both in the Administration and technical divisions was inadequate. Therefore, some officers continued to attend to additional duties.

STAFF AS AT 31ST DECEMBER 2002
TRI LOW COUNTRY STATION,RATNAPURA

Mrs S.I.Vitarana	Officer-in-Charge of the Station and Acting Head Entomology
Mr.S.Wimaladharma	Head Advisory & Extension Services/ Senior Advisory Officer
Dr.M.A.Wijeratne	Senior Research Officer
Dr.K.G.Prematilaka	Senior Research Officer
Mr.G.L.C.Galahitiyawa	Research Officer
Mr.N.P.S.N.Bandara	Research Assistant
Miss.S.M.Samarasinghe	Research Officer
Mr.S.L.D.Amarathunga	Advisory Officer
Mr.H.S.N.Peiris	Experimental Officer
Mr.E.R.Perera	Experimental Officer
Mr.P.D.Upali	Experimental Officer
Mr.W.M.U.A.B.Marapana	Experimental Officer
Mr.A.K.Prematunga	Experimental Officer
Mr.D.W.Vitana	Experimental Officer
Mr.A.J.Gamage	Experimental Officer
Mrs B.S.N.Vitana	Experimental Officer
Mr.D.S.E. Weerasooriya	Chief Clerk/ Acting Administrative Officer
Mrs H.K.Seetha	Accounting Assistant
Mr.K.A.D.Mervin	Accounting Assistant
Mrs P.V.G.Karunanayaka	Stenographer(English)
Mr.K.A.S.Kumarapperuma	Clerk/Typist
Mr.J.S.K.de Silva	Electrician
Mr.K.Gunawardena	Works Supervisor
Mrs P.I. Jayawardena	Telephone Operator
Mr.K.G.J.P.Mahindapala	Extension Officer
Mr.T.G.N.Mahinda	Extension Officer
Mr.J.H.N.Piyasundera	Experimental Officer
Mr.A.K.M.Jayasena	Technical Assistant
Mrs E.W.T.P. Prematunga	Technical Assistant
Mr.M.A.Chamindra	Technical Assistant
Mr.M.A.B. de Silva	General Mechanic
Mr.Muditha Jayalatilaka	Technical Assistant

LIBRARY

Wasantha Illanganthilake-Librarian

Collecting & disseminating information on tea and allied areas were carried out throughout the year.

The total number of the new accessions during the year was 37. The TRI subscribed to 42 journals, and about 21 journals were also received on a gift/exchange basis.

The library continued its normal routine work such as classification, cataloguing , indexing , lending materials and also maintained a news clipping collection.

Inter-library loan activities continued satisfactorily. On request 28 articles were sent to various agricultural libraries while 26 articles were received for our users.

Ten literature surveys were done using CD-ROM database & Internet facilities available at the CARP.

The Library continued to maintain its relationship with AGRINET (Agricultural Information Network) with a view to resource sharing. About 73 journals content pages were received according to our user requirements and 370 content pages we forwarded to AGRINET Libraries on SDCP services. A further 31 articles were received from other Libraries & 74 articles were sent to other libraries through AGRINET.

In addition, reference services were made available to students, out side scientists etc., on request.

ST COOMBS/LAMILIERE ESTATE

S G Ekanayake - Superintendent

Field Works & Cultivation

Hectare Statement as at 31st December 2002

	Total
Old Seedling Tea in Bearing	11.60
V.P.Tea in Bearing	122.82
ADB Project	14.01
Nurseries	1.30
T R I Experimental Area	5.90
Labour Housing	1.09
Ravines & Grass Land	32.00
Buildings, Roads, Workers' Gardens etc.	48.98
TOTAL	**237.70**

Weather and Rainfall

A rainfall of 1,708.3 mm was recorded over 171 wet days as against 1,949.3 mm over 181 days in 2001.

Crop and Yield

	2002		2001	
	Crop (kg)	Yield (kg/ha)	Crop (kg)	Yield (kg/ha)
St.Coombs	183,869	2,043	168,219	1,828
Lamiliere	111,331	2,369	103,841	2,308
Total	295,200	-	272,060	1,986
Bought Leaf	-	-	8,369	-
Grand Total	295,200	2,155	280,429	1,986

The yield recorded in 2002 was the highest at 2,155 kg per ha.

Cultural Operations

Regular upkeep of the work was done during the year.

Field No. 14 – 1.68 ha. Uprooted for ADB mother bush project.
1,493 Grevellia plants planted in field Nos. 6A in Lamiliere and 6A, 9A, 10, 11,12 & 13, in St.Coombs.

Labour / Labour Accommodation
Re-roofing was undertaken in St.Coombs Upper Division Line No.51, and Lamiliere Division Line Nos. 8, 13 & 16.

Workers went on strike in July for 3 days demanding profit share bonus and wages increase.

National Housing Development Authority Housing Project started in St.Coombs Upper Division Field 4 and Lower Division Field No.12 for 36 beneficiaries.

Nursery
88,230 plants of T.R.I. 3000 & 4000 series clones were raised in the estate nursery for the ADB Project and Infilling work for St.Coombs & Lamiliere.

Factory and Manufacture

Top Prices
Silver Tips tea sold in November – Rs.5,000.00

SLS ISO 9002 : 1994 for tea processing at St.Coombs Factory
Quality System Certificate was received. (QSC – 0164)

Factory road tarring work was in progress.

Factory workers rest room was completed.

General

Computerizing estate accounts is in progress.

Working Results

The loss for the year is Rs. 1,653,120.00.

Support Staff

Mr.D.H.Jayatillake was appointed as Chief Clerk with effect from 15th October 1999 and letter of appointment to the effect was received on 27th August 2002.

Mr.P.A.Piyadasa , Driver was transferred to St.Joachim Estate with effect from 23rd September 2002.

TABLE 1: Working Results of St.Coombs / Lamiliere Estate for 2002 compared to previous years

Year	Total Crop kg (MT)	Bought Leaf (kg)	Yield (MT kg/ha.)	Net Sale Average Actual (Rs/kg)	Cost of Production Estimated Rs/kg	Cost of Production Actual Rs/kg	+ Profit - Loss Rs.
1997	279,718	104,319	1,915	120.30	85.79	99.49	+ 7,922,124.19
1998	218,264	35,063	1,509	152.85	102.76	119.10	-746,355.40
1999	266,001	13,872	1,840	121.60	94.95	116.14	- 14,031,161.11
2000	288,058	-	2,036	148.50	103.29	115.74	+9,431,018.92
2001	272,060	8,369	1,986	160.00	108.31	130.00	+ 633,769.54
2002	295,200	-	2,155	141.18	118.78	146.78	-1,653,120.00

TABLE 2: Monthly Yield (kg/ha), Rainfall and Average 'N' applied from 1997-2002 St.Coombs Estate - St.Coombs Division

Month	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
January	161	176	190	165	176	153
February	86	118	168	179	154	151
March	58	66	173	182	123	90
April	69	48	193	201	165	160
May	403	95	118	244	209	327
June	140	156	73	144	195	162
July	203	60	130	98	87	134
August	115	135	168	183	123	90
September	109	112	120	133	118	160
October	190	83	166	101	108	228
November	196	168	127	192	171	201
December	193	196	199	172	199	178
Total	1,923	1,413	1,825	1,994	1,828	2,034
Rainfall (mm)	2,395.9	2,292.0	2,032.0	1,887.6	1,949.3	1,708.3
No. of wet days	199	170	190	184	181	171
Average N ($kg\ ha^{-1}\ yr^{-1}$)	226	220	170	225	270	270

TABLE 3: Monthly Yield (kg/ha) of fields and amounts of "N" applied – St.Coombs Division (2002)

Field	Extent (ha.)	Total (N/ha.)	Mixture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	6.5	270	VPUM	170	149	99	151	378	219	186	136	258	348	335	305	2734
1A	0.6	200	STUM	118	97	158	124	413	68	100	102	105	228	132	135	1780
2	2.6	270	VPUM	68	197	138	254	338	145	192	103	242	392	362	279	2710
3A	7.0	270	VPUM	157	230	79	159	346	175	142	111	202	243	215	185	2244
3B	6.7	270	VPUM	183	153	109	208	383	177	87	3	7	-	28	32	1370
4	9.1	270	VPUM	182	201	82	192	364	264	168	92	116	209	176	174	2220
5	7.4	270	VPUM	174	151	118	226	447	184	186	118	321	359	304	354	2942
6A	3.0	270	VPUM	124	92	42	6	12	5	3	6	20	12	99	89	510
6B	2.9	270	VPUM	108	149	57	162	23	-	-	-	-	7	15	48	569
7	4.7	270	VPUM	186	126	110	161	314	210	143	131	153	217	199	185	2135
8	5.2	270	VPUM	176	161	98	139	390	196	111	116	200	340	239	234	2400
9	7.8	270	VPUM	212	140	99	170	435	141	175	110	184	283	304	180	2433
10	2.0	270	VPUM	157	182	48	68	263	104	103	72	112	244	48	149	1550
11A	2.0	270	VPUM	149	153	96	132	378	117	131	74	176	296	138	139	1979
11B	1.0	200	STUM	142	182	59	131	279	119	175	94	149	238	111	105	1784
12A	1.2	270	VPUM	144	160	108	126	300	232	238	153	212	286	261	295	2515
12B	1.0	200	STUM	149	3	-	-	-	12	-	-	-	-	24	2	190
13	9.0	200	STUM	70	102	95	183	299	114	120	74	151	245	190	134	1777
13A	1.4	270	VPUM	106	129	59	108	94	109	102	63	149	116	155	124	1314
13NC	2.0	270	VPUM	32	6	41	37	202	91	63	58	91	82	151	86	940
14	7.3	270	VPUM	163	160	72	131	306	177	133	119	169	225	202	155	2012

TABLE 4 : Cultural Operations - St.Coombs Estate - St.Coombs Division

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2001	Yield (kg/ha) 2002	Shade	Experiments
1	-	6.5	T R I 2016,2023 2025 & DN	Sep. 1999	1953-1959	2404	2734	Dadaps & Grevillea	Nil
1A	0.6	-	-	Aug. 2000	Before 1935	1765	1780	Grevilllea	Nil
1B	-	0.6	T R I 777	Sep.1999	1993	-	-	Dadaps	ADB Mother Bush Area
2	-	2.6	T R I 2043,2142 2025 DT 1 & DT 95	May 2001	1964	622	2710	Dadaps ,Grevillea & Calliandra	Plant Breeding
3A	-	7	T R I 2027,2043 2025	June 1998	1965 - 1968	2852	2244	Dadaps ,Grevillea & Calliandra	Agronomy & Agri Chemistry
3B	0.4	6.3	WT 26	June 2002	1965-1968	2496	1370	Dadaps ,Grevillea & Calliandra	Agronomy & Agri Chemistry
4		9.1	T R I 62/9,2025,3016 DN, N2 & CY9	May 2000	1978-1981	2163	2220	Dadaps ,Grevillea	Agronomy &
5	-	7.4	T R I 2142,2025 2023,TC9,DT95 &N2	May 2001	1970	904	2942	Dadaps ,Grevillea & Calliandra	Agronomy & Agri Chemistry & Plant Breeding
6A	-	3	T R I 2025, DN	June 2002	1985-1986	2003	510	Dadaps ,Grevillea	Agronomy & Agri Chemistry
6B		2.5	N2 & T R I 4061	June 2002	1985-1986	1543	569	Dadaps ,Grevillea	Plant Breeding
7		4.7	T R I 2024,2025,62/9 DT1,DT95 & 3019	April 2000	1962-1964	1814	2135	Dadapas ,Grevillea	Nil

TABLE 4 : Contd..

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2001	Yield (kg/ha) 2002	Shade	Experiments
8	-	5.2	T R I 2024,2025,4052 4072 & DT 1	June 1999	1962-1964	2380	2400	Dadaps ,Grevillea & Calliandra	Agronomy
9	4.8	3	TR I 3000 & 2043	Dec. 1995	1986	1794	2433	Dadaps ,Grevillea & Calliandra	Agronomy
10	-	2	SALT area	Mar-99	1993	2136	1550	Dadaps ,Grevillea & Calliandra	Agronomy
11A	-	2	T R I 2025,62/9	June 1998	1988	2231	1979	Grevellia & Caliandra	Nil
11 B	1	-	-	June 1998	1935	1802	1784	Dadaps ,Grevillea & Calliandra	Plant Breeding
12A	-	1.2	T R I 2025, KO 145	June 1999	1985	2046	2515	Dadaps ,Grevillea	Plant Breeding & Pathology
12 B		1.5	-	June 1999	1935	1115	190	Grevellia	Nil
13	8	-	-	July 2001	1935	1114	1777	Dadaps ,Grevillea & Calliandra	Agri Chemistry
13A	-	1.4	T R I 2025,2043 DT 1	July 2001	1986	901	1314	Grevellia & Calindra	Nil
13 NC	-	2	T R I 3000 Series 2025, DT 1	July 2001	1996	-	940	Grevellia & Calindra	Entomology
14	-	5.1	T R I 777, 2023 2024,3000 Series & N2	Oct. 1999	1961	2022	2012	Dadapas ,Grevillea & Calliandra	Plant Breeding & Pathology

TABLE 5 : Monthly Yield (kg/ha) of fields and amounts of "N" applied - Lamiliere Division (2002)

Field	Extent (ha.)	Total (N/ha.)	Mixture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
4A	5.1	270	VPUM	159	95	109	263	378	243	175	108	249	318	275	178	2550
4B	1.9	270	VPUM	313	117	94	189	595	183	151	127	291	285	315	341	3001
5	0.5	200	STUM	242	232	156	158	376	290	174	180	148	346	222	260	2784
5NC	0.5	270	VPUM	322	100	134	240	386	268	304	452	450	666	408	532	4262
6A	1.5	200	STUM	181	81	58	91	222	117	111	77	134	235	149	211	1667
6B	3.0	270	VPUM	253	95	119	267	276	148	150	95	188	103	-	-	1694
7	4.5	270	VPUM	181	148	112	247	284	159	154	112	232	262	348	233	2472
8A	5.0	270	VPUM	224	145	142	229	306	241	143	149	277	305	307	285	2753
8B	4.0	270	VPUM	207	142	104	281	410	229	185	148	268	366	301	234	2875
9A	4.0	270	VPUM	248	143	69	141	-	-	-	-	10	127	114	265	1117
9B	4.0	270	VPUM	242	102	77	209	235	214	102	-	-	-	54	20	1255
10	6.6	270	VPUM	218	115	105	202	500	177	159	144	221	328	307	227	2703
11	6.4	270	VPUM	227	208	93	174	536	176	151	200	227	335	242	199	2768

TABLE 6 : Monthly Yield (kg/ha), Average 'N' applied from 1997-2002 St.Coombs Estate – Lamiliere Division

Month	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
January	149	197	176	175	230	220
February	76	170	178	174	206	134
March	58	65	196	203	197	103
April	76	75	174	200	185	214
May	311	185	139	261	280	355
June	186	189	84	125	244	180
July	196	122	126	93	113	141
August	111	117	134	193	128	119
September	142	114	131	133	161	199
October	191	95	172	127	137	262
November	209	153	134	218	213	236
December	193	225	227	220	214	204
Total	**1,898**	**1,707**	**1,871**	**2,122**	**2,308**	**2,367**
Average N ($kg\ ha^{-1}\ yr^{-1}$)	213	219	169	220	270	270

TABLE 7: Cultural Operations - St.Coombs Estate - Lamiliere Division

Field No.	Seedling Tea (ha.)	V.P. Tea (ha.)	Clones	Last Pruned	Planting Year	Yield (kg/ha) 2001	Yield (kg/ha) 2002	Shade	Experiments
4A	-	5.1	T R I 2025	July 2001	1984	1775	2550	Dadaps & Grevellia	
4B	-	1.9	T R I 2025	Aug 1998	1986	2505	3001	Dadaps & Grevellia	
5	0.5				1999	2534	2784	Dadaps & Grevellia	
5NC		1.0	T R I 3041				4262	Dadaps & Grevellia	
6A	1.5		Mixed Clones				1667	Dadaps & Grevellia	
6B	-	2.0	DT 1, WT 26 & T R I 2025	Oct 2002	1990-1991	2166	1694	Dadaps & Grevellia	1.0 ha.ADB - PPPB
7	-	4.5	T R I 2025	July 1998	1983	1969	2472	Dadaps & Grevellia	
8A	-	5	T R I 2025 & CY 9	June 2000	1979	3151	2753	Dadaps & Grevellia	
8B	-	4	T R I 2025 , DN N2, WT 26 & CY 9	June 2001	1989 - 1990	1587	2875	Dadaps & Grevellia	
9A	-	4	T R I 2025	May 2002	1979	2258	1117	Dadaps & Grevellia	
9B	-	4	T R I 2025, DN & CY 9	July 2002	1980	2282	1255	Dadaps & Grevellia	
10	-	6.6	DN & T R I 2025	June 1999	1967-1969	2285	2703	Dadaps	
11	-	6.4	DN & T R I 2025	May 2000	1970-1971	2418	2768	Dadaps	

ST. JOACHIM ESTATE

M S E Perera-Superintendent

1. General

Mr. M.S.E . Perera functions as the Superintendent with effect from ,15/12/2001.

Mr. D.H. Wickremasooriya of Kelani Valley Plantations Ltd., visited this estate on 5/07/2002.

The A.D.B Mid -Term Review Mission , M/s. Ai Tee Loh and other members visited this estate on 09//09/2002 to inspect the progress of the Mother Bush Programme.

2. Hectarage as at 31st December 2002

	Ha	
Mature tea	47.92	
Nursery	1.58	
Land under coconut (TRI)	3.89	
ADB Project	32 .19	
Land under paddy	8.74	
Crop - Tea /Rubber	3.68	
Rubber	7.12	
Mana Grass	13.02	**118.14**
Other Lands		
Acquisition by Government		
Buildings/roads/ravines and jungle		**23.84**
Total extent		**141.98**

3. Crop (made tea kg)

The production on St.Joachim Estate in 2002, compared to previous year was as follows:-

Year	Estate Crop (Kg)	Bought Crop (Kg)
2001	66,459	609,732
2002	65,071	658,619

The production on the estate registered a decrease of 1388 Kgs or 2.09 % comparison to the previous year. This is due to 5.05 Ha being uprooted during the year for the ADB Project.

Y.P.H Although the crop has declined by 1388 kgs due to above reason, there is an increase of 218 kgs in Y.P.H compared to last season.

3.1 Bought Leaf

The bought leaf manufactured at St.Joachim factory showed an increase of 48,887 kgs or 8.02 % in comparison to previous year.

3.2 A.D.B. Project

An extent of 12.83 ha has been planted during the season 2002 under the ADB Project with clones of 30/40 series.

4. Prices

All teas produced at St.Joachim factory were sold at the Colombo Auctions in the Low Grown catalogue. M/s Bartleet & Co.Ltd, Forbes & Walker and De Silva Abeywardena and Peiris sold the teas in an equal proportion.

The Nett sale average for the year was Rs.147/84, and compared with last year shows an increase of Rs. 10/61. The working of St.Joachim Estate resulted in a Profit of Rs.265968/- as at 31st October, 2002.

5. Nursery

The supply of planting materials to small holders in the District continued this year too. Sale of Planting materials compared to the previous year was as follows :-

Year	Shoots sold	Proceeds Rs.	Profit on sale of Shoots Rs.	Plants sold	Proceeds Rs.	Profit on sale of Plants Rs.
2001	-	-	-	39063	273438/=	-
2002	432475	108119/=	7774/=	80082	585813/=	176213/=

Table 1

WORKING ACCOUNTS OF ST. JOACHIM ESTATE FOR 2002 IN COMPARISON WITH PREVIOUS YEARS

YEAR	TOTAL CROP SOLD MADE TEA- KG	YIELD MADE TEA KG/HA	NET SALE AVERAGE RS. /KG	ESTIMATED C.O.P RS. /KG	ACTUAL C.O.P RS. /KG	.+ PROFIT . - LOSS RS
*1996	* 1,094,941		113/81	87/06.38	102/30.88	+17,978,
	# 63,330	1248				
*1997	996,106		120/61	98/24.30	111/60	+19,325,3
	66,847	1236				
*1998	890,131		133/64	94/25.00	87/43	+16,605,6
	73,473	1359				
*1999	746,768		120/22	100/30.00	117/33	+8,262,01
	78,197	1446				
* 2000	711,325		138/70	82/98.00	75/62	+ 9,360,5
	75,336	1393				
*2001	609,732		137/23	89/48	89/13	- 424,4
	66,459	1140				
*2002	658,619		147/84	96/26	87/14 *	+ 265,9
	65,071	1358			*(To end October)	

* Bought Crop Made Tea

Estate Crop Made Tea

Table 02

Monthly Yield (kg/ha) rainfall and average N applied from 1997 to 2002

St.. Joachim Estate

Month	1997	1998	1999	2000	2001	2002
January	112	146	122	117	123	102
February	42	99	94	105	115	81
March	61	81	132	139	122	109
April	118	131	133	141	113	109
May	111	104	108	143	118	127
June	147	123	113	118	87	130
July	113	103	102	95	86	116
August	95	98	101	100	88	130
September	99	120	135	101	56	104
October	90	127	121	100	88	113
November	122	107	138	110	78	105
December	126	120	147	124	90	85
Total	**1236**	**1359**	**1446**	**1393**	**1140**	**1358**
Total Rainfall (mm)	4552.3	4579.9	4526.4	3740.6	3593.5	3194.8
No.of Wet Days	199	220	224	211	189	206
Average N (kg/ Ha/ Yr -)	143	158	164	162	163	162

METEOROLOGICAL OBSERVATIONS - 2002
ADVISORY & EXTENSION CENTRE, DENIYAYA *
(Elevation 250 m amsl)

Month 2002	Mean Temperature		Soil at 30 cm		Total Rainfall mm	Wet Days	Total Wind (Km)	Total Evaporation (mm)	Sun Shine Hours
	Min. °C	Max. °C	8.30 h	15.30 h					
JANUARY	20.93	29.90	28.66	28.72	190.0	12	752	2.61	188.2
FEBRUARY	20.45	32.47	28.98	29.27	29.9	08	872	3.26	207.9
MARCH	21.20	32.70	29.12	29.66	173.1	13	859	3.12	217.8
APRIL	22.56	31.72	29.19	29.55	582.1	26	632	3.57	178.0
MAY	24.00	30.20	28.95	29.27	324.9	25	861	2.86	180.9
JUNE	23.60	29.88	28.18	28.65	192.9	12	3630	3.49	177.6
JULY	23.68	28.92	28.66	28.17	252.4	23	3223	3.30	164.5
AUGUST	23.20	29.34	27.56	27.71	121.5	11	2941	3.25	193.1
SEPTEMBER	23.20	30.63	29.28	29.45	108.6	12	1928	3.33	233.3
OCTOBER	21.57	30.29	27.99	28.44	420.8	26	1176	3.93	151.5
NOVEMBER	21.92	29.89	27.47	27.74	458.3	23	744	2.96	132.75
DECEMBER	21.54	29.99	27.64	27.93	308.2	18	617	2.04	151.7
TOTAL					3162.7	209	18235		2177.25
MEAN	22.32	30.49	28.47	28.71	263.56	17	1519	3.14	181.4

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METEOROLOGICAL OBSERVATIONS- 2002
MID-COUNTRY, RESEARCH, ADVISORY AND EXTENSION STATION, KANDY
(Elevation 762 m amsl)

Month	Mean temperature (oC). Min.	Max.	Relative Humidity (%) 08.30 h	15.30 h	Mean sunshine (hrs/day)	Cum.Rainfall (mm)	No:of wet days	Cum.Evaporation (mm)

Month	**Mean temperature °C**		**Relative Humidity %**		**Mean Sunshine (hrs/day)**	**Cum.Rainfall (mm)**	**No:of Wet days**	**Cum.Evaporation (mm)**
	Min.	**Max.**	**8.30h**	**15.30h**				
January	20.65	25.30	90.85	92.10	5.92	20.00	00	94.20
February	20.10	27.50	93.85	80.82	6.53	41.00	03	116.60
March	20.70	25.30	94.94	76.76	8.00	137.20	06	111.50
April	20.85	29.50	95.01	85.76	6.52	498.50	18	88.70
May	22.10	27.85	97.10	97.20	6.90	125.97	05	101.36
June	20.60	26.80	97.10	97.20	5.90	180.90	10	102.75
July	20.60	25.70	97.40	97.40	5.50	86.31	07	171.50
August	20.50	26.70	98.40	98.40	5.40	140.34	08	166.50
September	20.10	29.00	98.60	98.60	7.80	24.00	01	115.13
October	20.40	27.70	99.10	99.00	5.00	280.50	13	68.43
November	19.80	27.30	99.00	99.50	4.10	450.80	15	45.35
December	19.60	25.60	99.00	98.00	3.30	142.80	08	67.27
Mean	**20.50**	**27.02**	**96.69**	**93.39**	**5.90**	-	-	
Total	-		-		-	**2118.32**	**95**	**1219.39**

METEOROLOGICAL OBSERVATIONS - 2002
UVA ADVISORY AND EXTENSION CENTRE, PASSARA

(Latitude 6^0 56'N , Longitude 81^0 07'E , Elevation 1120 m amsl)

Month	Mean Temperature ^{0}C		Mean Relative Humidity %		Mean Sun Shine hrs day^{-1}	Mean Wind Speed Km / h	Total Rainfall (mm)	Total Evaporation (mm)
	Min Dry	Max Dry	9.00 AM	4.00 PM				
January	17	23.7	83	85	4.5	2.84	110.2	57.54
February	17.2	24.4	80	78	5.6	3.12	121.2	68
March	17.9	26.6	71	69	7.3	1.66	109.8	104.16
April	19.1	-	76	74	5.5	0.81	385.8	76.61
May	19.8	-	75	82	5	1.87	128.6	90.06
June	19	-	75	74	4.9	1.07	57.6	89.40
July	18.6	27.6	72	68	5.3	2.22	17.5	90.45
August	18.6	28.3	71	70	5	1.66	143.3	91.02
September	18.6	28.1	66	68	6.2	1.56	23.3	105.71
October	18	25.5	81	86	3.9	0.75	360.5	57.04
November	17.9	24.7	85	88	3.1	1.27	332.1	44.8
December	17.3	23.1	84	87	2.6	3.93	325.8	53.67
Total							2152.7	928.46
Mean	18.2	25.8	76	77	4.9	1.89		

Rainfall (mm) Total for Month , Evaporation (mm) Total for Month
Min Dry (^{0}C) Average for Month
Max Dry (^{0}C) Average for Month

METEOROLOGICAL OBSERVATIONS – 2002

TRI-LOW COUNTRY STATION RESEARCH ADVISORY & EXTENSION CENTRE RATNAPURA-

(Lat $6^0$41'N, Long 80^0-40^0E, 29 m amsl)

Month	Temperature (^{0}C) Min. Dry	Max. Dry	Relative Humidity % 9.00 hrs	16.00 hrs	Mean Sun Shine hours	Rain Fall Total mm.	Difference From 30 years	Wet Days	Difference From 30 years	Pan Evaporation mm.
January	22.11	33.56	88	61	5.84	43.9	-6.72	07	-2	2.48
February	22.06	34.81	86	58	6.64	179.5	+42.5	09	-	2.96
March	22.73	35.20	87	64	6.12	146.0	-66.2	11	-3	3.41
April	23.37	34.64	87	71	4.78	306.1	-32.8	22	+2	2.95
May	24.32	33.11	86	72	3.73	440.4	-35.5	25	+5	2.74
June	24.39	30.18	82	67	4.67	380.9	-31.3	16	_5	2.91
July	23.89	31.76	86	69	4.26	186.0	-106.8	17	-3	2.48
August	23.80	31.96	84	61	5.19	176.9	-127.2	16	-4	2.86
September	23.21	33.63	83	62	6.89	178.4	243.0	11	-9	3.59
October	23.12	32.50	88	67	3.64	446.4	+9.6	27	+6	1.93
November	23.26	32.43	87	65	3.41	343.3	-28.1	22	+4	2.79
December	22.45	32.07	90	65	3.43	260.3	+25.0	15	+1	2.00
Total	-	-		-	-	3088.1	-	-	-	-
Mean	23.23	32.98	86	65	4.88	-	-	-	-	2.75

METEOROLOGICAL OBSERVATIONS - MONTHLY SUMMARY 2002
TRI - ST.COOMBS, TALAWAKELLE (LAT.6"54768'N,LONG.80"4239'E,1382m amsl)

Month	Mean Temperature(^{0}C)		Soil Tem.(^{0}C)at 20 cm under grass		RH(%)		Wind Travelled	Mean Sunshine	Total Rainfall	Wet	Total Evaperation
	Min.	Max.	09.00hrs	16.00hrs	09.00hrs	16.00hrs	(miles)	(h day-1)	(mm)	Days	(mm)
JANUARY	11.2	25.0	20.4	21.9	91.5	90.1	2750.36	6.0	26.9	3	85.12
FEBRUARY	12.6	26.4	21.0	22.9	91.9	94.6	1940.06	7.1	11.6	3	66.88
MARCH	12.2	27.4	21.5	23.4	92.6	95.0	2023.92	7.7	111.2	6	99.45
APRIL	14.1	26.1	21.7	23.1	94.5	95.9	1422.21	5.7	269.6	21	57.55
MAY	15.8	24.7	22.3	23.2	96.0	94.8	1713.76	3.9	135.4	18	51.71
JUNE	15.7	23.0	21.2	22.1	96.7	93.2	2330.14	3.9	203.7	13	49.33
JULY	15.9	22.1	21.1	21.6	97.1	94.8	2055.75	2.6	193.0	18	40.46
AUGUST	15.4	22.7	20.7	21.6	96.6	94.8	2791.27	3.8	207.7	18	44.14
SEPTEMBER	13.5	24.9	21.7	23.4	94.3	95.5	1790.75	6.8	54.5	7	72.71
OCTOBER	14.5	24.6	21.6	23.0	95.2	93.9	1230.16	4.9	243.8	23	57.31
NOVEMBER	14.3	25.2	21.6	22.8	95.4	94.4	1476.91	4.7	149.0	12	51.17
DECEMBER	13.6	24.4	21.0	22.1	94.3	91.3	1831.42	4.2	59.4	9	58.63
AVERAGE	14.1	24.7	21.3	22.6	94.7	94.0	1946.4	5.1			
TOTAL									1665.8	151	734.46

METEOROLOGICAL OBSERVATIONS- YEAR 2002

Advisory and Extension centre, Kottawa, Talgampola
(Elevation-30m amsl)

Month	Mean Temperature(°C) Min	Max	Relative Humidity(%) 09.00 h	16.00h	Mean Sunshine (h day^{-1})	Total Rainfall (mm)	Rainfall differnce from 20 years	wet days
January	22.2	30.5	88	73	6.0	87.5	- 33.4	07
February	22.0	32.8	89	82	7.8	69.6	- 20.1	06
March	21.9	32.3	87	80	7.4	101.2	- 11.6	07
April	23.3	31.6	90	78	5.9	145.4	- 109.5	14
May	24.0	31.0	90	79	7.1	277.6	- 86.8	20
June	24.3	30.6	87	79	6.1	110.5	- 162.8	11
July	24.1	30.0	86	76	5.5	128.3	- 65.8	13
August	24.0	30.1	86	86	7.0	78.6	- 136.7	13
September	23.0	31.0	86	77	8.0	161.4	- 153.7	18
October	23.1	30.2	87	75	6.1	533.6	- 170.7	21
November	18.2	30.1	87	76	4.1	336.4	+ 44.7	19
December	22.3	30.7	90	86	4.1	131	- 41.9	13
Total						2161.1		162
Mean			88	79	6.3			