ANNUAL REPORT – 1998

TEA RESEARCH INSTITUTE OF SRI LANKA

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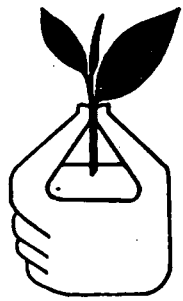
ANNUAL REPORT
FOR THE YEAR
1998



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Contents

Report of the Chairman, Tea Research Board

Prioritization of Research at the Tea Research Institute (TRI) was accomplished using the CADMAR (Composite Approach to Decision Making in Agricultural Research) methodology. Initial identification of basic and applied research thrusts and projects resulted following four workshops involving the participation of the diverse stakeholders in the tea industry. After subjecting the researchable items to cost-benefit and environmental impact analyses, they were categorised into two priority groups. Through this process, the rapid development of new technology, so vital for our tea industry to be competitive globally, is anticipated.

Recruitment of suitable scientific and technical staff to TRI has been an intractable problem. Following representations to the Ministry of Public Administration, Home Affairs and Plantation Industries, the criterion for selection as stipulated in the Public Administration Circular No. 15/90 was changed to an acceptable 60:40 ratio for written examination and interview, respectively. Earlier, the selection was based only on written examination whilst the interview served merely to authenticate the stated qualifications of candidates.

TRI has for long been beset with difficulties in attracting suitable candidates for high level managerial and scientific positions. As an aspect of its resolution, the remuneration attached to the post of Director, TRI, which is on a contractual basis, was enhanced with the approval of the Cabinet of Ministers. Further, the Tea Research Board (TRB) gave approval to the TRI to engage the services of former scientists, on contractual basis, to mitigate the dearth of experienced scientific staff.

Recognizing the lack of professionally qualified tea technologists locally for the sustainability of the tea industry, the TRB initiated action through the University Grants Commission for the Post Graduate Institute of Agriculture (PGIA), Peradeniya, to conduct a diploma course in tea processing and technology. The PGIA's draft proposal on this course is now before the University Senate.

The TRB, in pursuance of its policy on Human Resource Development, involving upgrading the knowledge level of TRI staff, ensured their participation in scientific conferences, meetings, workshops, training programmes and seminars. During the year, TRI staff participated in a GIS (Geographical Information Systems) user conference in India; a conference on Plant Management for Sustainable Agriculture in Thailand; a training workshop on Monitoring and Management of Heavy Metals, Pesticides, Dyes and Pigments in Pakistan; a specialized training course on Isotopic Techniques in Germany; an International Conference on Precision Agriculture in Minnesota, USA; a Training Programme on Flood Disaster Mitigation at AIT, Bangkok, Thailand; the Fourth Asia Pacific Food Analysis Conference in Cheng Mai, Thailand; the Seventh International Congress of Plant Pathology in U.K.; and a short-term training at Instituto Di Nematologia Agraria Application Ai Vegetali

in Italy. A TRI scientist also visited the University of Agricultural Sciences, Institute of Meteorology and Physics, Vienna, Austria, and the Pacific Northwest Laboratories, Richland and Washington State University, USA, to refine a mechanistic crop simulation model developed for tea. TRI scientists also attended a full-time residential training in advanced computer applications for plantations at the Kothari Agricultural Management Centre, Coonoor, India, under the Colombo Plan. Further, the scholarship scheme adopted by TRI was pursued in order to expose scientists to the latest developments in specialized fields of research. Accordingly, one scientist was sponsored for a Ph.D degree at James Cook University, North Queensland, Australia, for a three year period.

In order to formulate a Corporate Plan for the TRI and its two estates, a workshop was held with the participation of representatives of different stakeholder groups to refine the draft plan. The refined version is expected to be ready early next year.

The ADB Consultant to the tea smallholder sector, attached to the TRI, completed his assignment. A consultant biometrician funded by the Commonwealth Secretariat assumed duties during the year. The Chairman, TRB, on invitation, attended the International symposium on Tea and Health held at Sydney, Australia, and made a presentation on 'Field and Factory Practices in Tea'. TRI participated at the exhibition held to commemorate Sri Lanka's 50th Independence Anniversary at the BMICH, Colombo.

Schemes of recruitment were approved by the TRB for the posts of heads of divisions, public relations officer and computer systems manager. TRB also approved the replies by TRI to the report of the Auditor General in terms of Section 13 (7)(a) of the Finance Act No. 38 of 1971 on the accounts of the TRB for the year ended 31st December, 1996.

To ensure that the two TRI estates, St Coombs, Talawakelle, and St Joachim, Ratnapura, serve as model estates for the tea industry, a Visiting Agent was appointed to oversee both field and factory activities. For the same reason, action was taken to explore the possibilities of factory modernization through computer aided tea manufacturing and automated withering at St Coombs Estate, Talawakelle. Action was taken to create cadre positions to upgrade the posts of Superintendent St Coombs Estate to Group Manager and the post of Assistant Superintendent St Joachim Estate to Superintendent.

An analytical laboratory at Walahanduwa, Galle, was taken over by the TRB, through the mediation of PERC (Public Enterprises Reform Commission), with some of its staff, being only those that were accepting the terms and conditions of the TRI. This laboratory will cater to the soil and plant tissue analytical needs of mainly the southern low-country tea smallholders. Simultaneously, the TRB approved the purchase of a modern atomic absorption spectrophotometer and a high-tech piece of equipment to strengthen the analytical capacity of the Soils and Plant Nutrition laboratory at TRI, Talawakelle.

With the objective of retaining high calibre staff in TRI's two estates, the TRB approved an ex-gratia payment, as in the JEDB/SLSPC, for the Superintendent at St Coombs and the Assistant Superintendent at St Joachim. The TRB decided to trade St Coombs tea using the services of Asia Siyaka Commodities (Pvt) Ltd.

In recognition of its mandate, the TRB resolved that at least one aspect of research and extension activities should be presented by the Director, TRI, at every one of its meetings. To counter institutional dissatisfaction, which is not an uncommon phenomenon, the TRB took action to constitute a Grievance Committee with clear terms of reference and with an unbiased membership, to redress grievances, imagined or not, of TRI staff. To strengthen the fleet of field vehicles required for on-call and scheduled visits to estates, a Board of Survey was instituted for the disposal of unserviceable and unroadworthy vehicles by public tender and to obtain necessary authorisation to purchase new vehicles as replacements, which has now been accomplished. Cadre vacancies of staff were filled resolving a long standing deficiency regarding adequate staff.

Two new members were appointed by the TRB to its Consultative Committees, Dr Sarath Samaraweera to the Committee on Research and Mr S.C. Imbuldeniya to the Committee on Administration and Finance. The TRB also took steps to strengthen the links with local Universities in conducting collaborative research. In this regard, a Memorandum of Understanding between the TRB and the PGIA (Post Graduate Institute of Agriculture) of the University of Peradeniya is due to be finalised.

During the year under review, the TRB held 10 meetings and its three Consultative Committees on Research, Estates and Advisory Services, and Administration and Finance held 3, 4 and 9 meetings, respectively.

Dr. S. D. I. E. Gunawardena
Chairman

Review of the Director, Tea Research Institute

Apart from the research, extension and other activities detailed in this Report, the year 1998 has been significant for developments which are reviewed below.

Corporate Plan

For the first time in the history of the Institute, a Corporate Plan was drawn up. This is to cover the five-year period, 1999-2003. The Plan was exhaustively discussed at a residenital Stakeholder's Workshop held in June. The purpose of the Plan is to show how to identify, optimise and harness, within a reasonable time frame, the human and material resources available to the Institute for its research and extension. It is gratifying that, at the Stakeholder"s Workshop, no serious or sustainable criticisms were voiced of the TRI's recent performance; indeed, many of the views expressed were appreciative and complimentary. The overall image of the TRI at this time is something about which both stakeholders and staff could well be pleased.

For setting research and extension objectives and for project prioritisation in formulating the Plan, use was made of a procedure called the Composite Approach to Decision Making in Agricultural Research (CADMAR). This takes into account the goals of both the national economy and the producers. The objectives of TRI research, which is now designed to be multidisciplinary, would therefore be predicted on profitability and a rational use of resources. Using CADMAR, we planned projects to fulfill our research objectives, made estimations of project success, benefits and costs, and set time-frames.

Cess Re-Allocation

A Committee, set up by the Ministry of Plantation Industries during the review year, recommended re-allocations of the cess levied on tea exports. As a result, the TRI's share of the cess was increased from 17.5 to 32 percent for the ensuing year, 1999. While the realisation on the cess account to the TRI during 1998, based on projected shipments of 250 million kg, was put at Rs.110 million, it is expected to be Rs.215 million approximately in 1999.

During 1996-98, the division of the budgets between research and extension activities on the one hand, and overheads on the other, was close to 50:50, whereas ideally it should be closer to 75:25. With comprehensive, multidisciplinary research plans for utilising the increased income, and corresponding expenditure adjustments, the ratio is expected to be about 68:32 in 1999.

Tea Development Project

During the year, we participated in the discussions for instituting a Tea Development Project (1999-2005) with funds from the Asian Development Bank, primarily for the smallholder sector and service agencies. Key areas for funding were identified for the TRI under this Project: the expansion of adaptive and collaborative research with smallholders; the strengthening of facilities at our five outstations for further extending our advisory and extension services in conjunction with the Tea Small Holdings Development Authority (TSHDA) and the National Institute for Plantation Management (NIPM); the establishment of 80 hectares of clonal mother bushes and the development of tea nurseries, in collaboration with the TSHDA; and the provision of new infrastructure for expanded research and extension capabilities at our Low-Country Station in Ratnapura.

Fertilizer "Think-Tank"

Early in 1998, four national experts in fertilizer usage and with experience in tea or crop research were invited by the Director to form a Committee, or "think-tank", to review the TRI's fertilizer recommendations, as given in Advisory Circulars, and advise on revisions based on available experimental data. By the end of the year, they were nearing completion of their exacting task, assisted by three TRI scientists.

Asia International Tea Conference

The Director was invited as a guest speaker to the Third Asia International Tea Conference held in Singapore in October. He spoke on the urgent need for inculcating a new professionalism in the Sri Lankan tea industry, involving also field and factory personnel, in order to meet the challenges arising from the flight of labour. What the TRI is doing to this end, with mechanisation, worker wellness studies, field ergonomics and biomechanics, was detailed. The presentation engendered vigorous discussions among the participants, some of whom said they would use it as source material in their countries.

Dr W.W.D. Modder
Director

TEA RESEARCH INSTITUTE OF SRI LANKA
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1.1 Introduction

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

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

1.2 Functions of the Tea Research Board

The specific functions of the Tea Research Board are:

(a) to conduct, assist and encourage scientific and technological research into, and investigations of, all problems and matters affecting the production and manufacture of tea, including the prevention and control of pests affecting tea, the prevention and control of diseases affecting tea and the improvement of the 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 the encourage, research into the economic viability of the tea viability of the tea industry in Sri Lanka, including future economic trends in such industry;

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

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

1.3 Tea Research Institute Head Office at Talawakelle

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

1.4 Members of the Tea Research Board as at 31st December, 1998

1. Dr.S.D.I.E.Gunawardena - Chairman
2. Dr.W.W.D.Modder - Member
3. Mr.Rohana Illangaratne - Member
4. Mr.Clifford Ratwatte - Member
5. Dr.U.Vidanapathirana - Member
6. Mr.E Kanendran - Member
7. Mr.S.K.Seneviratne - Member

8. Mr.J.S.Ratwatte - Member
9. Mr.S.C.Imbuldeniya - Member
10. Mr.Sivam Loganathan - Member
11. Mr.V.Puthirasigamoney - Member
12. Mr.I.L.A.Fernando - Member
13. Mr.S.Wirasinghe - Member
14. Prof. H.P.M.Gunasena - Member

Secretary to the Board : Mr.C.C.Mawilmada

1.5 Members of the Consultative Committee on Estates & Advisory Services

1. Mr J S Ratwatte - Chairman
2. Dr W W D Modder - Member
3. Dr S D I E Gunawardena - Member
4. Mr A Somaratne - Member
5. Mr S K Seneviratne - Member
6. Dr M T Ziyad Mohamed - Member
7. Mr S Loganathan - Member
8. Mr S Wirasinghe - Member
9. Mr J P M Y Ratnayeke - Member
10. Mr S C Imbuldeniya - Member

Convenor/Secretary - Mrs S I Vitarana

1.6 Members of the Consultative Committee on Research

1. Dr S D I E Gunawardena - Chairman
2. Dr W W D Modder - Member
3. Prof Y D A Senanayake - Member
4. Prof H P M Gunasena - Member
5. Dr D Kirtisinghe - Member
6. Dr Anura Ekanayake - Member
7. Mr Camillus Silva - Member
8. Mr N F G P Athukorale - Member
9. Mr G V Tissera - Member
10. Dr D S A Samaraweera - Member

Convenor/Secretary - Dr M T Ziyad Mohamed

1.7 Members of the Consultative Committee on Administration & Finance

1. Dr S D I E Gunawardena - Chairman
2. Dr W W D Modder - Member
3. Mr G W S K de Silva - Member
4. Mr C S Ratwatte - Member
5. Mr I L A Fernando - Member
6. Mr R Illangaratne - Member

7. Mr C Kanendran - Member
8. Mr V Puthirasigamoney - Member

Convenor/Secretary - Mr W B Herath

1.8 Senior Management Staff as at 31st December 1998

1. Director	- Dr.W.W.D.Modder
2. Deputy Director Research (Technology)	- Dr.M.T.Z.Mohamed
3. Deputy Director (Administration)	- Mr.C.C.Mawilmada
4. Senior Accountant	- Mr.W.B.Herath

1.9 Heads of Divisions, Administrative, Scientific & Research, Technical and Advisory Staff as at 31st December, 1998

Administration Division

Mr C.C.Mawilmada	- Deputy Director (Administration)
Mr.D.W.Bartholomeusz	- Administrative Officer

Finance Division

Mr.W.B.Herath	- Senior Accountant
Mr.M.Bowatta	- Accountant

Internal Audit Division

Mr.R.Kariyawasam	- Internal Auditor

Library

Mrs.R.W.M.W.K.Illanganthillake	- Librarian

Publication Unit

Vacant	- Publication/Publicity Officer

Advisory & Extension Service Division

Mr.J.C.K.Rajasinghe	- Advisory Officer
Mr. B.A.D. Samansiri	- Advisory Officer

Agronomy Division

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

Agricultural Economics Unit

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

Biochemistry Division

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

Entomology Division

Mrs.S.I.Vitharana	- Acting Head /Entomologist
Dr.(Mrs.) L.D.Amarasinghe	- Senior Research Officer
Mrs.K.M.S.M.Nagahaulla	- Research Officer (on overseas studies)
Mr.R.S.Walgama	- Research Assistant
Mr.M.M.Keerthi	- Research Assistant (on overseas studies)

Plant Physiology Division

Dr.A.Anandacoomaraswamy	- Acting Head /Research Officer
Mrs.A.J.Mohotti	- Research Assistant (on overseas studies)

Plant Pathology Division

Dr.A.Balasooriya	- Acting Officer-in-Charge/Research Officer
Mr.T.S.Gunasekera	- Research Assistant
Miss.N.H.L. Pradeepa	- Research Assistant

Plant Propagation & Breeding Division

Mr.V.Shanmugarajah	- Acting Officer-in-Charge/Research Officer
Dr.(Mrs.) M.T.K.Amarakoon	- Research Officer
Mr.M.Ratnayake	- Research Officer
Miss. S.D.N.Dhason	- Research Assistant

Soils & Plant Nutrition Division

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

Technology Division

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

TRI Sub-Station, Deniyaya

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

TRI Low-Country Station, Ratnapura

Mrs. S.I.Vitharana	- Officer-in-Charge
Mr. S.Wimaladharma	- Acting Head Advisory & Ext. Services /Advisory Officer
Dr. M.A.Wijeratne	- Senior Research Officer
Mr. D.I.N.N. Giddawage	- Administrative Officer
Dr. K.G.Premathilake	- Research Officer
Mr. G.L.C.Galahitiyawa	- Research Officer
Mr. N.P.S.N. Bandara	- Research Assistant

TRI Sub-Station, Hantane

Mr. P.B.Ekanayake	- Officer-in-Charge/Senior Research Officer
Dr.(Mrs.) S.K.J.Sathyapala	- Research Officer

Mr. S.T.Yatawatta	- Advisory Officer
Mrs. R.M.D.T.Pallemulla	- Research Officer

TRI Sub-Station, Kottawa

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

TRI Sub-Station, Passara

Mr.M.B.A.Perera	- Officer-in-Charge/Advisory Officer

1.10 Other Administrative, Scientific & Research and Advisory Staff - Grades III-V as at 31st December 1998

Administration Division

Mrs. S. M. Jayasingham	- Secretary to the Director
Mr. D.S.E. Weerasooriya	- Chief Clerk
Mr. B. Thilakaratne	- Purchasing Officer
Mr. M.M.P.J. Gawarammana	- Transport Officer (under interdiction)
Mr. D.V.D. Vithanage	- Clerk of Works
Mr. U.A. Wickremasinghe	- Electrical Foreman
Mr. K G Piyasena	- Stenographer (Sinhala)
Mrs. S Shanmuganathan	- Stenographer (English)
Mrs. P Marapana	- Stenographer (English)
Mrs. Devika Ratnayake	- Stenographer (English)
Ms. D H Kalikotuwa	- Stenographer (English)
Ms. A P V Kalyani	- Stenographer (English)
Ms. C S K Kiribathgoda	- Stenographer (English)
Mr. P D S L De Silva	- Clerk/Typist
Mr. R Nadarajah	- Clerk/Typist
Mrs. I Jayawickrama	- Clerk/Typist
Mrs. R Jayasinghe	- Clerk/Typist
Ms. Ramani Wijeratne	- Clerk/Typist
Mrs. C. Jeyaram	- Clerk/Typist (under interdiction)
Mr. R. Rajendrakumar	- Clerk/Typist
Mr. D.H. Jayatilleke	- Clerk/Typist
Mrs. W.M.S.R. Wanasinghe	- Clerk/Typist
Mr. S.H. Chandrasena	- Clerk/Typist
Mr. P T Perera	- Clerk/Typist
Mr. J M R K Bandara	- Electrician
Mr. R W Rengasamy	- Electrician
Mr. K M Seneviratne Banda	- Telephone Operator
Ms. P K Nalika Damayanthi	- Telephone Operator-cum-Receptionist
Mr. W.P.A.N. Jayasinghe	- General Clerk
Mr. V. Shanmuganathan	- Clerk/Typist (on 'No Pay' Leave)
Mr. C.J.B. Abeykoon	- Works Supervisor
Mr. J.G. Gamage	- Filter Plant Assistant
Mr. W C K Fernando	- Chief Plumber Mechanic

Finance Division

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

Internal Audit Unit

Mr. P S Wickramasinghe	-	Internal Audit Officer

Library

Mrs. R W M S K Amunugama	-	Library Assistant

Advisory & Extension Services Division

Mr. V. Sithakaran	-	Extension Officer (on overseas training)
Mr. W.A.K.C. Udapola	-	Extension Officer
Mr. K.G.J.P. Mahindapala	-	Extension Officer
Mr. R.M.A.C. Rajakaruna	-	Extension Officer
Mr. K.R.M. Priyantha	-	Clerk/Typist (under interdiction)

Agronomy Division

Mr. A R Amarasekera	-	Experimental Officer
Mr. U P Abeysekera	-	Experimental Officer (on 'No Pay' Leave)

Agricultural Economics Unit

Ms. H W Shyamalie	-	Experimental Officer

Biochemistry Division

Mr. M D L P Gunatilaka	-	Experimental Officer
Mr. K M Mewan	-	Experimental Officer
Mr. G A A R Perera	-	Experimental Officer
Mr. P B Chandradasa	-	Technical Assistant
Mr. M W Silva	-	Skilled Mechanic

Entomology Division

Mr.	D D Liyanage	- Experimental Officer
Mr.	N Nawaratne	- Experimental Officer
Mrs.	P V A R Abeysekera	- Experimental Officer
Ms.	R D P Dharmalatha	- Experimental Officer
Mr.	P D Peter De Silva	- Technical Assistant
Mr.	G P Udumulla	- Experimental Officer

Plant Physiology Division

Mrs.	D M S Navaratne	- Experimental Officer (on overseas training)
Mrs.	V Sidhakaran	- Experimental Officer

Plant Pathology Division

Mr.	R M A Ratnayake	- Experimental Officer
Mr.	J W K Jayasundera	- Experimental Officer
Mrs.	K M N K Ratnamalala	- Experimental Officer

Plant Propagation & Plant Breeding Division

Mr.	S W Gunadasa	- Experimental Officer
Mr.	R Paskaradevan	- Experimental Officer
Mr.	B A Rathnagoda	- Technical Assistant

Soils & Plant Nutrition Division

Mr.	R G A Wijayawardhana	- Experimental Officer
Mr.	C S K A Ratnayake	- Experimental Officer
Ms.	P L K Tennakoon	- Experimental Officer
Mr.	H A P Warnasiri	- Experimental Officer
Mr.	S M Dissanayake	- Technical Assistant

Technology Division

Mrs.	S H P Waduge	- Experimental Officer
Mr.	L Jayasinghe	- Technical Assistant

Mechanical Workshop

Mr.	A Nandasiri	- Workshop Mechanic

Statistics Divsion

Miss.	T S N Senaratne	- Data Entry Operator

TRI Sub-Station, Deniyaya

Mr.	O W Jayawardana	- Station Assistant

TRI Low-Country Station, Ratnapura

Ms.	S M Samarasinghe	- Experimental Officer
Mr.	H S N Peiris	- Experimental Officer
Mr.	T S Lokuhetti	- Clerk/Typist
Mr.	M K S L D Amaratunga	- Extension Officer
Mr.	A K Prematunga	- Experimental Officer
Mr.	E R Perera	- Experimental Officer
Mr.	C Gunasekera	- Experimental Officer

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

TRI Mid-Country Station, Hantane

Mr. T M Sarathchandra	-	Experimental Officer
Mr. P.D. Upali	-	Experimental officer
Mr. H J M de Silva	-	Extension Officer
Mr. A P D A Jayasekera	-	Experimental Officer
Mr. U B Herath	-	Experimental Officer
Mrs. B Sureshkumar	-	Experimental Officer
Mr. Saman Wijetunga	-	Experimental Officer
Ms. R.M.S. Rajapakse	-	Experimental Officer
Mr. A H M L S Abeysinghe	-	Experimental Officer
Mrs. U Sritharan	-	Experimental Officer
Mrs. S N Wijesekera	-	Experimental Officer
Mr. H Jayaweera	-	Experimental Officer
Mrs. K Sarathchandra	-	Experimental Officer
Mrs. C N K Edirisinghe	-	Station Assistant
Mrs. B K S Herath	-	Accounts Clerk
Mr. K Pahalathanthrige	-	Works Supervisor

TRI Sub-Station, Kottawa

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

TRI Sub-Station, Passara

Mr. R Nandasena	-	Station Assistant

1.11 Retirements

(a) Mr.H.L. Gunasiri, Driver, retired after18 years of service on 25/02/1998.

(b) Mr.K.T.C. Perera , Technical Assistant, Agronomy Division, retired after 38 years of service on 25/05/1998.

(c) Mr. C.C. Rajasingham, Senior Advisory Officer, retired after 32 years of service on 20/07/1998.

(d) Mr. K. Thirugnanasunderan, Senior Research Officer, Entomology Division, retired after 38 years of service on 21/09/1998.

(e) Mr. P.D. Benadict de Silva, Assistant Plumber Mechanic, retired after 36 years of service on 24/09/1998.

1.12 Staff Recruitments

The following staff were recruited during the year 1998

(a) Research Assistants	-	07
(b) Experimental Officers	-	17
(c) Extension Officers	-	06
(d) Drivers	-	07

1.13 Overseas Training/Visits

a) Dr. (Mrs.) M.T.K. Gunasekera, Research Officer, proceeded to Faisalabad, Pakistan, on 15th February to follow a practical course on application of Genetic Engineering in Agriculture. She returned on 2nd March.

b) Mr. H.A.P. Warnasiri, Experimental Officer, left for South India on 1st May for a 4-month full-time Residential Advanced Course in Computer Applications for Plantations at Kothari Agricultural Management Centre, Coonoor. He returned on 30th August.

c) Dr. S.D.I.E. Gunawardena, Chairman, Tea Research Board, proceeded to Australia on 28th April to attend the International Tea and Health Symposium. He returned on 30th May.

d) Mr. G. Ganewatte, Research Assistant, left for Australia on 4th May to follow a Post Graduate Course leading to PhD Degree.

e) Mr. A. Balasuriya, Research Officer/OIC, Plant Pathology Division, proceeded to Edingburgh, Scotland, on 9th August to present a paper at the 7th International Congress of Plant Pathology. He returned on 21st August.

f) Dr. I.S.B. Abeysinghe, Senior Research Officer/Acting Head, Biochemistry Division, and Mrs. M.J. Jayasundera, Research Officer, proceeded to Furnkfurt on 17th May for a training in GC-IBMS with Prof. Mosandi on methyl salicylate. They returned on 31st May.

g) Mrs. K.M.S.M. Nagahaulla left for Australia on 7th August to complete her Post Graduate Course in Pest Management in Tea with special reference to shot-hole borer Pest - Stage II.

h) Mr. D.D. Liyanage, Experimental Officer, left for Italy on 25th August for a short-term training in Biological Control of Nematode Pest. He returned on 26th November.

i) Mrs. M.S.D.L. de Silva, Research Officer, left for Australia on 15th September to follow a Post Graduate Course leading to PhD Degree in Tropical Weeds.

j) Dr. W.W.D. Modder, Director, TRI, proceeded to Singapore on 1st October to attend the 3rd Annual Asia International Tea Conference. He returned on 3rd October.

1.14 Action was taken to strengthen the TRI security service at the Head Office and the sub-stations. At present, the security provided within the campus is of a very high standard.

1.15 The draft Manual of Disciplinary Procedure of the TRI was completed and approval of it has been received from the Attorney General's Department.

1.16 As per the Annual Report of 1997, work relating to the revision of existing schemes of recruitments promotions, etc. is in progress.

1.17 A new telephone switch board with the latest electronic devices was installed and 100 additional lines connected to the TRI.

1.18 Buildings

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

TRI Head Office, Talawakelle

The Engineering Division completed renovations/re-furbishing of the following:

a) TRI Guest House was completely renovated/re-furbished under the facelift programme during the year.

b) Hantane Guest House was completely renovated/re-furbished under the same programme.

c) Passara Guest House was also renovated and an additional structure completed as an extension to the Guest House.

d) External colourwashing of the main buildings was completed under the facelift programme.

e) External colourwashing and roof painting of TRI quarters was also completed under the same programme.

f) Re-surfacing of roads (approx. mileage of 08 km x 03 m. width) was done under the same programme.

g) Fabrication and fixing G.I. Gutters and down pipes at TRI quarters were partly completed under the programme and this work is in progress.

h) Work relating to the fixing of iron grills for windows of the main building block under the same programme is in progress.

i) Construction of the building block for the Biochemistry Division under the annual budget provision was completed.

j) Renovation work of the hydro-power fire fighting system was completed.

k) Construction of 02 Nos. Servant's toilets at C-06 and C-55 quarters is in progress.

Sub-Station - Passara

a) Completed renovation work of abandoned servant's quarters under the facelift programme.

b) Completed renovation of manure shed under the same programme.

c) Installed 04 Nos. Security Light Posts under the same programme.

d) Completed re-surfacing of roads (0.5 km x 03 m width) under the same programme.

e) Completed construction of additional bathroom and renovation of 01 No. bathroom including roof, external and internal colourwashing at the Guest House, under the annual budget provisions.

f) Completed external and internal colourwashing of all quarters in the station, under the annual budget provision.

g) Completed construction of cattle traps across the road.

Sub-station - Deniyaya

a) Completed renovation work and internal/external colourwashing at Experimental Officer's quarters under the facelift programme.

b) Completed construction of 01 No. additional bathroom and 02 Nos. additional bathrooms at the Guest House, including external/internal colourwashing, under the same programme.

Sub-station - Kottawa

a) Completed renovation of main building block including replacing of roof frames and covering and internal/external colourwashing, under the facelift programme.

b) Completed fixing of iron grills to windows of main building block, under the same programme.

c) Completed replacing of roof frame and roof covering at OIC's bungalow including external/internal colourwashing.

d) Installed 02 Nos. iron Gates at main entrance, under the annual budget provisions.

e) Renovated abandoned raw water well, under the annual budget provisions.

f) Completed alterations and additions to the TRI Guest House at Kottawa.

Low-Country Station - Ratnapura

A new building programme for the extension of Low-Country Station was envisaged and plans/drawings of the laboratories complex were completed, anticipating financial assistance from the Asian Development Bank.

Electrical Division

Electrical Division undertook 314 jobs in the year 1998 of which 143 were pertaining to TRI bungalow maintenance, 165 jobs were pertaining to lab maintenance and the balance work completed was for St. Coombs Estate factory and sub stations.

The entire wiring installations in respect of heavy electricity equipment, wiring of the Soils & Plant Nutrition Division, Technology experimental section, wiring installations in the new progress room and re-construction of the wiring of TRI Guest House were completed. In addition, wiring of the new electricity supply to St. Coombs workers' quarters was completed. Re-wiring of TRI Guest House was undertaken. In addition to the above, the completion of new 3 phase electrical line for electric equipments of the Biochemistry laboratory was completed.

TEA RESEARCH BOARD
BALANCE SHEET AS AT 31ST DECEMBER - 1998

1997 Rs.			Tea Research Institute 1998 Rs. Cts.	St. Coombs Estate 1998 Rs. Cts.	St. Joachim Estate 1998 Rs. Cts.	Total 1998 Rs. Cts.
	FIXED ASSETS					
259,049,643	Property, Plant, Equipment etc.		282,990,839.98	–	–	282,990,839.98
(145,542,408)	Less: Accumulated Depreciation	(Anx. I)	(157,642,204.80)	–	–	(157,642,204.80)
113,507,235			125,348,635.18			125,348,635.18
15,542,178	Capital Work in Progress	(Anx. II)	11,592,585.73		447,883.19	12,040,468.92
129,049,413			136,941,220.91		447,883.19	137,389,104.10
	CURRENT ASSETS					
11,369,042	Stocks	(Anx. III)	7,568,258.84	2,135,578.68	1,252,737.04	10,956,574.56
90,288,010	Debtors and Other Debit Balances	(Anx. IV)	78,193,429.03	3,100,986.15	355,295.45	81,649,710.63
13,224,593	Deposits,Pre-Payments & Purchase Advances	(Anx. V)	13,917,485.97	129,736.33	62,402.47	14,109,624.77
10,862,373	Loans and Advances to Staff & employees	(Anx. VI)	14,044,534.99	1,117,211.10	631,701.06	15,793,447.15
10,300	Other Current Assets-Patents		10,300.00			10,300.00
34,000,000	Short Term Investments-7 day Call Deposits		81,000,000.00			81,000,000.00
11,841,734	Cash and Bank Balances	(Anx. VII)	1,501,136.74	14,140.35	132,440.28	1,647,717.37
171,596,052			196,235,145.57	6,497,652.61	2,434,576.30	205,167,374.48
348,077	Suspense	(Anx.VIII)	–	–	–	
500,558	Identified Losses	(Anx.VIII)	500,557.87	–	–	500,557.87
14,319	Excess & Shortages	(Anx.VIII)	58,655.07	–	–	58,655.07
172,459,006			196,794,358.51	6,497,652.61	2,434,576.30	205,726,587.42
	CURRENT LIABILITIES					
(28,822,817)	Creditors and Provisions	(Anx. IX)	(20,301,572.88)	(8,137,726.47)	(10,235,977.66)	(38,675,277.01)
143,636,189	Net Current Assets		176,492,785.63	(1,640,073.86)	(7,801,401.36)	167,051,310.41
272,685,602	TOTAL ASSETS LESS CURRENT LIABILITIES		313,434,006.54	(1,640,073.86)	(7,353,518.17)	304,440,414.51
	REPRESENTED BY					
41,371,432	Grants and Reserves	(Anx. X)	41,670,457.53	–	–	41,670,457.53
213,441,710	Tea Research Fund		247,858,748.57	–	–	247,858,748.57
-	A/C Current St.Coombs Estate		2,215,345.95	(2,215,345.95)	–	–
-	A/C Current St.Joachim Estate		8,356,064.49		(8,356,064.49)	–
754,670	Long Term Liabilities-Land Reform Commission		754,670.00			754,670.00
17,117,790	Provision for Gratuity		12,578,720.00	575,272.09	1,002,546.32	14,156,538.41
272,685,602			313,434,006.54	(1,640,073.86)	(7,353,518.17)	304,440,414.51

Sgd. W. B Herath
Senior Accountant

Sgd. S D I E Gunawardena
Chairman

Note:- Negative figures are shown within brackets

TEA RESEARCH BOARD

OPERATING ACCOUNT FOR THE PERIOD 1ST JANUARY 1998 TO 31ST DECEMBER, 1998

1997 Rs.					1998 Rs. Cts.	
	INCOME					
94,433,902	3.1 Cess				119,749,513.25	(Note 1)
33,910,940	3.2 Income from Estates and Other Commercial Activities		(Annx. XIV)		25,307,003.45	
3,226,182	3.3 Interest on Investments				4,591,057.47	
4,279,304	3.4 Miscellaneous		(Annx. XIV)		3,040,610.68	
135,850,327	Total Income				152,688,184.85	
	EXPENDITURE	Administration Finance and Common Service	Advisory, Extensions & Publicity	Research	Total	
31,120,839	4.1 Personnel Emoluments	15,832,134.57	7,015,000.92	15,344,667.01	38,191,802.50	
4,285,504	4.2 Travelling	1,530,664.22	1,017,393.51	1,448,916.49	3,996,974.22	
9,476,067	4.3 Supplies and Requisites	2,340,092.36	2,285,895.78	3,154,796.36	7,780,784.50	
13,012,056	4.4 Repairs and Maintenance of Capital Assets	7,186,846.23	2,814,483.67	381,235.45	10,382,565.35	
8,300,297	4.4 Depreciation of Fixed Assets	3,604,575.20	2,191,312.39	3,498,136.19	9,294,023.78	
15,746,117	4.5 Transportation,Communication,Utility and Other Service	13,322,756.47	6,599,791.71	42,688.59	19,965,236.77	
29,238	4.5 Losses and Write Offs	5,004,378.05			5,004,378.05	
1,431,020	4.7 Contributions,Grants and Subsidies	1,438,180.95	128,153.77	117,101.61	1,683,436.33	
3,312,759	4.8 Pensions and Retirement Benefits	1,818,745.22	751,064.00	1,851,232.00	4,421,041.22	
4,827,854	Gratuity Provision	1,569,271.89			1,569,271.89	
474,130	4.10 Media,Advertising,Publicity and Gifts	129,031.16	2,104,219.70		2,233,250.86	
4,328,305	4.11 Cultivation and Field Trials		4,901,934.47		4,901,934.47	
4,196,538	4.12 Miscellaneous	523,244.97	660,466.43	6,159,131.22	7,342,842.62	
	Expenditure - Walahanduwa			1,438,628.18	1,438,628.18	(Note 2)
100,540,724	**Total Expenditure**	54,299,921.29	30,469,716.35	33,436,533.10	118,206,170.74	
35,309,603	Operating Surplus				34,482,014.11	
(112,493)	Prior Year Adjustments		(Annx. XV)		(64,975.34)	
35,197,110	Excess of Income over Expenditure transferred to Tea Research Fund				34,417,038.77	

Note: 1. Tea Cess receivable - Rs. 48,427,349.94

2. Walahanduwa Laboratory came under Tea Research Board with effect from 01/06/1998

TEA RESEARCH BOARD
SOURCE AND APPLICATION OF FUNDS 1998

Source of Funds		
Surplus for the year before prior year adjustments		34,482,014
Adjustments in respect of items not involving the movement of funds		
Add: Provision for Depreciation		12,099,797
		46,581,811
Less: Provision for Gratuity	(2,961,252.00)	
Prior Year Adjustments	(64,975.00)	(3,026,227)
		43,555,584
Other Sources		
Grants and Reserves		299,026
		43,854,610
Application of Funds		
Purchase of Fixed Assets	23,941,197	
Decrease in Capital Work-in-Progress	(3,501,709)	20,439,488
		23,415,122

Increase in Working Capital as analysed below

Effect on Working Capital	Increase/(Decrease)
Stocks	(412,467)
Debtors	(8,638,299)
Deposits Pre-Payments and Advance for Purchases	885,032
Loans and Advances	4,931,074
Short Term Investments (7 Day Call Deposits)	47,000,000
Cash and Bank Balances	(10,194,017)
Suspense	(348,077)
Excess & Shortages	44,336
Creditors & Provisions	(9,852,460)
	23,415,122

AGRONOMY DIVISION

Acting Head – A Anandacoomaraswamy

Project B/INCR-Intercropping in tea lands to maximize income and conserve soil through optimal land utilization

Project Leader - P.B. Ekanayake

1. A/INCR

1.1. Effect of intercropping tea and rubber on productivity

1.1.1 RRI-Kuruwita (1990)

This experiment is being 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') and tea (rehabilitated) under rubber (40'x8'), tea (unrehabilitated) under rubber (27'x8'), tea (unrehabilitated) under rubber (40'x8'). Tea and rubber were planted in unrehablitated plots in 1990 while tea was planted in rehabilitated plots in 1992. The rehabilitated plots are in second year after first prune and the tea in unrehabilitated plots is in the first year after the second prune. The yields for the first and second 6 month period are given in the table 1. As the age of tea differs, analysis of results was done separately for tea on rehabilitated and unrehabilitated plots.

TABLE 1- *Yield of tea under different spacings of rubber*

	Green leaf yield (kg/bush)	
	January-June	*July-December*
Rehabilitated		
Tea (monocropping)	0.756	0.849
Tea+Rubber (8'x27')	0.242	0.276
Tea+Rubber (8'x40')	0.285	0.319
LSD (P=0.05)	0.189	0.208
CV%	25.0	24.9
Unrehabilitated		
Tea+Rubber (8'x27')	0.118	0.126
Tea+Rubber (8'40')	0.184	0.162
LSD (P=0.05)	NS	NS

The results show that the yield of tea under rubber is significantly lower than that of monocropped tea. The magnitude of the yield loss of tea under rubber was in the range of 63-68%. Although there was a reduction in yield of tea under closer spacing (27'x8') compared with wider spacing of rubber (40'x8'), this was not significant.

1.1.2 St. Joachim Estate, Ratnapura (1990)

Feasibility of intercropping tea in rubber is being tested at St. Joachim Estate. There were three treatments viz. tea, tea under rubber (40' x 8') and rubber (20'x 12') in three replicates. Rubber was planted in 1990 and tea was introduced in 1993. Tea bushes were pruned in July 1998.

Pruning (fresh) weight of tea under rubber was 1.64 kg/bush and that of monocropped tea was 1.25 kg/bush. Although there was a reduction of pruning weight of tea under rubber, the difference was not statistically significant ($p>0.05$). Analysis of results showed that the yield of tea under rubber was significantly lower than that of monocropped tea. The yield recorded from January-July 1998 was 717 g/bush for monocropped tea and 370 g/bush for tea under rubber. This shows a reduction of tea yield by about 50% under rubber. It is to be noted that the yield of rubber over the last 2 years of tapping was significantly high when intercropped with tea. The mean dry weight of rubber (latex) was 32.1g/tree(dry weight) ± 1.6 for monoculture and 39.2g/tree(dry weight) ± 2.4 for intercropping. The experiment is in progress.

1.1.3. Demonstration plot, St. Joachim Estate, Ratnapura (1989)

Harvesting of rubber and tea continued together with other cultural practices.

1.1.4. Observation Block, Field No. 6A (1995)

In this study, a different system of planting of tea in rubber is being tested. Rubber (RRIC 100) and tea (TRI 2027) were planted simultaneously in June 1995. Rubber rows were located in the East-West direction. Each treatment- rubber (20'x 12'), tea, tea in rubber (40'x 8') and tea in rubber (60'x 8'x 8')- had only one plot. Growth measurements indicated that the girth of rubber trees was comparatively high when they are intercropped with tea. The girth of rubber trees (40" above ground level) was 24.7 cm, 30.0 cm and 29.4 cm respectively for monoculture, rubber (40'x 8') with tea and rubber (60'x8'x8') with tea.

Tea was brought into plucking in June 1998. Yield of tea from June-December 1998 was 600 g/bush, 472 g/bush and 497 g/bush respectively for monocropped tea, tea under rubber (40'x8') and tea under rubber (60'x8'x8'). Although statistical analysis is not possible without replications, it appears that tea yields was less when intercropped with rubber. The observation is in progress.

P.B. Ekanayake, M.A. Wijeratne, K.G. Premathilake and C.Gunasekara

1.1.5 Shoot growth studies under rubber and tea intercropping systems

This study was undertaken at the experimental block at RRI, Kuruwita. Rubber was planted in 1990. Direct planting of tea under rubber (unrehabilitated) was done simultaneously with rubber in 1990 and brought into bearing in 1992. Tea in rehablited plots intercropped with rehabilitated tea under rubber and monocropped tea (rehabilitated) were planted in 1992 after 2 years of rehabilitation under mana grass and the tea was brought into bearing in 1994.

Tea on rehabilitated plots intercropped with rubber at spacings of 27'x8' and 40'x8' showed a yield decline of 62 and 55% while yield in direct planting (unrehabilitated) of tea under rubber at the correponding spacings declined by 16 and 9% respectively.

When the total yield of tea under rubber was compared with that of monocropped tea, there was a loss under rubber. Yield decline of tea under rubber can be attributed to lower shoot population density, more dormant shoots and root competition. More casualties of tea were also found under rubber: 0.8% for monocropped tea, 1.3-2.6% for tea under rubber (rehabilitated) and 10-15% for tea under rubber (unrehabilitated), with more casualties being recorded under closer spacings of rubber.

The results of this study indicate that planting both crops simultaneously is more beneficial when tea is intercropped with rubber.

M.A.Wijeratne, P.K.Rupasinghe and G.Wadasinghe

1.2 Effect of intercropping in seedling tea

1.2.1 Effect of intercropping minor export crops in mid-grown tea at Ratwatte Estate, Matale (1998)

This experiment was initiated to study the economic benefits that could accrue by intercropping coffee, pepper and cinnamon in tea land and to investigate the compatibility between tea, pepper, coffee and cinnamon for light, moisture and nutrients.

The following intercrops were planted in mid-July.

Minor export crops: Pepper, Coffee and Cinnamon

Varieties of pepper: Paniyur and Local

Varieties of Coffee: Catiemore and IMY

Spacings: 4m x 4m and 6m x6m

This experiment is in progress.

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

1.3 Investigations on Sloping Agricultural Land Technology

1.3.1. Mid-Country Station, Hantana –SALT demonstration Hedgerows

Four loppings were done during the year. *Calliandra calothrysus, Cassia spectabilis and Flemingia congesta* gave higher biomass production than the other species. Biomass produced by *Calliandra calothrysus* was superior while the biomass production of *Adathoda vasica and Tecoma stans* was very low. There was 100% casuality in *Desmodium rensonii*. The biomass production is presented in Table 2.

TABLE 2 - *Biomass production of different Hedgerow species*

Species	Biomass production (kg ha^{-1})
Flemingia congesta	3,933
Desmodium rensonii	0
Calliandra calothrysus	10,777
Cassia spectabilis	5,552
Tecoma stans	1,142
Adathoda vasica	1,419

This demonstration trial is in progress

A.P.D.A.Jayasekara

2. Project B/PLUK - Harvesting practices

Project Leader - M.A.Wijeratne

2.1. Effect of different methods of plucking (machine, plucking shear and hand plucking) on yield of tea Hapugastenna Estate - (1992)

A new set of treatments were introduced in January as follows:

1. Manual plucking - 7 day round
2. Manual plucking - 10 day round
3. Shear plucking - 10 day round
4. Machine plucking - 20 day round (Cropping season only)
5. Machine plucking - 20 day round

The treatments were replicated four times.

Yield for current year, coarse leaf percentage, bush height and percentage of immature shoots (*arimbus*) are given in Table 3.

TABLE 3 - *Yield, bush height (cm), immature shoots (%) and coarse leaf (%) in the harvest*

	Made Tea Yield (kg ha^{-1})	Coarse leaf (%)	Plant height (cm)	Immature shoots (%)
Manual 10 day	4899 (100)	3.6	103	3.1
Manual 20 day	4252 (86)	8.1	106	6.0
Shear 10 day	3147 (64)	30.7	98	12.0
Machine 20 day (cropping season)	2435 (50)	41.0	106	16.3
Machine 20 day	1811 (37)	45.6	107	14.3
LSD (P =0.05)	660	5.1	4.5	4.9
CV(%)	12.9	13.0	2.8	25.0

The results show that mechanical harvesting has given significant yield reductions compared with manual harvesting. The magnitude of yield loss with the use of machines can be as high as 50-63% while the percentage of coarse leaf and removal of immature shoots are also higher under mechanical harvesting than under manual plucking. A significant reduction in the bush height and higher amount of coarse leaves of shear harvested shoots indicate that hard shearing has been continued with lack of skills.

M.A.Wijeratne and D.W.Vithana

2.2. Mechanical harvesting at Rassagala Estate - (1996)

Two 0.2 ha blocks (TRI 2023) were demarcated and harvested, one by machine and another by hand at extended rounds of about 2 weeks. The machine is Kawasaki NV60H with 60 cm reciprocating blades. The yield from March-November 1998 was 2689 kg/ha for machine and 2910 kg/ha for manual harvesting. Over this period of 9 months, 325 workers/ha were utilized for mechanical harvesting while 550 workers/ha were for manual plucking. Coarse leaf content of the harvest was comparable for the two systems i.e. 7% for machine and 8% for manual harvesting. From these observations, it appears that plucking machines can be effectively used, if plucking rounds are extended due to shortage of workers.

M.A.Wijeratne and D.W.Vithana

2.3. Comparision of shear harvesting with manual harvesting, St Coombs Estate, Field No 3, Observation Trial – (1996)

The objective of this experiment is to compare the efficiencies of different shears with manual harvesting. This field was pruned in July but the recovery was very poor due to heavy rains experienced during August. Plots each with 24 bushes were marked out in the above area for a statically designed experiment. The pre-plucked yield record will be carried out till June 1999. The following treatments will be imposed in July 1999, replicated four times:

1. Manual harvesting
2. Shear (TRI) harvesting
3. Harvesting with shears with the box (Indian type)
4. Harvesting with shears with a bag (Malaysian type)
5. Harvesting with shears with a handle (Indian type)
6. Harvesting with shears with a box (Malaysian type)

A.R.Amerasekara

2.4. Effect of shear plucking (with TRI-shear) and hand plucking, Observation trial, Hantana substation, Kandy – (1997)

Two blocks of approximately 0.1 ha are being continuously plucked by hand and TRI shear. From the crop recorded, a sample is separated into different components to ascertain the dry weight. There were no significant differences between shear

and hand plucking on yield and other assessments made on dry weight of different components.

S.N.Wijesekara

3. Project B/PRUN - Pruning practices in tea

Project Leader - M.A.Wijeratne

3.1. Study on different methods and time of pruning on shot-hole borer damage (SHB Task Force) at Kiriwanaganga Estate, Deniyaya (Low-country), New Peacock Estate, Pussellawa (Mid-country) and Attempitya Estate (Uva)

The effects of different times and styles of pruning on shot-hole borer damage are being studied in collaboration with the Entomology Division. The three styles of prunings adopted were, rejuvenation pruning (10"), lung pruning (18") and cut across (24"), and the three times of prunings were January, April and October. All treatments have been replicated four times. Shot-hole borer assessments are being done by the Entomology Division at regular intervals. An assessment of SHB infestation is made in the report of the Entomology Division.

Assessments on shot-hole borer damage are also being taken from tea bushes, with and without shade.

M.A.Wijeratne, D.W.Vithana, A.R.Amarasekara,
A.P.D.A.Jayasekara and Staff/Entomology Division

3.2. Different styles of pruning and bringing into plucking on recovery after pruning and yield of tea

Different styles of pruning (lung pruning at 20"- partial cleaning, lung pruning at 20"- full cleaning, cut across at 26" and lung + cut across pruning alternate cycles) and two types of bringing into plucking (plucking-in and tipping to hard green wood) were tested.

3.2.1 Noragalla Estate (1996)

Analysis of results over the second year after pruning showed that there was no significant difference in yield between treatments. The experiment is in progress.

M.A.Wijeratne and D.W.Vithana

3.2.2. St. Coombs Estate (1995)

The results for the current year is given in Table 4.

TABLE 4- *Effect of height of pruning, retention of lungs and method of tipping on yield*

Height of Pruning (cm)	Made Tea Yield(kg ha^{-1}) With lungs		Without lungs	
	Plucking-in	Tipping	Plucking-in	Tipping
45	2472	2306	2217	2437
55	2522	2363	2447	2447
65	2463	2312	2270	2512
SE	50.3			
CV(%)	8.4			

A.R.Amerasekara

3.3. Seasonal variation of root starch reserves of tea, with and without resting, St. Joachim Estate, Ratnapura (1996)

Monthly variation of root starch reserves are being monitored on three clones, TRI 2027, TRI 2025 and S106. Roots are removed from tea bushes at monthly intervals and root starch reserves are analyzed in the laboratory. There are three replicates and the analysis of results was done as per factorial design.

The yield over the year and starch content for every other month are given in Table 5.

TABLE 5 - *Yield (made tea, kg/ha/yr) and root starch content (%)*

		Root starch content (%)					
	Yield	*Dec'97*	*Feb'98*	*Apr*	*Jun*	*Aug*	*Oct*
Sample Clone		20	22	24	26	28	30
TRI 2027	3512	6.5	6.0	7.0	4.5	6.0	7.2
TRI 2025	4402	7.4	7.1	7.7	4.3	4.4	5.7
S 106	6075	4.4	5.8	7.4	7.2	7.3	8.8
LSD (P=0.05)	537	NS	NS	NS	1.9	2.2	1.9
CV(%) 11.5	–	–	–	–	35.9	39.3	27.5
Resting vs No resting							
No resting	5.3	5.1	6.3	4.4	5.4	6.9	
Resting for 1 month	4.4	5.5	6.8	5.7	5.9	7.0	
Resting for 2 months	8.7	8.3	9.1	6.0	6.4	7.8	
LSD (p=0.05)	2.9	2.2	2.0	NS	NS	NS	
CV(%)	48.8	35.2	28.2	–	–	–	

Clones TRI 2027 and S106 gave a significantly higher yields compared to TRI 2025. Results on starch reserves show that the root starch content of clone S106 is significantly higher than the other two clones. Further analysis shows that the starch content of roots during the first half of the year varied significantly among different resting periods. Tea bushes rested for 2 months before pruning recorded a higher root starch content compared to non rested bushes. Assessments are in progress.

M.A.Wijeratne and P.Premathunga

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

Two styles of pruning viz. lung pruning (22") and cut across (26") and 6 times of pruning viz. January, March, May, July, September and November are being tested on recovery and yield of tea. Treatments were arranged factorially in 4 blocks. September and November pruning has already been completed. Yield records are being maintained by the estate.

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

4. Project B/ENGY II – Management of shade and fuelwood trees

Project Leader – A Anandacoomaraswamy

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

The objective of this study is to compare the performance of tea, with and without dadap (Erithrina lithosperma). The spacing of dadap is 6 x 6m.

The yield for the third year (December 97 – November 98) is given in Table 6.

TABLE 6 – *Effect of Dadap shade on yield*

Treatments	Yield (kg Mt ha-1)
Without Dadaps	2418
With Dadaps	2290
SE	146.2
CV(%)	6.2

There is hardly any difference in the yield due to the treatments.

A R Amarasekera

4.2 Evaluation of suitable Calliandra provenances

The objective of this experiment is to evaluate the performance of provenances of Calliandra in the Up-country and Mid-country. Trials on Calliandra provenances at St. Coombs Estate, Talawakelle, Dessford Estate, Nanu Oya, and Park Estate, Kandapola are in progress. The total biomass (dry weight) obtained by the second lopping of branches is presented in Table 7.

TABLE 7 – *Biomass of lopped branches of Calliandra provenances*

Code No.	Biomass (kg/ha-1)			
	Park Estate	Dessford Estate	St. Coombs Estate	Mean
9/91	2643	1551	1626	1940
10/91	2239	2009	2284	2177
33/93	1549	1712	1704	1655

Provenance 10/91 (Flores Guatemala) produced the highest biomass.

A R Amarasekera

4.3. Performance of different provenances of Calliandra, Mid-country Station, Hantane – (1994)

The plants were established in 1994 and lopped in March and October. The mean dry weight of loppings is given in Table 8.

TABLE 8 – *Mean biomass production of different provenance of Calliandra*

Provenance	Mean dry wt. of loppings (kg.ha-1)
9/91	1271
10/91	1517
34/93	1245
33/93	1257

This trial is in progress.

A P D A Jayasekera

4.4. Evaluation of Grevillea robusta provenances

About 30 provenances performing well in the nursery were transplanted in the following estates in October/Novenber for field testing:

1. New Peacock Estate (Pusellawa)
2. Pedro Estate (Nuwara Eliya)
3. St Joachim Estate (Ratnapura)
4. Galphele Estate (Panwila)
5. Kottawa substation

A Anandacoomaraswamy, K G Prematillake, K D Dahanayake, A R Amarasekera and A P D A Jayasekera

5. Project B/WATU - Water use in tea plantations

Project Leader - A Anandacoomaraswamy

5.1. Soil reconditioning, soil fertility improvement and soil moisture conservation studies

5.1.1. Effect of soil rehabilitation with sugar cane varieties and grasses on the growth of tea

5.1.1.1. St. Joachim Estate, Ratnapura - (1991)

Three sugar cane varieties (Co 775, M292/71, LF) and 3 grass species (Mana, Eragrostis, Vetiver) were tested for rehabilitation before planting. Tea was planted in 1993 and pruned in 1998. Results showed that there was no significant difference in the yield over the first 6 month of this year. The plots were pruned in July. The experiment was terminated.

C. Gunasekara

5.1.2. Effect of rehabilitation after pruning on recovery and yield (K145) Observation trial, Mattakelle Estate, Talawakelle – (1991)

The objective of the experiment is to compare the effect of soil rehabilitation in a mature tea field by growing vetiver grass. The yield for the second year of the current cycle is given in Table 9.

TABLE 9 – *Yield of tea*

	Yield (Made tea kg. ha-1)
Rehabilitation	2390
No rehabilitation	2734

Non-rehabilitated plots contined to give higher yield, probably due to their bottom slope position in the topography.

A R Amarasekera

5.1.3. Effect of burying prunings on yield St. Coombs Estate – (1991)

The objective of this study is to compare the effect of recycling and retention of prunings with removal (control) of prunings.

This experiment is in the third year of the current cycle. The yields from September 1997 to August 1988 are presented in Table 10.

TABLE 10 – *Effect of burying and retention of prunings on yield*

Treatments	Yield (kg Mt ha-1)
T1. Control (with normal fertilizer)	4669
T2. Burying prunings + normal fertilizer	4650
T3. Burying prunings + half of normal fertilizer	4167
T4. Burying prunings only	3226
T5. Burying brush wood + normal fertilizer	4242
T6. Burying brush wood + half of normal fertilizer	3684
T7. Retention of prunings + normal fertilizer	4510
SE	190.4
LSD (P=0.-5)	567
CV%	9.1

There were no significant yield differences among treatments T1, T2, T3, T5 and T7, but treatments T4 and T6 depressed the yield.

5.1.4 Effect of direct planting *vis-a -vis* planting after soil reconditioning on yield. Concordia Estate – (1991)

The objective of the trial is to compare the effect of soil reconditioning before replanting in very high altitudes where soil fertility is not limiting the establishment of young plants. Five clones (PK2, TRI 2024, DT1, NAY3, TRI 2025) are being used in this investigation. The yield obtained is presented in Table 11.

TABLE 11 – *Effect of planting tea with and without rehabilitation on yield*

Treatments	Yield (kg made tea ha-1)		
	Rehabilitated	Direct planted	Mean
Clone			
TRI 2025	1985	1728	1857
TRI 2024	2361	1947	2154
NAY 3	2745	2613	2679
DT 1	2680	2290	2489
PK 2	2978	2913	2945
Mean	2550	2300	2945
LSD (P=0.05) for rehabilitation	144		
LSD (P=0.05) for clones	228		
SE for rehabilitation	123.4		
SE for Clone	77.3		
SE for Rehabilitation X Clone	157.4		
CV (%)	9.0		

All clones gave significantly higher yield in rehabilitated soil.

A R Amarasekera

5.1.4. Effect of alternate methods of rehabilitation compared with rehabilitation under grass. New Peacock Estate, Pussellawa – (1996)

The objective of this experiment is to test the available alternative methods with the traditional method to reduce the soil reconditioning period of two years. Compost and coir dust, with and without T200 (young tea mixture), were incorporated at the time of planting tea. The control treatment for this comparision was two years of soil reconditioning with mana grass. There were eight treatments with three replications. There was a delay in bringing into bearing due to the dry weather that prevailed in early 1998. Plucking commenced in July 1998.

A R Amarasekera

5.2. Cover crops

Cover crops were maintained as a source of plant material to be distributed among the plantations on request.

M A Wijeratne and D W Vithana

5.3. Mulching materials

5.3.1. Effect of different mulching materials on growth and yield of tea, Galphele Estate, Panwila – (1993)

The objective of this experiment is to compare the locally available materials for mulching in young tea fields.

Yields for the third year (January-December) are presented in Table 12.

TABLE 12- *Effect of mulching material on yield of young tea*

Treatments	Yield –Made Tea (kg ha^{-1})
Tea refuse	898
Mana grass	909
Paddy husk	843
Coir dust	828
Saw dust	941
Control	696
LSD(P=0.05)	105
CV(%)	9.0

The plots mulched with tea refuse and mana grass gave higher yields than the control. This experiment is in progress.

A.P.D.A.Jayasekara

6. Project B/WEED – Weed Management in tea

Project Leader: K. G. Prematilake

6.1 Screening of herbicides, Hapugastenne Estate, Gallelle

The experiment was commenced on 21st May 1998. Several herbicides were tested against broad spectrum of weeds in the low-country. The main target weeds are *Crassocephalem crepidiodes*, *Erigeron sumatrensis*, *Borreria latifolia*, *Hedyotis auricularia*, *Pennisetum polystachion* and other common weeds. The total control of weeds resulting from herbicide application was visually scored as 100% , and no weed control in untreated plots as 0%.

6.1.1 Test 1

All treatments with the exception of Spark at 1 l/ha with CDA, Bimaster at 1 l/ha, Spark at 2 l/ha using a knapsack sprayer showed better performances. Weedmaster @ 4.5 kg/ha gave almost total weed control. While there was no significant variation in the recovery rate of weed growth, a greater recovery was recorded with Weedmaster at 1.65 l/ha and Bimaster at 1-2 l/ha 2 WAS (Table 13).

TABLE 13 - *Mean visual scoring and weed fresh weight 3 WAS and the recovery rate of weed growth 8 WAS in May '98*

Treatment	Visual score(%)	Fresh weight (kg/m^2)	Recovery rate(%)
T1 Bimaster 1 l/ha	75.7 bc	0.81 bc	50
T2 do 2 l/ha	89.0 ab	0.43 cd	55
T3 Spark 2 l/ha	75.0 bc	0.75 bc	45
T4 do 4 l/ha	84.0 ab	0.49 c	38
T5 Weedmaster 1.6 kg/ha	84.3 ab	0.45 cd	65
T6 do 4.5 kg/ha	99.0 a	0.01 d	47
T7 0.3% Round up 1.65 l/ha	89.3 ab	0.42 cd	28
T8 Spark 1 l/ha with CDA*	60.0 c	1.17 b	37
T9 do 2 l/ha do	76.6 abc	0.56 c	40
T10 Round up 1.00 l/ha do	79.0 abc	0.57 c	45
T11 do 1.65 l/ha do	76.5 abc	0.39 cd	43
T12 Untreated control	0.0	2.59 a	23
CV%	17.4	39.0	36

* With Control Droplet Application sprayer (all other treatments with knapsack sprayer)

6.1.2 Test 2

Treatments were imposed at another location of the same estate on 2nd July 1998. The visual score and mean fresh weight of weeds are given in Table 14.

TABLE 14 - *Mean visual % of the weed damage 3 WAS and weed fresh weight 8 WAS*

	Visual score (%)	Fresh weight (kg/m²)
T1 Bimaster 1 l/ha	53.0 abc	0.909 b
T2 do 2 l/ha	60.0 abc	0.828 ab
T3 Spark 2 l/ha	52.0 abc	0.847 cb
T4 do 4 l/ha	46.7 bc	0.560 cb
T5 Weedmaster 1 kg/ha	43.3 c	0.828 cb
T6 do 2 kg/ha	61.7 abc	0.878 cb
T7 0.1% Roundup 0.55 l/ha	36.7 c	0.623 cb
T8 0.3% do 1.65	51.6 abc	0.657 cb
T9 Spark 2 l/ha - with CDA*	46.7 bc	0.663 cb
T10 do 4 l/ha - do	75.0 a	0.528 c
T11 0.1% Roundup 1.00 l/ha - do	50.0 abc	0.627 cb
T12 0.3% do 1.65 l/ha - do	72.0 ab	0.591 cb
T13 Untreated control		1.339 a
CV%	28.8	27.7

The percentage control was relatively low compared to the previous test because of the differences in location and weed flora and the unfavourable weather that prevailed soon after the sprays. Spark at 4 l/ha and 0.3% Roundup with CDA and Spark at 4 l/ha, Weedmaster at 2 kg/ha, Bimaster 2 l/ha sprayed with knapsack showed better performance. However, with Bimaster and Weedmaster, a greater fresh weight was recorded due to the fast recovery by 8 WAS. Weedmaster at 1 kg/ha and 0.1% Roundup were least effective.

6.1.3 Test 3

This was a repeat trial of Test 2 on the same plots. The treatments were imposed on 26th Nov. '98. The visual score and fresh weight of weeds are given in Table 15.

TABLE 15- *Mean weed fresh weight before the imposition of treatments and 4 WAS and visual injury % of weeds 4 WAS.*

	Weed fresh Weight(kg/m²) before	after	Visual score (%)
T1 Bimaster 1 l/ha with knapsack	1.88dc	0.07 c	84 ab
T2 do 2 l/ha do	2.69 ab	0.08 c	91 ab
T3 Spark 2 l/ha do	2.24 bc	0.09 bc	77 bc
T4 do 4 l/ha do	2.41 abc	0.12 bc	90 ab
T5 Weed Master 1 kg/ha do	1.86 dc	0.12 bc	85 ab
T6 do 2 kg/ha do	2.94 a	0.33 b	95 a
T7 0.3% do 1.65 do	2.46 abc	0.19 bc	82 abc
T8 Burned down 3 l/ha do	2.45 abc	0.15 bc	67 c
T9 Spark 2 l/ha with CDA*	2.51 ab	0.18 bc	87 ab
T10 do 4 l/ha do	1.59 d	0.17 bc	93 a
T11 Untreated control	2.30 abc	0.94 a	0
CV%	15.0	64.0	11.0

The highest visual score was recorded with Spark at 4 l/ha with CDA sprayer and Weedmaster at 2 kg/ha with knapsack sprayer which were significantly greater than that of Burndown at3 l/ha and Spark at 2 l/ha with knapsack sprayer. However, the values of fresh weight which had a high CV % 4 WAS were not more precise.

K.G. Prematilaka and H.S.N. Pieris

6.1.4 Screening of herbicides at Ratwatte Estate, Elkaduwa

Treatments were imposed in late August and mid Dec.'98 in the same plots.

TABLE 16- *Visual score (%) of weed damage and fresh weight of weed following herbicide application*

	Visual Score (%) 4 WAS		Weed f.wt(g/ft^2) 12 WAS
	Round 1	Round 2	Round 1
T1 Bimaster @ 1 l/ha	45	58	32.5 a
T2 do @ 2 l/ha	67	68	27.5 bc
T3 Spark @ 2 l/ha	22	70	31.7 bc
T4 do @ 4 l/ha	17	78	31.7 bc
T5 Weedmaster @ 1 kg/ha	58	73	33.0 b
T6 do @ 2 kg/ha	93	85	25.8 bc
T7 do @ 4 kg/ha	95	97	19.2 bc
T8 Burndown @ 2 l/h	72	72	22.6 bc
T9 do @ 4 l/ha	80	92	16.7 cb
T10 Roundup @ 2.75 l/ha	78	73	11.7 c
T11 Untreated control	0	03	60.0 a
CV %			13.9

Weedmaster @ 4 kg/ha and 2 kg/ha, Burndown 4 l/ha and 0.3% Roundup showed better performances with the first application. However, the weed fresh weight was greatly reduced in all treatments with the exception of those treated with Bimaster @ 1 l/ha and Weedmaster @ 1 kg/ha. With repeat application, Spark too performed well with knapsack sprayer.

In conclusion, Weedmaster >2kg.ha, Bimaster >3l/ha, Spark 4l/ha and burndown 4 l/ha gave better performances. However, the phytotoxicity in tea has to be studied particularly with higher dosage of these chemicals.

P. B. Ekanayake and Nilmini Wijesekare

6.2 Studies on Passali weeds in Bandarawela region

6.2.1 Control of Passali kodi (*Anredera basselloides*) with glyphosate herbicides using a new Control Droplet Application (CDA) sprayer at Uva Highland Estate, Bandarawela

Treatments

T1 Destroy 11.0 l/ha*
T2 Spark 11.0 l/ha
T3 do 8.5 l/ha
T4 do 5.5 l/ha
T5 Destroy 5.5 l/ha
T6 Manual collection of yams
T7 Control

* n.b.: Chemical was dissolved @ 25 l of water/ha (not in 550 l/ha)

Treatments were imposed in late Dec. 97 and repeated in the same manner on 20th Feb.'98.

Visual observation on control of passali kodi 3 weeks after spraying (WAS) of herbicides for each round.

Treatment

T1 Leaf wilting and lethered leaf, partially dead
T2 Leaf wilting, stunted growth, recovery of growth
T3 Partial wilting of leaves
T4 Partial wilting of leaves
T5 Wilting and stunted growth
T6 Stunted growth only in open patches

Third application was given at 1/2 the dosage of each of the same herbicides in June'98 *i.e.* 15 WAS of the second application.

Manual collection of yams was done four times i.e. at the time of imposition of treatments and at each round of herbicide application and the last one in July '98. The manhours required to collect yams and plants were 5.5, 9.3, 17.1, 7.4 (Mean=9.8) for the 4 rounds of collection respectively.

Weed growth was finally assessed before drought set in July. The fresh weight of yams, bulbils, vines are given in Table 17.

TABLE 17- *Mean fresh weight of vines and yams+bulbils.*

	Fresh weight (kg/ha)		
	Yams + Bulbils	Vines	Total
T1	181 b	126 b	307 b
T2	192 b	164 b	356 b
T3	293 b	232 b	525 b
T4	292 b	236 b	528 b
T5	126 b	110 b	236 b
T6	717 a	1603 a	2320 a
T7	308 b	232 b	540 b
CV%	58.1	47.8	37.6

Since the infestation of passeli was uneven in all plots, there was a large variation in fresh weight, particularly in the yam weight. All chemically treated and untreated control plots had comparable weights. However, a slight reduction in total weight was recorded with Destroy given @ 11 l/ha and 5.5 l/ha and Spark @ 11 l/ha. The manually removed plots had a significantly greater fresh weight of the components since the figures were in effect the accumulated weights of weeds removed over 4 times.

K. G. Prematilaka and H. S. N. Peiris

6.2.2 Pot Experiments, TRI Low-country Station, Ratnapura

Impact of the bulbil size and shade on the germination and shoot growth of Passali kodi (*A. basselloides*) weed.

Treatment combinations	
Main	Sub
1 Shade	1 Size 1 (0-1 g fresh weight)
2 No shade	2 Size 2 (1-2 g „ „)
	3 Size 3 (2-3 g „ „)

The treatments were imposed under open air conditions. Shade was provided with coir matting.

In every treatment, 4 bulbils from each size were dibbled into the soil. The treatments were replicated five times. The plots were arranged in CRD with Factorial. The shoots that emerged from the bulbils were cut at the base at given intervals as indicated in Table 18. The following assessments were recorded.

Assessments: a) Number of shoots emerged.
b) Fresh weight of shoots.

TABLE 18 - *Mean shoot number/pot emerged and their fresh weight*

	Shoot No./pot				
Days after planting	20	30*	40	60	90
Light regime					
Shade	1.67	2.2	2.8	3.0	2.53
	±0.05	±0.07	±0.05	±0.06	±0.09
No Shade	1.07	1.73	2.6	2.73	3.47
	±0.05	±0.07	±0.07	±0.10	±0.10
Bulbil size					
Size 1	1.2	1.4	2.2	2.1	1.8
	±0.15	±0.23	±0.15	±0.16	±0.34
Size 2	1.1	1.7	2.6	2.7	2.5
	±0.11	±0.09	±0.28	±0.23	±0.12
Size 3	1.8	2.8	3.3	3.8	4.7
	±0.11	±0.11	±0.11	±0.38	±0.09

* Time of cutting (days after planting)

	Fresh weight (g/pot)			
	30*	40	60	90
Light regime				
Shade	0.54	2.11	0.74	3.16
	±0.02	±0.10	±0.03	±0.34
No Shade	0.29	1.36	0.57	1.39
	±0.017	±0.06	±0.03	±0.10
Bulbil size				
Size 1	0.35	1.09	0.30	0.65
	±0.06	±0.09	±0.03	±0.15
Size 2	0.42	1.73	0.48	0.39
	±0.05	±0.34	±0.05	±0.05
Size 3	0.46	2.24	1.14	5.79
	±0.07	±0.11	±0.16	±0.97

Both shoot number and shoot fresh weight of Passeli kodi in unshaded pots were significantly lower than in shaded pots. Bulbil size also greatly influenced the germination and shoot growth. The bigger the size of bulbils the greater the shoot number and fresh weight.

K. G. Prematilaka

6.3 Control of Getakola (*Hedyotis aricularia*), Mount Vernon Estate, Patana

The objective of the following trials is to test the presently recommended and new herbicides on the control of Getakola weed (*Hedyotis auricularuia*) which has become a common problem in many tea estates of the Up-Country (notably Mount Vernon Estate) and Mid-Country as a result of its tolerance to many herbicides. Its removal by hand is a laborious and ordurous job. Although *Borreria latifoli, B. ocymoides* weeds were also targeted, they were not abundant in this location.

6.3.1 Chemical control of *Hedyotis auricularia, Borreria latifolia, B. ocymoides* in tea lands

Treatments were imposed on 31st Aug. '98. Weed damage was visually scored and fresh weight of weeds were recorded.

T1 MCPA (40%) 20 ml/10 l + Paraquat 20 ml/10 l
T2 MCPA (40%) 20 ml/10 l **followed by**+ Paraquat 20 ml/10 l
T3 MCPA (60%) 15 ml/10 l + Paraquat 20 ml/10 l
T4 MCPA (60%) 15 ml/10 l **followed by** Paraquat 20 ml/10 l
T5 Hedonal D (55%) 15 ml/10 l+ Paraquat 20 ml/10 l
T6 Hedonal D (55%) 15 ml/10 l **followed by** Paraquat 20 ml/10 l
T7 MCPA (60%) 20 ml/10 l alone
T8 MCPA (40%) 15 ml/10 l alone
T9 Hedonal-D 15 ml/10 l alone
T10 Untreated Control
+ - Paraquat application was done 1 week after MCPA or Hedonal spray

TABLE 19 - *Mean percentage damage (Visual score) in Getakola and weed bio mass yield as affected by herbicides*

	F.wt. (g/0.09m²)		Visual score (%)	
	Prior to	3 WAS	3 WAS	5 WAS
T1	115	204	53	60
T2	74	220	55	63
T3	133	242	45	67
T4	85	133	43	63
T5	128	223	33	38
T6	122	181	58	73
T7	176	199	37	47
T8	89	188	17	37
T9	134	167	43	53
T10	97	166	05	03
LSD(0.05) ns	ns			
CV%	40.8	33.4		

There was no significant difference between fresh weight of weeds before and after and the same was increased following spraying herbicides although there was some damage to the weed foliage. A greater damage was observed with Hedonal-D followed by Paraquat. MCPA 40% and MCPA 60% followed by Paraquat and cocktailed with Paraquat also showed almost 65% damage due to the effect of Paraquat.

However, the above treatments also had a good recovery of weed growth 7 weeks after spray.

6.3.2 Control of Getakola weed with new herbicides

This was commenced on 28th August 1998. The visual injury percentage and the fresh weight of weeds were recorded.

Treatment

T1	Weed Master	@ 2.0 kg/ha	with a knapsack sprayer
T2	„	@ 3.6 kg/ha	do
T3	Sulphosate	@ 2.0 l/ha	do
T4	„	@ 3.0 l/ha	do
T5	Bimaster	@ 3.0 l/ha	do
T6	Spark 3 l/ha(120 ml/l) with new CDA sprayer		
T7	„ 4 l/ha(160 ml/l)		do
T8	Round up(0.5%) (2.75 l/ha) with a knapsack sprayer		
T9	Control		

TABLE 20 - *Mean injury percentage (Visual score) in Getakola and weed fresh weight before and 3* weeks after spraying

	Visual score %			Weed fresh weight (g/ft^2)	
	2 WAS	3WAS	6 WAS	Before	3 WAS
T1	25	60	43	253	117
T2	69	73	72	177	110
T3	57	65	55	105	178
T4	64	76	57	140	106
T5	55	75	48	93	67
T6	96	96	51	157	54
T7	96	98	83	227	67
T8	63	75	57	158	113
T9	04	04	02	104	167
CV%	3.8		16.1		
LSD (0.05)					

Weedmaster @ 3.6 kg/ha, Sulphosate @ 3.0 l/ha, Bimaster @ 3.0 l/ha with a knapsack sprayer had occurred only about 75 % kill. Killing rate of other treatments was below 75%. However, a fast recovery was observed in partially damaged shoots and there was sufficient foliage in plots 3 months after spray.

The first round of herbicide application was completed. Plots have been slashed before the second spray.

The experiment is in progress.

K. G. Prematilaka, H.S.N. Peiris,
A. Gamage and M.S. Madugalle

6.4 Chemical control of *Caladium bicolor* weed

Treatment

T1 Round up 5.00 l/ha + kaolin 3.4 kg/ha
T2 do + „ 1.7 „
T3 do 2.75 l/ha + „ 3.4 „
T4 do + „ 1.7 „
T5 Touch down 3.0 l/ha
T6 do 1.5 l/ha
T7 Bi Master 2.0 l/ha
T8 Bi Master 4.0 l/ha
T9 Spark 4.0 l/ha with CDA
T10 do 3.0 l/ha do
T11 Weed Master 3.0 kg/ha
T12 Cover crop (Arachis pintoii)
T13 Untreated control

TABLE 21- *Mean plant count as affected by various herbicide and a cover crop treatments*

	Weed Count (No./m^2)				
	Prior to spray	2 WAS	3 WAS	4 WAS	8 WAS
T1	48 a	14.0 b	11.5 b	7.6 b	5.2 a
T2	47 a	9.8b	10.5 b	6.3 b	2.2 a
T3	48 a	14.7 ab	12.2 b	7.8 b	7.5 a
T4	51 a	10.8 b	11.3 b	10.3 b	7.0 a
T5	39 a	17.0 ab	13.5 b	12.5 b	9.7 a
T6	41 a	21.3 ab	17.7 b	14.0 b	6.3 a
T7	65 a	11.5 b	10.8 b	13.5 b	6.5 a
T8	52 a	10.2 b	14.0 b	18.7 b	17.7 a
T9	51 a	16.7 ab	17.7 ab	12.2 b	5.7 a
T10	36 a	6.7 b	5.2 b	5.3 b	2.3 a
T11	53 a	8.3 b	8.2 b	11.3 b	9.7 a
T12	67 a	32.2 a	41.0 a	38.5 a	16.2 a
T13	51 a	31.3 a	35.7 a	40.3 a	27.0 a
CV %	10.5	19.1	20.8	20.9	43.9

K.G.Prematilaka and A. Gamage

6.5 Arboretum and Herbarium

Maintenance of arboretum and herbarium continued.

C. Gunasekara

7. D/AGRY - Divisional Activities

7.1. Effect of different size of polythene bags on growth of cuttings in tea nurseries (1996)

Growth of nursery plants on different sizes of poly bags has been monitored at the TRI Low-Country station nursery since November 1997. Three clones viz. TRI 2027, TRI 3041 and TRI 4049 were tested using three sizes of poly bags viz. 3", 5", and 6" (lay flat) and bed plants. Monthly assessments were taken on shoot weigh (SW), root weigh (RW) and root length (RL). The bags were arranged in a factorial design with five replicates. The results are given in Table 22.

TABLE 22 - *Growth of nursery plants*

	4MAP			*8MA*			*12MAP*		
	SW	*RW*	*RL*	*SW*	*RW*	*RL*	*SW*	*RW*	*RL*
Clone									
TRI 2027	0.41	0.19	16.5	3.76	0.91	22.9	9.6	2.9	27.8
TRI 3041	0.42	0.29	15.5	3.17	1.10	24.4	7.2	2.8	28.0
TRI 4049	0.73	0.38	18.3	5.11	1.08	24.7	14.1	3.4	26.1

LSD									
(P=0.05)	0.11	0.06	1.85	0.71	0.16	NS	1.11	0.43	NS
CV(%)	35.2	36.0	17.3	28.5	25.6	–	17.0	32.8	–
Bag size									
Bed	0.49	0.15	9.90	3.34	0.40	13.2	9.8	1.5	19.0
3"	0.32	0.21	19.2	2.36	0.92	27.9	6.2	2.3	30.9
5"	0.57	0.40	17.8	4.54	1.09	27.3	11.1	3.8	31.4
6"	0.69	0.39	20.3	5.81	1.71	27.5	14.0	4.7	27.9
LSD									
(P=0.05)	0.13	0.07	2.14	0.82	0.18	2.19	1.28	0.50	3.47
CV(%)	35.2	36.0	17.3	28.5	25.6	16.4	17.0	22.8	17.2

When the overall performance is considered, clone TRI 4049 recorded a faster growth compared to others. TRI 3041 showed a comparable performance with TRI 2027. The results also revealed that the performance of bed plants was very poor compared to the bagged plants. Further analysis indicated that the growth of nursery plants was more vigorous when a larger size bag (6") was used. An appraisal will be made after the completion of all assessments and analyses.

M.A.Wijeratne and P.Premathunga

7.2. Effect of different systems of planting on productivity of tea lands, Balangoda Estate, Balangoda

Four systems (spacings) of planting were tested using two clones at Balangoda Estate, Balangoda. The different spacings were 2'x4' (100), 2'x3'x5' (100) 2'x2'x5' (114) and 3'x1.5'x5' (133) employing clones TRI 2026 and DG 39. The treatments were arranged factorially in 5 replicates. Growth assessments and yield will be recorded after establishment of plants in the field.

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

7.3. Effect of application of refuse tea on soil properties and yield of tea

Observations were made on the effect of application of refuse tea on soil and leaf properties. Soil samples were collected from three different locations of St. Joachim Estate where refuse tea had been applied and partially decomposed. For the purpose of comparison, soil sampling was also done from the same field where refuse tea was not applied. Soil pH, soil organic carbon, soil K and leaf K contents were determined and have been tabulated below:

	Control	*Refuse tea*
Soil pH	4.5-5.5	4.9-6.3
Organic carbon (%)	0.9-1.1	1.1-1.6
Soil K (ppm)	116-200	200-475
Leaf K (%)	1.0-1.25	1.27-1.37

The results indicated that the application of refuse tea increased the pH, organic Carbon and K content of the soil as well as the leaf K content. In order to investigate further, an experiment was commenced at St.Joachim Estate, Field No. 3 with the following treatments:

1. Application of refuse tea (18 t/ha)
2. Application of Dolomite (1.5 t/ha)
3. Control

The treatments were repeated 4 times.

Monthly assessments on pH, organic Carbon and K content of soil and leaf K content are being monitored along with the yield of tea.

M.A.Wijeratne and P.Prematthunga

7.4. Earthworm culture

7.4.1. Effect of inoculation of earthworms on yield of tea Galphele Estate, Panwila (1995)

This experiment was terminated.

7.4.2. Effect of inoculation of earthworms with and without compost on yield of tea, Anninkanda Estate, Deniyaya

This experiment was terminated.

7.4.3. Effect of earthworm casts on growth and yield of tea plants, Galphele Estate, Panwila

This experiment was terminated due to the high casualties seen this year.

7.4.4 Effect of vermicompost on growth and yield of tea, Doragala, Kotmale Observation trial (1997)

This observation trial was started in April 1997 in a tea smallholder's newly planted tea land. Guidelines were given to him for culturing earthworms and to produce vermicompost using cow dung, kitchen waste and mana grass. The land was divided into two parts.

Treatments

T1 : 250 g of vermicompost per plant
T2 : T200 fertilizer at recommended rate

From January to December, 9 applications of vermicompost were done. Centering of the tea plants was done in June and the weight of cut shoots was recorded (Table 23).

TABLE 23 - *Effect of vermicompost on growth of young tea*

Treatment	Weight (kg ha^{-1}) of Shoots
250g vermicompost per plant	36.7
T200 fertilizer	22.1

Enhanced growth of tea plants was seen in the vermicompost treatment.

This experiment is in progress.

R.M.S.S. Rajapakse

7.4.5 Effect of earthworm casts on growth and yield of tea, Stellenberg Estate, Pupuressa

The objective of this study is to investigate the effect of earthworm casts on the growth and yield of tea. The following treatments were applied.

T1 - Earthworm casts at 300g per plant with 6 applications per year and T200 fertilizer at the recommended rate with 6 applications per year

T2 - Earthworm casts at 300g per plant with 6 applications per year and T200 fertilizer at recommended rate with 3 applications per year

T3 - Earthworm casts at 300g per plant with 6 applications per year

T4 - T200 fertilizer at recommended rate with 6 applications per year

Experimental design was RCBD with 4 replicates.

Growth measurements were taken before treatment application and 6 months after treatment application. Growth differences were analysed. The results are presented in Table 24.

TABLE 24 - *Effect of earthworm casts on growth of tea*

Treatment	Height (cm)	Increase in No. of leaves	Girth (cm)	Branches
T1	3.06 a	13	0.4	4
T2	3.05 ab	11	0.2	3
T3	4.92 a	10	0.3	3
T4	2.72 b	10	0.4	3
CV%	35.13	38.52	60.33	30.94

The results indicated that plant height increased significantly when earthworm casts were applied at 300g per plant with 6 applications per year along with T200 fertilizer at the recommended rate with 6 applications per year (T1) as well as when earthworm casts were applied at 300g per plant with 6 applications per year (T3).

This experiment is in progress.

P.B.Ekanayake, R.M.S.S. Rajapakse and S.N. Wijesekera

7.4.6 Effect of organic materials on nitrogen requirement of tea plants, Brunswick Estate, Maskeliya

This experiment was started to investigate the effect of vermicompost on yield of tea and N requirement of tea plants under higher organic matter content. Clone Norwood 2 was used for this study. The following treatments were imposed.

T1 - 1800 kg/ha/year C + 150 kg/ha/year N
T2 - 1800 kg/ha/year C + 300 kg/ha/year N
T3 - 1800 kg/ha/year C + 450 kg/ha/year N
T4 - 3600 kg/ha/year C + 150 kg/ha/year N
T5 - 3600 kg/ha/year C + 300 kg/ha/year N
T6 - 3600 kg/ha/year C + 450 kg/ha/year N
T7 - 150 kg/ha/year N
T5 - 300 kg/ha/year N
T6 - 450 kg/ha/year N

Yield records were taken from July to December and statistically analysed (Table 25)

TABLE 25 – *Effect of vermicompost and N on yield of tea*

Treatment	Yield (made tea kg/ha)
T1	2423
T2	2413
T3	2430
T4	2554
T5	2504
T6	2551
T7	2531
T8	2398
T9	2514
CV%	5.08

There was no significant difference between treatments within the 6 months period.

7.4.7 Effect of mana, refuse tea, *Arachis pintoii* and vermicompost on growth of tea, Brunswick Estate, Maskeliya

This experiment was started to investigate the effect of refuse tea, mana, vermicompost and *Arachis pintoii* cover crop on the growth of tea plants. The experiment was laid as a RCBD with 5 replicates. Refuse tea, mana and vermicompost were used as thatching materials and spread in the inter-rows. *Arachis pintoii* was also planted in the inter-rows. Centering weights were taken and statistically analysed. The results are presented in Table 26.

TABLE 26 – *Effect of thatching material and cover crops on shoot growth*

Treatment	Average centering weights prior to the treatment application (g)	Average centering weights after the treatment application (g)
Vernicompost	2340	2098 ab
Mana	1600	1567 b
Refuse tea	1860	2648 a
Arechis pintoii	1690	1567 b
CV%	33.4	27.96

The results indicated that after applying the treatments, vermicompost and refuse tea increased the weight of shoots.

This experiment is in progress.

P.B.Ekanayake, R.M.S.S. Rajapakse and S.N. Wijesekera.

9. Seminars / Conferences / Publications

Workshops / Seminars - Local

Ms. R.M.S.S. Rajapakse addressed the Up-Country RSC seminar on 'Stimulation of growth of tea plants by using earthworms' on 30th March.

Ms. R.M.S.S. Rajapakse attended a seminar on 'training for trainers' on 10th March at Talawakelle.

Ms. R.M.S.S. Rajapakse presented a paper on 'Effects of some selected herbicides on population and activity of earthworms under field condition' at the annual technical sessions of Institute of Biology on 16th September.

Ms. R.M.S.S. Rajapakse presented a paper on 'Stimulation of growth of tea plants by using earthworm casts' at SLAAS annual technical sessions on 18th December .

Publications

Rajapakse R.M.S.S. (1998), Earthworm casts - A natural fertilizer TRI Update Vol. 3, No. 1

BIOCHEMISTRY DIVISION

Acting Head – I. S. B. Abeysinghe

1. General

Mr. P.A.N.Punyasiri, Research Officer, was transferred to Biochemistry Division with effect from 13th October.

Messrs. M.D.L.D. Gunatilake, K.M.Mewan and G.A.A.R. Perera were appointed as Experimental Officers with effect from 5th November.

Dr. I.S.B.Abeysinghe was a member of the Board of Study in Chemical Sciences at the Post Graduate Institute of Science, University of Peradeniya, and the Technical Committee on Tea appointed by the Sri Lanka Standards Institution (SLSI). As a member of the resource pool of assessors for laboratory accreditation, his services were available to the SLSI.

Dr. S.Ratnayake, Research Assistant, appointed for the SAREC project, left in January and Ms. Y.G.P.de Silva assumed duties as Research Assistant on 4th August.

The Council for Agricultural Research Policy awarded a grant of Rs. 1,547,000 to conduct a project on the use of DNA markers for molecular characterisation of tea. The principal investigator of this project is Dr. (Mrs.) A.C.Liyanage.

Projects

2. Development of chemical / biochemical method on the control of shot-hole borer (*Xyleborus fornicatus)* in the tea plant

The shot-hole borer, *Xyleborus fornicatus*, is a major insect pest of tea. Its infestation is a serious problem in about 30% of the land under tea in Sri Lanka. A consequence of this has been the debilitation of the tea bush, leading to loss of yield and exposure to attack by the live wood termite. The biology and life cycle of *X. fornicatus* is well documented (Dantanarayana, 1970).

Some clones of tea have been found to be more susceptible to attack than others. It had been suggested that the susceptibility to *X. fornicatus* is related to the saponin content of tea stems, the saponin complexing with a spinasterol in the stem, making it unavailable as an ecdysone precursor to the beetle (Wicramasinghe et. al.,1976). The saponin fraction of *Sapindus emarginatus*, azasterols and amines have been shown to suppress brood development in beetles fed on diets containing yeast extract while tea saponins were effective only when the diet was free of yeast extract (Sivapalan and Shivanandarajah, 1977).

The aim of this project is to understand the mechanism of the action of caffeine, polyphenols and sugars in the resistance of tea clones for attack by *X. fornicatus* and also to study the role of any host plant or insect odour chemicals in attracting the beetle and thereby develop a strategy for the control of the pest.

In the Annual Report for 1997, it was reported that with infestation, levels of epicatechin, epicatechin gallate and caffeine increased in the bark of both clones TRI/2025 and TRI/2023. However, more interestingly, epicatechin and epicatechin gallate content in the stem of the infested plants decreased significantly. This experiment was repeated in 1998, using samples from St. Coombs Estate and Attampitiya Estate, Bandarawela, which confirmed the observations made in 1997. In order to study the effect of individual catechins on the growth of ambrosia fungus, separation of catechins from tea is being carried out. Stem and bark extractions of the infested and non-infested plants of clones TRI/2023 and TRI/ 2025 were extracted and freeze dried. Studies on the effect of these extractions on the ambrosia fungus and the effect of caffeine polyphenol complex formation on SHB attack are proposed to be carried out.

In order to study the SHB beetle attractant and repellent volatile compounds in tea, volatile fraction of tea leaves, bark and stem from clones TRI 2023 and TRI 2025 were extracted and analysed using a Gas Chromatograph. In the tea leaves, the major volatile compounds were Z-3-hexen-1-ol, E-2-hexenal, linalool, methyl salicylate and, to a lesser extent, linalool oxides (both furanoids and pyranoids). In the bark of clone TRI 2023, linalool, linalool oxides and hexynyl hexonate were the major volatile compounds present. However, in the infested bark, linalool oxide content was significantly higher than the non-infested bark. A similar observation was made for the clone TRI 2025. In addition, several unidentified peaks were found in the infested bark and experiments will be carried out to identify these unknown compounds.

It has been reported that verbenone, an oxidative product of a-pinene can act as a repellent for pine beetles. It may be possible that linalool and its oxides can act in a similar manner in the tea plant. Olfactometry studies and field experiments are proposed to test this hypothesis. This project was carried out in collaboration with the Entomology Division, TRI, and the Department of Chemistry, University of Peradeniya.

I.S.B.Abeysinghe, M.D.L.D. Gunatilake, V.Kumar, S.Kumar,
L.D.Amarasinghe and Y.G.P De Silva

3. Development of a method to completely inhibit PPO and peroxidase activity

This project was carried out in collaboration with the Technology Division. The first part of the study was published in the Annual Report for 1995, under both Biochemistry and the Technology Divisions.

The two enzymes, PPO and peroxidase, play a major role during black tea manufacture, namely, in the formation of quality contributing compounds TFs (Theaflavins) and TRs (Thearubigins) during fermentation. However, prolonged activity of these two enzymes is undesirable as it converts TFs to TRs. The presence of an excessive amount of TR pigments is organoleptically undesirable.

The results of the previous study indicated that both PPO and peroxidase enzymes do not get irreversibly denatured using the conventional driers. As a result, during storage, with the absorption of moisture, the enzymes get re-activated, resulting in a decrease in the TF content and an increase in TR. As such, modifications of the existing driers which may result in increased enzyme inactivation were suggested. In this connection, the possibility of using microwave (MW) energy for drying of tea has been proposed by the Technology Division.

Processing food products using microwave heating has been done since 1950. Microwaves are a form of energy, not a form of heat, and are only manifested as heat upon interaction with a material as a result of one or more energy transfer mechanisms. The major advantages of MW heating for processing are speed, uniformity of heating, product quality and selective heating.

The objectives of this study is to develop a method to completely inhibit PPO and peroxidase activity in order to improve the keeping qualities of tea.

As a preliminary investigation, microwave energy was used to check if the PPO gets inactivated fully in the fermented dhool. For this purpose, a domestic model MW oven was used in the laboratory.

Initially, the conventional method of enzyme extraction with mortar and pestle was modified using the homogeniser and the high speed centrifuge. This method of extraction was found to be more consistent and quicker.

For enzyme inactivation studies, the first dhool after normal fermentation prior to drying was used. Three batches of dhools, each of 100g, were exposed to MW drying at 100% power level for 3, 5 and 7 minutes. These samples were subsequently assayed for PPO activity and the moisture content was determined. As a control, unfired dhool and dhool fired using the FBD was used. The results obtained are given in Table 1.

TABLE 1 - *Changes in PPO activity and moisture content in relation to MW exposure at 100% power level*

Sample (100g)	Time of exposure (min)	%PPO activity in comparison to unfired dhool	Moisture content (%)
Dhool	3	13.6	39.37
Dhool	5	8.42	14.71
Dhool	7	–	2.46
Controls			
Dhool	–	100	61.16
Black tea (FBD)	–	26	3.66

The PPO activity in the dhool was assumed to be 100%.

The results indicate that the samples that were subjected to MW energy for 3 and 5 mins. contained a high moisture content; hence, these teas could not be compared with the teas dried using the FBD. The sample exposed for 7 mins had a low moisture content and was devoid of any enzyme activity but had a dull infusion, thin liquor and a high fired character. All the samples that were dried using MW had a better appearance than that of FBD dried sample. In order to obtain a desirable product, it was decided to use a lower power level (80%) and prolong the time of exposure accordingly (Table 2).

TABLE 2 - Changes in PPO activity and moisture content in relation to MW exposure at 80% power level

Sample (100g)	Time of exposure (min)	%PPO activity in comparison to unfired dhool	Moisture content (%)
Dhool	3	8.7	49.28
Dhool	5	5.5	34.87
Dhool	7	3.2	13.91
Dhool	8	–	6.28
Dhool	8.5	–	3.51
Control Dhool	–	100.0	58.53
Black tea (FBD)	–	26.0	3.66

The PPO activity in the dhool was assumed to be 100%.

The results indicate that when teas were exposed to MW energy at 80% power level for 8 mins. and above, the enzymes get denatured fully. On tasting the samples exposed for 8 and 8.5mins with moisture content of 6.28 and 3.51% respectively, they were slightly better than the teas exposed to 100% power level. But these teas are however not comparable to conventionally dried teas. The appearance was superior to that of conventionally dried teas.

From the results obtained so far, it is observed that MW could inhibit PPO activity fully but the quality of the liquor of teas subjected to MW is not comparable to that of conventionally dried teas. However, the appearance of teas dried using MW is superior to conventionally dried teas.

Experiments are proposed to be carried out to obtain a product comparable to conventionally dried teas by fine tuning the fermentation time, power level and time of exposure to MW. In addition, teas dried by MW and stored will be analysed for residual enzyme activity. These experiments will be repeated for peroxidase enzyme as well.

A C Liyanage, P A N Punyasiri and M T Ziyad Mohamed

4. Identification of the changes of chemical composition through a pruning cycle and the effect on made tea quality

The effect of length of time after pruning on the quality of made tea has not yet been well established. Although data is available from studies done in India and Africa, experimental data is not available for Sri Lanka. Therefore, a study to ascertain the correlation between quality of made tea and length of time after pruning was initiated at St.Coombs Estate during the rainy season of 1998.

A randomized block design with 5 blocks was used with 4 treatments (i.e. 1st, 2nd, 3rd and 4th year after pruning) in each block. The clone used was TRI 2025. Flush was harvested weekly and yields recorded. Total chlorophyll, total amino acids, total polyphenols and polyphenol oxidase activity of the flush were measured fortnightly. The results obtained for three months during wet season are given in Table 3.

TABLE 3 - *Total chlorophyll (Ch), total amino acids (AA), total polyphenols (TP) and polyphenol oxidase activity (PPO) of flush in successive years from pruning*

Year after pruning	Ch	AA	TP	PPO
1	3.92	8.10	411	0.028
2	3.54	7.40	409	0.029
3	3.60	6.54	398	0.028
4	3.65	6.64	400	0.033
LSD	NS	0.12	NS	NS
CV%	9.9	17.3	8.2	19.2

Theaflavin, thearubigin and flavour index of black tea processed from the flush were also measured. The results obtained so far are given in Table 4.

TABLE 4 - *Theaflavin (TF), thearubigin (TR) and flavour index (FI) of made tea after different time periods from pruning*

Year after pruning	TF	TR	FI
1	0.83	11.03	1.36
2	0.83	11.26	1.17
3	0.83	11.20	1.20
4	0.87	11.47	1.16
LSD	NS	NS	NS
CV%	11.6	7.9	34.5

Among the parameters measured, only total amino acids (AA) show a statistically significant decrease with the time period after pruning. This project was carried out in collaboration with the Agronomy Division. The experiment will be continued during the dry season of 1999.

A.M.T.Amarakoon, J.Jayasundara, P.A.N.Punyasiri, Sharmila Balendran, A. Anandacoomaraswamy and I. S.B.Abeysinghe

5. Polyphenol content and antioxidant activity of teas produced in different regions

In Sri Lanka, different regions adopt various types of manufacturing procedures and therefore the types of teas produced also differ. A question often raised is whether there is a difference in the health-giving properties of teas produced in different regions. The antioxidant activity of polyphenolic components mainly contributes to the health-giving properties of tea. However, the relative amounts of polyphenols in different types of Sri Lankan teas are not known. Further, theaflavins and thearubigins are unique polyphenols in black tea, which are produced during black tea processing. Although it has been demonstrated that black tea extracts possess antioxidant activity, relative contribution from these unique black tea components are not known. Therefore, a study was initiated to find the relative amounts of polyphenols and their relative contribution to antioxidant activity in teas produced in the up-country, Uva, mid-country and low-country regions of Sri Lanka.

Teas were collected monthly from 51 estates in these regions, starting in November 1998. Mean values of Total Polyphenols (TP), Theaflavin (TF) and Thearubigin (TR) contents of the samples analyzed so far are given in Table 5.

TABLE 5 - *Total Polyphenol (TP), Theaflavin (TF) and Thearubigin (TR) contents of teas produced in different regions of Sri Lanka*

	TP(mg/g)	TF%	TR%
Up-Country	17.5 ±2.1	0.80 ±0.25	14.1 ±2.0
Uva	19.1 ±1.5	0.73 ±0.18	12.9 ±1.7
Mid-Country	17.2 ±1.8	0.77 ±0.29	14.4 ±1.4
Low-Country	17.9 ±1.7	0.73 ±0.16	14.5 ±2.0

Values are mean ±SD

This study will be continued in 1999.

A.M.T.Amarakoon and Riyalini Singarajer

6. Substances characteristic of green and black tea

The study reported here has been carried out under ISO/TC34/SC8 work item: Substances characteristic of tea. The principal objective of the study is to develop a robust analytical procedure which, by providing suitable compositional information, could help establish and determine compliance with any proposed green tea specification. It would be desirable if it could also provide a means of discriminating green from black tea.

Polyphenolic compounds, of which tea is an extremely rich source, were considered most suitable for this investigation. Although the fresh green leaf polyphenolics consist primarily of catechins, the post-harvest control and processing conditions

have a major influence on the type and level of polyphenolics present. The production process for green tea products incorporates an initial heating step to deactivate endogenous enzymes in the fresh leaf.

Any damage to the fresh green leaf structure and delay prior to the enzyme deactivation will invariably lead to partial fermentation, with catechin utilisation and formation of polyphenolic pigments. Although with control, this is intentional in the production of semi-fermented oolong and fermented black teas, particular attention to post-harvest conditions is essential if the desired green tea product is to retain the maximum amount of catechins.

An analytical approach which uses a combination of two methods to evaluate the nature of the polyphenolic compounds present has been developed. The intact catechins are determined by HPLC in conjunction with a total polyphenol colorimetric assay on the same extract using Folin Denis reagent. This reagent responds to all phenolic hydroxy groups, be they associated with the catechin or other polyphenolic pigments that may be present. Thus, in addition to providing information on green tea catechin content, comparison against the total polyphenolic value may provide a convenient means of distinguishing green, oolong and black tea.

At the 7th meeting of ISO/TC34/SC8 held in Colombo in 1997, having considered the results of the preliminary inter-laboratory studies into the discrimination of total polyphenols and catechins carried out in accordance with resolution No.122/ London in document 34/8 N 463, it was decided to carry out an international inter-laboratory ring test of Folin Ciocalteu assay for the determination of total polyphenols in green and black leaf tea. Sri Lanka offered to participate in this inter-laboratory test.

This ring test was carried out in two stages for instant teas and for leaf tea samples. Results submitted by the Biochemistry Division for these international ring tests are given in Tables 6 and 7.

TABLE 6 - *Results for the stage 1 of the international ring test*

Sample Code	Optical Density l 725 nm	% Total Polyphenols to nearest 0.01%
1A	0.481	46.00
	0.465	
1B	0.476	47.19
	0.489	
2A	0.167	16.24
	0.161	
2B	0.166	16.22
	0.170	

TABLE 7 - *Results for the stage 1 of the international ring test*

Sample Code		Sample Wt. g.	Optical Density λ 725 nm	%Total Polyphenols to nearest 0.01%
Leaf Tea	1A	0.2002	0.404	18.86
			0.402	18.79
Leaf Tea	1B	0.2002	0.383	17.88
			0.382	17.84
Leaf Tea	2A	0.2003	0.406	18.95
			0.403	18.81
Leaf Tea	2B	0.2006	0.404	18.83
			0.399	18.59
Leaf Tea	3A	0.2004	0.511	23.84
			0.521	24.30
Leaf Tea	3B	0.2001	0.522	24.39
			0.515	24.06
Leaf Tea	4A	0.2006	0.290	13.51
			0.290	13.51
Leaf Tea	2B	0.2002	0.281	13.12
			0.282	13.17

In order to establish the total polyphenol levels of teas from various tea growing regions, 5 estates from Dimbulla region: Watagoda, Waltrim, Talawakelle, Henfold and St. Coombs; 4 estates from Maskeliya region: Gartmore, Alton, Loinorn and Tillyrie; 6 estates from Uva: Craig, Uva Highlands, Ambagasdowa, Attampitiya, Hopton and Hugoland; two estates from Nuwara Eliya: Somerset and Labookelle, one estate from low-country: Christhombu, were analysed for total polyphenol levels, using the method described by the International Organisation for Standards. Results of the analysis are given in Table 8.

TABLE 8 - *Total polyphenol levels of estates in Dimbulla, Uva, Maskeliya and Nuwara Eliya*

Estate	No. of replicates	Total Polyphenols % Average
Watagoda	5	16.06
Waltrim	5	16.34
Talawakelle	5	16.16
Henfold	5	16.66
St. Coombs	5	18.12
Gartmore	5	16.88
Alton	5	16.16
Loinorn	5	16.94
Tillyrie	5	16.04
Craig	5	14.12

Uva Highlands	5	16.92
Ambagasdowa	5	16.22
Attampitiya	5	15.48
Hopton	5	14.62
Hugoland	5	18.32
Somertset	5	17.08
Labookelle	5	17.46
Christhombu	5	14.90

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

7. The establishment of correlation between the chemical composition of tea clones and made tea quality - Screening lines for quality (CADMAR Projects A.1.4, A.2.4 and A.3.4)

Quality potential of a clone is one of the important criteria that is taken into account during the characterisation of clones. This is particularly true for the clones recommended for the up-country and mid-country and, in this respect, quality potential for most of the TRI 2000 series clones have been determined. However, the quality potential of the TRI 3000 and 4000 series clones are not available. Therefore, 9 clones from 3000 series, namely, 3013, 3014, 3016, 3017, 3018, 3019, 3020, 3022 and 8 clones from 4000 series, namely, 4042, 4043, 4044, 4045, 4046, 4052, 4053 and 4071 were selected for screening for quality. Flush from the selected clones were collected from Mahadowa Estate by the Plant Breeding Division and sent to the Biochemistry Division for evaluation of quality. The manufacture of these clones was carried out at the Technology Division using a miniature manufacturing facility and made tea samples were sent for taster's evaluation. Chemical analysis of made tea samples was carried out to determine the correlation between the chemical composition of made tea and the taster's evaluation. The experiment was repeated twice during the Uva season. Results of the experiment are given in Table 9.

TABLE 9 - *Quality parameters of made tea for TRI 3000 and 4000 series*

TF=Theaflavins, TR=Tearubigins, TC=Total Colour, B=Brightness

Clone	TF%	TR%	TC	B%	TR/TF
TRI 3013	0.88	10.76	2.99	28.55	12.16
TRI 3014	0.90	11.99	2.65	29.05	13.39
TRI 3016	0.84	11.41	2.84	28.84	13.64
TRI 3017	0.89	12.12	2.81	29.29	13.94
TRI 3018	0.96	11.21	3.36	29.20	11.81
TRI 3019	1.00	12.05	3.02	30.77	12.45
TRI 3020	0.68	12.38	4.02	25.43	18.77
TRI 3022	0.87	13.54	3.52	24.03	15.68
TRI 3042	0.86	13.98	3.62	24.49	19.80
TRI 4043	0.89	15.30	3.77	31.24	18.86
TRI 4044	0.87	12.17	3.40	24.48	16.70

TRI 4045	0.96	15.18	3.39	27.59	17.53
TRI 4046	0.77	14.73	2.82	31.06	19.15
TRI 4052	1.33	13.57	4.10	27.12	10.18
TRI 4053	1.44	14.45	4.47	26.70	10.17
TRI 4071	1.05	12.91	3.48	34.44	12.32

It would be very useful if the quality potential of a plant can be determined during the early stages of the breeding programme. In addition to the morphological characters, it is possible to use the quality contributing chemical and biochemical compounds present in tea flush for this purpose. In order to establish a correlation between the chemical composition of flush and quality, 11 clones from (both quality and non-quality clones) TRI 2000 series: 2023, 2025, 2024, 2027, 2042, 2016, 2021, 2022, 2026, 2043, 2142; 11 clones from TRI 3000 series: 3013, 3017, 3049, 3052, 3014, 3016, 3018, 3019, 3020, 3022, 3015; 10 clones from 4000 series: 4042, 4043, 4044, 4045, 4046, 4052, 4053, 4071. 4067 and 4079 were selected for this study. In addition, 10 estate clones, DT1, K145, PK2, NAY3, CY9, TRI 777, TC9, N2, DN and MT18, were also selected.

Flush from these clones was collected from St.Coombs Estate on a weekly basis and analysed for chemical parameters, namely, total polyphenol content, total amino acid content, total chlorophyll content, polyphenol oxidase activity and for individual catechins. This experiment was repeated 3 times and the averages are given in Table 10.

TABLE 10 - *Chemical parameters analysed for selected clones*

EGCG = epigallocatechin gallate

Clone	Amino Acid mg/g	Chloroph-yll mg/g	PPO activity nmol/ml/min	TF/TR	Caffeine mg/g	Catechin mg/g	Epicat-echin mg/g	EGCG mg/g
TRI 2016	10.63	4.15	0.040	16.13	28.33	12.47	6.85	60.68
TRI 2023	8.23	3.87	0.036	15.08	28.13	18.06	16.25	81.18
TRI 2024	10.44	3.57	0.049	16.44	30.04	12.15	12.15	74.31
TRI 2025	8.93	4.25	0.022	18.72	29.49	7.8	7.8	77.46
DT1	8.10	2.83	0.057	16.04	30.07	21.42	21.42	60.18
PK2	9.46	3.05	0.032	11.42	31.46	24.81	24.81	62.19
CY9	11.52	3.05	0.060	15.24	33.01	27.16	27.16	49.28
TRI 2043	15.79	3.81	0.019	18.22	–	–	–	–
TRI 3015	11.38	2.85	0.021	17.64	32.55	29.27	29.27	73.26
TRI 777	10.07	4.40	0.029	12.12	–	–	–	–
TRI 2016	10.08	3.11	0.024	13.70	–	–	–	–
TRI 2143	10.92	2.65	0.019	15.46	–	–	–	–
K145	12.88	3.90	0.026	11.67	–	–	–	–
TRI 3015	9.12	5.76	0.033	9.86	–	–	–	–
TRI 3022	9.12	5.70	0.022	16.62	–	–	–	–

Flush samples from individual clones were manufactured at the Technology Division and made tea samples were sent for taster's evaluation. In addition, made tea samples were analysed for quality parameters to establish the relationship between chemical composition of black tea and quality. Results of this analysis are given in Table 11.

TABLE 11 - *Quality parameters of made tea for selected clones*

TF=Theaflavins, TR=Tearubigins, TC=Total Colour, B=Brightness

Clone	TF	TR	Brightness	TC
TRI 2016	0.72	11.53	24.22	3.01
TRI 2023	0.81	12.21	26.07	3.08
TRI 2024	0.86	14.28	24.70	3.62
TRI 2025	0.66	12.19	20.60	3.05
DT1	0.87	13.61	25.11	4.08
PK2	1.09	12.28	33.24	3.61
CY9	0.78	13.51	21.56	3.05
TRI 2043	0.67	12.08	22.29	3.16
TRI 3015	0.77	11.82	23.11	2.88
TRI 777	1.09	13.32	31.27	3.77
TRI 2016	0.97	13.30	29.67	3.12
TRI 2143	0.81	13.02	29.34	2.87
K145	0.62	11.97	25.28	2.70
TRI 3015	0.98	9.24	25.34	2.80
TRI 3022	0.76	12.58	24.36	2.62

J.Jayasundara, N.Punyasiri, V. Selvarajah and I.S.B.Abeysinghe

8. Attempts to increase the soluble solid content of the TRI formulated liquid tea concentrate

This is a continuation of last year's project. Trials to increase the dilution ratio from 1:3 to 1:6 have been successful. Attempts to further increase the concentration of the liquid tea concentrate failed owing to the poor standard of the refuse tea, which is the starting material of this product. However, the stability of the concentrated product has been improved and its shelf life could go up to around 1 year.

Taking into account the poor standard of refuse tea currently available in the market, it is envisaged that future trials would involve improvement of the quality of the tea concentrate by using various ratios of refuse tea with broken mixed fannings.

A.C. Liyanage, G. A. A. R. Perera, M. W. Silva and I. S. B. Abeysinghe

9. Use of DNA markers for molecular characterisation of tea

At present, taxonomic characterisation of clones of *C.sinensis* has been restricted to morphological and reproductive triats. Since tea is outbreeding and highly heterogeneous, these characters may not reflect the true genetic variation within the crop. Furthermore, most of the vegetative characteristics used as descriptors can only be assessed at maturity and are greatly influenced by the environment, showing high plasticity.

Conventional breeding programmes have mainly been centred on the selections from within the same populations coupled with clonal propagation which has restricted the level of genetic variability within the cultivated gene pool. Therefore, it is of paramount importance to characterise the variability between clonal selections and maintain a degree of heterogeneity within the germplasm. The development of molecular biology has resulted in alternative DNA-based procedures for the detection of polymorphism. Development of DNA markers will be useful for accurate assessment of the level of genetic variation, to minimise duplications in germplasm conservation, to establish core collections representative of the total available genetic variation and to provide a source of germplasm that is accessible to tea breeding.

The Council for Agricultural Research Policy has awarded a grant of Rs 1,547,000 to conduct the above project at the Department of Molecular Biology/Biochemistry at the Medical College of Colombo. This is a collaborative study between CRI, Medical College and the Plant Breeding Division of the TRI. The project is scheduled to commence in January 1999 and would be continued for 2 years.

The main objectives of this project is the determination of the genetic identity of the existing tea clones, detection of genetic diversity between tea clones and setting priorities for future breeding programmes.

Extraction of DNA from protoplasts of recommended tea clones will be carried out and to perform RAPD - PCR reactions using DNA from the above mentioned clones using 10mer oligonucleotides from OPERON primer kits. Detection of best primer DNA template combinations by repeatable experimentation of RAPD-PCRs and construction of a random DNA library of DNA sequences containing simple sequence repeats will be carried out. Finally, sequencing of clones positive for simple sequences will be carried out.

A. C. Liyanage, K.M.Mewan, J.M.D.T. Everard,
E.Karunanayake and M.T.K.Amarakoon

10. Collaborators (Non - TRI)

Prof. V.Kumar and Prof. (Mrs.) S. Kumar, Chemistry Department, Faculty of Science, University of Peradeniya, on Biological Pest Control Project

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

Mr. J.M.D.T.Everard, Coconut Research Institute, Lunuwila, on Use of DNA markers for Molecular Characterisation of Tea

11. Students

Ms. Sharmila Balendran, undergraduate student from the Faculty of Agriculture, Eastern University, completed her undergraduate project titled "Identification of the changes of chemical composition through a pruning cycle and the effect on made tea quality" in December.

Ms. V. Selvarajah and Ms R. Singarajer, undergraduate trainees from the Faculty of Agriculture, University of Jaffna, have commenced their projects titled "The establishment of the correlation between the chemical composition of the tea clones and made tea quality" and "Polyphenol content and antioxidant activity of teas produced in different regions of Sri Lanka" respectively.

12. Journal Articles

"Effect of standard of plucking on quality and profitability of made tea production in the up-country Uva region during non-flavour season". Journal of Tea Science (accepted for publication), W.S.Botheju and I.S.B.Abeysinghe

13. Conference Papers and Workshop Proceedings

Proceedings of the Fifth International Symposium on Tea Culture, 10-12 October, 1998. Hangzhou, China, titled "Studies on Antioxidant Activity and Immunomodulatory Properties of Black Tea", A. M. T. Amarakoon.

14. Training Materials

Biochemistry Division, in collaboration with Chemistry Department, University of Peradeniya, conducted a workshop under the SAREC sponsored project on Olfactometry and Trapping - tools in behavioural ecology, from 18-22 March at TRI, Talawakelle.

15. Donors

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

Council for Agricultural Research Policy for Project on Use of DNA Markers for Molecular Characterisation of Tea.

16. Meetings/Seminars

On the invitation of Colombo Tea Traders Association, Dr. I.S.B. Abeysinghe made a presentation on International Standards on Tea at the Chamber of Commerce, Colombo, on 2nd February.

Dr. I.S.B. Abeysinghe completed a training programme on the development of a resource pool of assessors for accreditation activities, organised by the Sri Lanka Standards Institute and conducted by Swedish Board of Accreditation (SWEDAC) in February.

On the invitation of the Sri Lanka Tea Board Dr. I.S.B. Abeysinghe and Mrs. J. Jayasundara visited Johann Goethe University in Frankfurt, Germany, from 18th to 29th May to study the methodology involved in Gas Chromatography - Isotope Ratio Mass Spectrometry (GC-IRMS).

Dr. I.S.B. Abeysinghe and Mr. P.A.N. Punyasiri participated in the SAREC sponsored workshop on NMR spectroscopy from 15th to 20th September in Kandy.

Dr. I.S.B. Abeysinghe attended the fourth Asia Pacific Food Analysis Network Conference and the Workshop on Pesticide Immunoassay from 16th to 20th November in Chiangmai, Thailand.

On the invitation of the Regional Scientific Committees (RSC) in Galle and Kandy, Dr. A.M.T. Amarakoon addressed the RSC seminars in Galle and Kandy on Antioxidant Activity of Black Tea on 30th October and 27th November respectively.

Dr. A.M.T. Amarakoon attended a workshop on "Accessing Information" on 25th July organised by SLAAS and National Science Foundation.

Dr. (Mrs.) A.C. Liyanage and Mrs. J. Jayasundara attended the Annual Congress of the Post Graduate Institute of Agriculture on 19th November.

ENTOMOLOGY DIVISION

Acting Head and Entomologist - Sushila I. Vitarana

General

Mrs. S.I. Vitarana continued to serve in the dual capacity of Acting Head of Division and the Officer-in-Charge of the TRI Low-Country Station, Ratnapura.

Mrs. S.I. Vitarana continued to function as the Convenor/Secretary of the Consultative Committee on Estates and Advisory Services, a sub-committee of the TRB. Four meetings of this Committee were held during the year.

Mrs. S.I. Vitarana was re-nominated by the Hon. Minister of Agriculture and Lands, under the Control of the Pesticides Act 33, to serve a second term in the Pesticide Technical and Advisory Committee from January. She attended 3 meetings of this Committee during the year.

Prof. W. Danthanarayana spent a 3-month period working on Population Modeling in relation to shot-hole borer of tea, while he was on sabbatical leave from his University.

Mrs. S.I. Vitarana was appointed in May to the first Specialist Committee on Plant Protection set up by CARP. This Committee assists CARP by way of preparing national programs on plant protection and facilitates inter-institutional interaction in plant protection within the national Agricultural Research System (NARS).

Mrs. S.I. Vitarana was appointed in June, with the approval of the Sri Lanka Council for Agricultural Research Policy (CARP), to serve on the Steering Committee on National Plant Quarantine in place of the late Dr. R.L. de Silva. She attended 3 meetings of this Committee.

Mrs. S.I. Vitarana also served as the Convenor / Secretary of the Workshop to prepare the Corporate Plan of the Institute held in June and as a member of the National Apprentice and Industrial Training Advisory Committee (NAITA) on NDT Agriculture In-Plant Training, from August, to prepare a revised Training Standard for NDT (Agriculture). The latter task was completed in November.

Mrs. I. Aladeniya, Experimental Officer, resigned from the service of the Institute in June.

Mrs. S.M. Nagahaulla, Research Officer, completed the local component of the practical project as partial fulfilment of the requirements for the PhD degree, and returned to Australia in August to complete her post graduate training.

Mr. M.D.D. Liyanage proceeded in September to undertake a 3-month training on Techniques of Isolating and Handling of Biological Control Agents of Plant Parasitic Nematodes, at Instituto di Nematologia, Bari, Italy.

Mr. K. Thirugnanasuntharan, Senior Research Officer, retired from service with effect from 22nd September, having served the Institute for 34 years.

Mrs. S.I. Vitarana functioned as the Chairman of the Agro-chemicals Screening Committee which advises the Director. The Committee held five meetings during the year.

Mrs. S.I. Vitarana served on the Editorial Committee of the "Tea Bulletin" and also edited several papers of the "TRI Update".

Mr. S. Walgama assumed dutys as Research Assistant with effect from 1st October.

Ms. Padminie Dharmalatha assumed dutys as Experimental Officer with effect from 1st December.

Dr. K. Mohottie completed his post graduate training successfully and was awarded Ph.D degree in December. His thesis was on "Non-chemical approaches for the management of the root lesion nematode, *Pratylenchus loosi* Loof, 1960 in tea *(Camellia sinensis* (L) O.Kuntze), with special reference to use of endospore-forming bacterium, *Pasteuria penetrans."*

Research Activities

1.0 Project B/NEMA-Development of integrated strategies for the control of plant parasitic nematodes causing economic damage to tea

Project Leader - Sushila I. Vitarana

1.1 Screening of promising clones for natural resistance / tolerance/ susceptibility to plant parasitic nematodes attacking tea

1.1.1 N 1 A - Screening of the TRI 4000 series of clones against the root-lesion nematode, *Pratylenchus loosi,* with reference to build up of nematode population in root and soil and growth of tea plant (TRI, Talawakelle)

The final assessment of the test clones of this trial was carried out in June. The data has been analyzed and presented in Table 1.

It has been observed that the clones TRI 4002, 4003, 4004, 4005,4015, 4019, 4052, 4088 and 4089 harbour very low counts of nematodes in the roots. They are not significantly different from the known nematode tolerant clones, TRI 2025 and DT 1 in relation to the count of nematodes in the root. In relation to the count of nematodes in the soil around the root, it is only TRI 4089 of the above group of clones that is not significantly different from the two tolerant clones. Thereofre, the above clones can be considered as comparable to the two tolerant clones with regard to nematode susceotibility. However, all clones of this group have not recorded growth as vigorous as the two standard clones. In relation to growth, TRI 4052 exhibited the best shoot growth.

Clones TRI 4014, 4024, 4042 and 4047 are as susceptible as the highly susceptible clone TRI 2024 and should not be planted in areas where *P.loosi* is active. Clones

TRI 4042 and TRI 4047 seem to have very high ability for compensatory growth, in spite of harbouring very high populations. However, they cannot be recommended for *P.loosi* active areas as they can encourage build up of nematode populations from a very small initial population.

TABLE 1 - *Screening of 4000 series clones against the root-lescen nematode, Pratylenchus loosi*

Clone *	Nematode counts Root	Soil	Shoot weight (g)	Root weight (g)
TRI 4042	253.4 c	16.437 a	89.12 a	52.96 a
2024 (Ss)	224.5 c	41.290 b	61.37 b	27.35 c
4047	202.8 c	43.463 b	114.55 a	36.58 b
4024	131.6 b	21.083 a	74.90 a	31.33 c
4014	123.4 b	26.500 a	83.46 a	41.97 b
4019	87.6 a	32.875 a	61.82 b	22.37 cd
2025 (Tl)	86.6 a	33.500 a	81.80 a	35.60 c
4089	80.1 a	53.728 b	40.63 b	17.69 cd
4004	66.7 a	34.750 a	27.35 b	9.42 d
4088	63.0 a	19.250 a	65.48 b	33.41 c
4015	58.6 a	20.728 a	56.39 b	22.94 cd
DT 1 (Tl)	56.0 a	11.500 a	83.36 a	29.20 c
TRI 4052	53.0 a	17.437 a	97.44 a	33.54 c
4005	49.6 a	11.790 a	19.72 b	8.47 d
4003	47.7 a	17.375 a	39.51 b	21.54 cd
4002	43.6 a	21.138 a	30.58 b	11.97 d
Mean	101.8	26.428	64.22	27.27
SE (Mean)	22.229	7.400	15.683	5.922
LSD (P=0.05)	62.863	20.927	44.352	16.747
DF (Error)	45.0	45.0	45.0	45.0
CV	43.7	56.0	48.8	43.4

* Values with the same alphabetical letter are not significantly different from each other. The clones are arranged in the descending order of "Nematode counts in roots"(2nd column).

Ss - Susceptible to nematode; Tl - Tolerant to nematode

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

1.1.2 N 1B - Screening of the TRI 4000 series of clones against the burrowing nematode, *Radopholus similis*, with reference to build up of nematode population in root and soil and growth of tea plant (TRI, Mid-Country Station, Hantane)

During the period under review, measures were taken to increase the nematode population in the testing tanks to be used for the tolerant test. However, build up of nematodes in the tanks was very slow. An alternative site too was being prepared at Galaha Estate for a replicate trial.

This experiment is in progress.

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

2.0 Project MeBr -To find substitutes for methyl bromide for eradication of plant parasitic nematodes with environmentally acceptable fumigants and biological control agents and other means

Project Leader - Sushila I. Vitarana

2.1 Biological Control Agents N 315 - Isolation of endemic biological control agents of tea nematodes and formulating methods of augmenting their activity

Laboratory cultures of nematopathogenic agents were maintained. The cultures were taken to Italy for identification and screening purposes by Mr. D.D. Liyanage during his training at the Instituto di Nematologia, Bari.

2.1 Direct Planting of Nematode Infested Lands

2.1.1 Direct planting using alternatives to rehabilitation of land with grass to eradicate soil borne parasitic nematodes

N 316 – (MeBr No.1) - 1996 N.C. Block, Agrakanda Estate, Agrapatma (1996)

The experimental plots were being maintained. No assessments were during this year.

S.I. Vitarana, D.D. Liyanage, N. Navaratne Y.Konaratna,
G. P. Udumulla and G.Jayawardena, Director, Agarakanda Estate.

2.2.2 Direct planting with nematicides applied at the time of planting

N319 - (MeBr 13) - Field No.6, New Forest Division, Cocogala Estate, Madulsima (1997) - (4 treatments x 3 replicates)

The experimental blocks planted in end 1997 were being maintained.

S.I.Vitarana, D.D.Liyanage, N.Navaratne and
Subash Jegatheesan, Superintendent, Cocagala Estate

N 324 - (MeBr 2) - 1997 NC, Nayapane Estate, Pussellawa (June 1997) – (4 treatments x 3 replicates)

Growth of the plants in the blocks intercropped with Vetiver grass continued to be better than those with other treatments ("Rugby", "Ebufos" and "Nemacur", fenamifos). The nematode counts were very low in all blocks. The trial is in progress.

S.I. Vitarana, D.D. Liyanage, U.B. Herath and U.P. Udumulla

N 325 (Mebr 3) - 1996 NC Block, Court Lodge Estate – (4 treatments x 3 replicates)
Treatments included the following:

T1 – 7g "Rugby" + (Tea waste + 3g "Suscon Fore")
T2 – 7 g Nemacur + (Tea waste + 3g "Suscon Fore")
T3 – Compost (Tea waste + cow dung+ weeds) + 3g "Suscon Fore")
T4 – Control + (Tea waste + 3g "Suscon Fore")

The assessments carried out during the year included the nematode count in the soil and measurement of height and girth of plants. The nematode counts were very low, mostly zero in all treatments. The height and girth measurements showed no statistically significant difference between treatments.

The experiment is in progress.

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

N 330 – (MeBr 8) - Field No.10, Yelverton Division, Queenstown Estate, Hali-ela (4 treatments x 2 clones in factorial design)
The treatments included:
T1 – "Rugby @ 7g /plant
T2 – "Neemazal 1%" @ 850 ml /ha
T3 – "Nemacur " @ 7g / plant
T4 – untreated control
Clones: C1 – Clone DN; C2 – Clone CY 9

Plant growth measurements showed significant differences. (height and girth). Tables of means are given below:

TABLE 2 - *Effect of incorporating nematicides on plant height (cm)*

Treatment Clone	"Rugby"	"Neemazal"	"Nemacur"	Control	Clone Avg.
DN	66.9	107.9	83.1	94.5	88.1
CY 9	66.7	102.9	92.4	96.6	89.6
Treat. Average	66.8	105.4	87.8	95.6	

LSD at 0.05% for treatment means = 6.53

While there was no significant difference between clones, only "Neemazal" significantly enhanced plant heights within clones.

TABLE 3 - *Effect of incorporating nematicides on plant growth (mm)*

Treatment Clone	"Rugby"	"Neemazal"	"Nemacur"	Control	Clone Avg.
DN	1.143	1.560	1.380	1.610	1.423
CY 9	1.023	1.453	1.423	1.540	1.360
Tr. Average	1.083	1.507	1.402	1.575	

LSD at 0.05% for treatment means = 0.149

There was no significant difference between and within clones in relation to plant girth. The trial is in progress.

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

2.2.3 Use of organic amendments in direct planting

N 328 - (MeBr 6) -Handford Estate, Deniyaya - (04 treatments x 3 replicates)

Treatments included the following:

T1 – Thatching with *Tithonia diversifolia*

T2 – 'Vetiver" grass planted in the inter-row

T3 – "Nemacur" @ 7 g per plant at planting

T4 – Control (only the basal treatment of 3g "Suscon Fore)

Assessments on plant growth and nematode counts in the roots and soil were carried out. The treatments showed significant differences between their means in relation to root counts (Table 4).

TABLE 4 - *Effect of organic amendments on growth and nematode counts*

Treatments	Mean height (cm)	Mean girth (mm)	Nematode Counts per gram root on 07.07.1998	Nematode Counts per gram root on 30.09.1998
Tithonia thatch	61.8	6.48	0.61	1.49 a
Vetiver intercropping	57.1	6.31	0.61	1.33 a
"Nemacur" @7g/plant	57.1	6.52	1.02	0.92 a
Control (3g Suscon Fore)	59.5	6.25	1.48	2.16 b
LSD at 0.05%	NS	NS	NS	1.079 **

The nematode count had significantly declined in the treated plots by September 1998.

S.I. Vitarana, A.K. Prematunge, P.K. Jayawickrama and P.R. Dharmabandu, Superintendent of Handford Estate

2.2.4 Eradication of nematodes in infested young clearings

N 327 (MeBr 5) - Kelliewatte Estate (March 1997)

Thatching with "Vetiver"grass and tobacco dust continued. The experiment is in progress.

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

N 332 (MeBr 15) - 1990 NC, Field No.1A, Galaha Estate, Galaha (October 1997)

Thatching with fresh neem leaf was renewed repeatedly as the old thatch disintegrated. Application of molasses was repeated once during the year. Three assessments on nematode counts were carried out. Data are given in Table 5.

TABLE 5 - *Effect of nemacur and thatching materials on mean nematode counts per 5g soil*

Treatment	Dates of Sampling		
	28.06.98	14.09.98	19.11.98
Nemacur	1.18	1.63	2.59
Fresh neem	1.84	2.09	1.02
Thatch Denatured molasses	1.68	2.13	1.74
Untreated control	1.43	1.63	6.22
LSD at 0.05%	NS	NS	2.32 **

By the third sampling, the nematode counts were significantly reduced by the treatments. The experiment is in progress.

S.I. Vitarana, U.B. Herath, P. Udumulla and B. Suresh Kumar

2.3. Soil Solarization as a means of soil sterilization

N 320 - MeBr 18- TRI Sub Station, Diyadawa, Deniyaya (1997)

Two assessments on nematode counts in the roots were carried out.
Treatment differences were seen only in respect of one assessment which is presented in Table 6.

TABLE 6 - *Effect of soil solarization on average root nematode counts*

Treatment	Nematode count per 1 g root	
Methyl bromide (standard)	0.6	bc
Fumigation with dazomet in bulk	0.6	bc
3 week solarization of bagged soil	16.6	ab
6 week solarization of bagged soil	5.1	b
9 week solarization of bagged soil	5.5	b
3 week solarization of bagged soil + Urea @ 2 g per plant	1.3	b
3 week solarization of bagged soil + Sulphate of ammonia @ 2 g per plant	2.0	b
6 week solarization of soil in bulk		
LSD at 0.05%	14.35	

Methyl bromide and dazomet treatments were similar to each other. Three week solarization of bagged soil that had been treated with either Urea or Sulphate of Ammonia each @ 2g per plant gave the next lowest counts of nematodes. The experiment is in progress.

S.I. Vitarana, D.D. Liyanage, P.K. Jayawickrama and A.K. Prematunge

2.4 Survey on the usage of Methyl Bromide

Data on the usage of methyl bromide for eradication of nematodes in tea soils were collected from 58 tea estates during the course of the year, covering the areas in Deniyaya, Deraniyagala, Yatiyantota, Balangoda, Rakwana and Ratnapura.

D.D. Liyanage, P.K. Jayawickrama and A.K. Prematunge

2.5 *In vitro* culturing of nematodes (TRI, Mid-Country Station, Hantane)

A pure population of the burrowing nematode *Radopholus similis* was being maintained on carrot callus tissue, for use in experimental areas. Voltage fluctuations at the station were affecting the progress of cultures.

S.I. Vitarana, U.B. Herath, B. Sureshkumar and G.P. Udumulla

3.0 Project B/PECO - Pest ecology and management of pests with special reference to shot-hole borer and up-country live-wood termite

Project Leader –L.D. Amerasinghe

3.1 Studies on shot-hole borer of tea

3.1.1 Resistance of tea clones to the borer

E 224 -*Evaluation of the TRI 3000 and 4000 series of clones for shot-hole Borer*, Sooriyagoda Estate

Branch samples were taken for assessment of the shot-hole borer infestation, from Sooriyagoda Estate (TSHDA) to evaluate clonal resistance of some of the 3000 and 4000 series clones. Mean level of shot-hole borer infestation (n=4) in the basal 30 cm of the branch has been interpreted as an infestation rating as follows:

TABLE 7 - *Shot hole borer infestation on clones*

Infestation Rating of Clones

CLONE	SHB RATING
TRI 2025	2
TRI 3013	3
TRI 3014	2
TRI 3015	2
TRI 3018	2
TRI 3019	2
TRI 3020	2
TRI 4006	2
TRI 4042	3
TRI 4046	2
TRI 4047	2
TRI 4053	2

1= resistant; 2= moderately resistant; 3= susceptible; 4= very susceptible

The rating for clone TRI 2025 in this study is 2, which indicates moderate resistance and is contrary to its accepted rating for this clone. In order to avoid misinterpretation of the clonal character of the new clones, it was decided to assess the above clones from other locations, in due course.

K. Thirugnanasuntharan, L.D. Amerasinghe, L.S. Abeysinghe, U.B. Herath and P. D.P. de Silva

LVP 38 - *Screening of clones for SHB resistance*
Field No. 13,Watapotha Estate, Nivitigala

Assessment of SHB infestation in the new growth of the plants in the clonal trial LVP 38 of the Division of Plant Breeding commenced in April, at 8 months after prune. Five assessments were carried out during the year. Results are given in Table 8.

TABLE 8 - *Occurrence of galleries and the degree of infestation in standard unit samples*

Average of infestation from five assessments with two replicates

Clone	Average G%	Average of infestation (Live-stages per Std. Unit x $10^{2)}$
TRI 4053	2.0%	0
4055	0.8%	0
4059	10.4%	2.4
4047	1.6%	0.8
4056	1.6%	0
4054	1.6%	0.4
3020	1.2%	0
TRI 2023 (R)	1.6%	0
DG 39 (T)	2.0%	0.8
KEN 16/3 (S)	3.6%	0.8

It was observed that the overall infestation levels remained low as expected at the elevation of the particular estate. However, clone TRI 4059 was found to be more susceptible than KEN 16/3 which is known to be a highly susceptible clone. Clone 4053 is comparable to clone DG 39. The other clones, TRI 4055, 4047, 4056, 4054 and 3020, are as resistant as TRI 2023.

V. Shanmugarajah, S.I.Vitarana, R. St. E. Perera and A.K. Prematunga

3.1.2. Screening of insecticides against shot-hole borer

E 266- *Screening of Conventional Insecticides*, Field No. 17, First Division, Attampitia Estate, Ettampitia, 1994

Three post-treatment assessments of branch sampling for shot-hole borer infestation were carried out: the mean number of open galleries and mean population per 30 cm of primary branch (n=30) were recorded. Treatments included imidachloprid ("Admire 200SL") @500 (T1) and 750 (T2) ml per ha, quinalphos ("Ekalux 25EC) @ 1000 (T3) and 2000 ml (T4) per ha, and chlopyrifos @4500 (T5) and 1500 ml (T6) per ha. An untreated control (T7) was included for comparison. Results are given in Tables 9 and 10.

TABLE 9 - *Mean number of galleries per 30 cm of a primary branch (n= 30)*

Insecticide treatment	Months after pruning					
	23 Feb.	25 Apr. P2	28 July	27 Jan.	29 Mar. P1	32 June
TI	4.1	4.9	5.4	4.0	5.0	5.9
T2	4.2	4.5	5.3	3.7	4.8	5.4
T3	4.8	5.5	5.3	3.4	4.9	5.5
T4	4.0	4.6	5.4	3.5	3.9	5.0
T5	4.0	4.4	5.6	3.7	4.7	5.3
T6	4.0	4.2	5.3	4.1	4.3	5.2
T7	4.2	5.0	5.0	3.2	5.4	5.8
T8	4.4	5.0	5.0	4.0	5.5	5.3

LSD = NS; (P=0.05)

TABLE 10 - *Mean population per 30 cm of a primary branch (n =30)*

Insecticide treatment	Months after pruning					
	23 Feb.	25 Apr. P2	28 July	27 Jan.	29 Mar. P1	32 June
TI	6.0	5.6	4.5	6.2	3.8	2.3
T2	7.6	4.1	6.9	3.8	1.2	2.0
T3	8.5	5.1	4.2	3.1	1.6	2.3
T4	8.5	4.6	4.4	6.7	4.5	2.5
T5	6.8	4.0	7.0	4.7	3.8	2.3
T6	6.5	7.5	6.0	9.3	3.0	2.5
T7	4.3	5.6	4.1	5.6	3.0	3.3
T8	7.1	7.0	7.8	5.7	2.1	2.2

LSD = NS; (P=0.05)

P 1= Plots pruned in October 1995
P 2= Plots pruned in March 1996

Results were not statistically significant. Nevertheless, two treatments, quinalphos ("Ekalux") and chlopyrifos, were selected out for further screening, together with imidachloprid ("Admire") and pyrethroid formulations in 1999.

Experiment E 266 was terminated in October.

L. D. Amerasinghe, K. Thirugnanasuntharan,
A.R. Abeysekera and P.D.P. de Silva

E 275 - *Screening of Insecticides against shot-hole borer in young tea.* Field No.3, NP Div., New Peacock Estate, Pussellawa, 1995

Chemical treatments are the same as in E 266. Data will be analyzed at the first formative pruning in year 2000.

L.D. Amerasinghe, K. Thirugnanasuntharan, L.S. Abeysinghe, A.R. Abeysekera, D. Pallemulla, P.D.P. de Silva and B. Sureshkumar

3.1.3 *Screening of systemic fungicides to suppress the ambrosia fungus as an indirect method of controlling the borer.*

E 292- Screening of systemic fungicides to retard the growth of the ambrosia fungus as an indirect method of arresting the development of shot-hole borer brood. Clonal nursery (TRI 2025), TRI Mid-Country Station, Hantane, 1998

This experiment was reinstated at the glasshouse and application of treatments commenced in February. The experiment is in a Randomized Complete Block Design with 3 replicates and 8 nursery plants per replicate per treatment. The treatments were given at monthly intervals from February to May while the shot-hole borer beetles were artificially introduced (one female per plant) in March, April and May.

Observations on the number of galleries made, new brood development and adult formation were recorded after five months from the first application of treatments (four months after beetle introduction) by destructive sampling. The results are given in Table11.

There was no statistically significant difference between treatments and the untreated control in relation to the development of the progeny or in the case of gallery making. The experiment was terminated.

TABLE 11- *Mean number of galleries and live stages (immature stages and adults) developing in galleries*

Treatment No.	Mean No. of galleries		Mean No. of live stages (adult & immature)
1. Untreated control	6.6	ab	9.3
2. Folicur 0.5% (foliar spray)	8.3	ab	9.0
3. Folicur 0.5% (root drench	9.6	ab	3.3
4. Folicur 2.5% (foliar spray)	3.3	a	1.0
5. Folicur 2.5% (root drench	6.3	ab	3.3
6. Contaf 0.5% (foliar spray	6.6	ab	6.6
7. Contaf 0.5% (root drench	6.3	ab	6.0
8. Contaf 2.5% (foliar spray)	1 1.6	b	10.0
9. Contaf 2.5% (root drench)	6.3	ab	5.3
LSD (P=0.05)	6.77		11.8 NS

L.D. Amerasinghe, K. Thirugnanasuntharan, A. Balasooriya (Pathology Division), A.R. Abeysekera, D. Pallemulla, P.D.P. de Silva and B. Sureshkumar

3.1.4 Effect of time and types of pruning in reducing shot-hole borer

Three experiments E 283, (Field No. 7, First Division, Attampitia Estate, Ettampitia, 1996), E 284, (Field No. 1, Sirimedura Division, Kiruwanaganga Estate, Deniyaya, 1996) and E 285, (Field No. 6, NP Division, New Peacock Estate, Pussellawa, 1996) are in progress. The assessments continued from October onwards by taking the total number of open, occupied and healed galleries in 10 branches (basal 30 cm) per plot at monthly intervals. Results are given in Tables 12, 13 and 14.

TABLE 12 - *Occurrence of galleries according to the style of prune at Attempitiya Estate*

Mean number of open galleries per 10 branches (n=4)

Time of prune	Type of prune	Mean No. of open galleries Oct. '98	Nov.'98	LSD (P=0.05)
October '96	Rejuvenation	26.5	30.0	
	Normal	27.5	27.0	
	Cut across	34.8	33.3	N S
January '97	Rejuvenation	25.5	23.3	
Normal		30.5	26.0	
Cut across		34.5	29.3	NS
April '97	Rejuvenation	36.0	36.0	
	Normal	38.3	29.5	
	Cut across	23.0	26.8	NS

Treatments were not statistically significant. The experiment is in progress.

TABLE 13 - *Mean number of open galleries per 10 branches (n=4) at Kiruwanagange Estate*

Time of prune	Type of prune	Mean No. of open galleries Oct. '98	Nov.'98	LSD (P=0.05)
October '96	Rejuvenation	1.8	1.0	
	Normal	4.3	0.5	
	Cut across	1.5	0.3	2.74
April '97	Rejuvenation	3.6	0.8	
	Normal	3.5	0.5	
	Cut across	1.8	0.5	1.33

TABLE 14 - *Mean number of open galleries per 10 branches (n=4) at New Peacock Estate*

Time of prune	Type of prune	Mean No. of open galleries		LSD (P=0.05)
		Oct. '98	Nov.'98	
April '97	Rejuvenation	12.8	7.0	
	Normal	9.3	7.5	
Cut across		7.0	4.8	5.49
October '97	Rejuvenation	8.8	6.0	
	Normal	14.0	7.3	
	Cut across	10.8	14.3	NS
January '98	Rejuvenation	4.0	7.5	
	Normal	6.0	10.0	
Cut across		8.3	6.8	NS

The three experiments are in progress.

L.D. Amerasinghe, K. Thirugnanasuntharan, L.S. Abeysinghe, A.R. Abeysekera, U.B. Herath and P.D.P. de Silva

3.1.5 Use of bark volatiles of tea and other plants in a biochemical approach to manage the shot-hole borer beetle

a. E 293 - Study of host volatiles for mass trapping

St. Coombs Estate, Attampitia Estate and Hantane/NewPeacock Estate - (1996)

This experiment was relaid in shot-hole borer infested clonal tea fields (clone TRI 2025) in three locations. Five chemical compounds extracted out of the tea bark were tested for their efficacy attractants towards the borer, using sticky traps. The results obtained from October to December are presented in Table 15.

The results indicated that the three chemicals, linalool, methyl salicylate and phenyl acetaldehyde, are attractive to the adult shot-hole borer beetle. Among them, linalool was found to be more attractive than the other two. The experiment is in progress.

TABLE 15 - *Attractiveness of different volatiles towards SHB Mean No. of beetles attracted (n=10)*

Chemical compound	St. Coombs	Attampitia	Hantane / New Peacock	Total
Linalool	11	26	10	47
Methyl salicilate	13	13	7	33
Phenyl acetaldehyde	23	9	3	35
Geraniol	0	0	0	0
t-2 hexanol	0	0	0	0

L.D. Amarasinghe, I.S.B. Abeysinghe (Biochemistry Division), P.D.P. de Silva and M. Sivanesan (Undergraduate, University of Jaffna)

b. Effect of shade trees in tea lands as diversionary hosts to shot-hole borer

The three experiments, E286, E 287 and E288, were continued as observation block trials at three locations to represent three climatic regions.

E 286-Field No. 14, Second Division, Attampitia Estate, Ettampitia, 1996

Pre-treatment monthly assessments on shot-hole borer infestation were carried out taking 20 branches (30 cm) from each block over the period June 1997 to December 1998, prior to establishment of shade. The mean number of galleries per 30 cm of a primary branch (n=20) was found to be 7.4 in the non-shade area and 7.7 in the shaded area. These figures not were significant at P=0.05. This indicates that the selected field is heavily and uniformly infested between the two blocks. Experimental blocks were pruned in December. The study is in progress.

K. Thirugnanasuntharan, L.D. Amerasinghe, A.R. Abeysekera, and P.D.P. de Silva

E 287- Field No.1, Sirimedura Div., Kiruwanaganga Estate, Deniyaya, 1996

Post-treatment assessments commenced in August 1998 and will continue at monthly intervals. The experiment is in progress.

L.D. Amerasinghe, K. Thirugnanasuntharan, A.R. Abeysekera, and P.D.P. de Silva

E 288- Field No.6, NP Div., New Peacock Estate, Pussellawa, 1996

Post-treatment assessments on fresh leaf weight commenced in August 1998 and will continue at monthly intervals. The experiment is in progress.

L.D. Amerasinghe, L.S. Abeysinghe, U.B. Herath, P.D.P. de Silva and B. Sureshkumar

3.1.6 Effect of high potash fertilizer on shot-hole borer damage

E289- Effect of high potash fertilizer on shot-hole borer infestation and its damage in mature tea
Field No. 2A, 1st Div. Attampitia Estate, Ettampitia, (October 1997)

Assessments based on the performance of the plant growth and the shot-hole borer infestation commenced. It was observed that borer population has started to develop in clone TRI 2025 compared to the other two clones. However, the effect of the different levels of potassium fertilizer is not yet observed.

L.D. Amerasinghe, L.S.K.Hettiarachchi (Soils & Plant Nutrition Division) and A.R. Abeysekera

E 290- Effect of applying high levels of potash fertilizer in the nursery stage on the subsequent build up of shot-hole borer and its damage Nursery at TRI, Mid-Country Station, Hantane (1996)

Assessments based on the performance of the plant growth and the shot-hole borer infestation and on the branch breakage were carried out from October 1998 at monthly intervals. The effect of the levels of potash is yet to be seen in this experiment. The experiment is in progress.

L.D. Amerasinghe, K. Thirugnanasuntharan, L.S.K. Hettiarachchi (Soils & Plant Nutrition Division), A.R. Abeysekera, P.D.P.de Silva and L.S. Abeysinghe

3.1.7 Study of microbial insecticides to control shot-hole borer

E 294 - Effect of *Beauveria bassiana*, an entomo-pathogenic fungus, in reducing shot- hole borer infestation. TRI, Talawakelle (1996)

Studies on the use of *Beauveria bassiana* re-commenced. However, work had to be suspended due to the test material becoming non-viable and non-virulent. However, this experiment will be repeated in future.

L.D. Amerasinghe and A.R. Abeysekera

3.1.8 Economic Studies

E 258- Economics of shot-hole borer damage

A study was initiated to assess the economics of the shot-hole borer damage that causes causalities in young tea (of very susceptible clones) and the wood rot accumulation and yield loss in mature tea. For this purpose, Hapugastenne Estate, Maskeliya, Deniyaya Estate, Deniyaya and Ratwatte Estate, Matale, were selected to represent three main agro-climatic regions, viz. up, mid, and low-country. The study is in progress.

L.D. Amerasinghe

3.1.9 Population Modeling

Formulation of mathematical models to describe shot-hole borer populations for forecasting purposes TRI, Talawakelle (1998) St. Coombs

A preliminary study was conducted using data stored in the Division from past studies to prepare population models for the shot-hole borer of tea. Supplementary data needed to complete the study in relation to life-tables were identified.

W. Danthanarayana (University of New England, Australia) and L.D. Amarasinghe

3.2 Studies on the up-country live-wood termite, *Postelectrotermes militaris*

3.2.1 Studies on Clonal Resistance

E 271- Selection of clones for resistance to the up-county live-wood termite Moccha Estate, Maskeliya, 1995

The 20 lines selected out in Field No.05, Lower Division, were abandoned after the bioassays proved them all to be host material suitable to the termite. Field No.3 of Valamalay Division of Laxapana Estate was earmarked for future selections that would be made in January next year. The experiment is in progress.

L.D. Amerasinghe, A.R. Abeysekera and P.D.P. de Silva

3.2.2 Screening of insecticides against the up-country live wood termite

E 277- Screening of conventional insecticides
Field No. 10, Fairlawn Div., Fairlawn Estate and
Field No.1, Strathspey Div. Strathspey Estate (1998)

The following chemicals were tested on termites in uprooted tea bushes at the rates given below with an untreated control in a paired-plot trial.

"Regent" EC (fiprinol EC)	@ 1 litre/ha (0.08ml/bush)
"Regent" EC	@ 2 litre/ha (0.16ml/bush)
"Regent" 0.3% G (fiprinol)	@ 15 kg ai/ha (1.2g ai/bush)
"Regent 0.3% G.	@ 30kg ai/ha (2.4g ai/bush)
"Mospilan "20% w/w	@ 250g/ha (0.02 g/bush)
"Mospilan" 20% w/w	@ 500g/ha (0.04 g/bush)

Post-treatment assessments were carried out. None of the above treatments gave 100% eradication of the colony inmates at the end of the 6-month period of observation. Further experiments will commence with new insecticides, in due course.

L.D. Amerasinghe, A.R. Abeysekera and P.D.P. de Silva

4.0 PROJECT B/TERM - Pest ecology and productivity of tea lands in relation to the containment and management of the live-wood termites in the low- country

Project Leader-Sushila I Vitarana

4.1 Clonal Screening

Clonal resistance to the live-wood termites is being studied on replicated plot trials as well as in mother bush blocks established in the low-country.

LE 78– Screening of tea clones selected for resistance to low-country live-wood termites, from heavily infested tea
Field No. 4, Hathdaraganga Division (1998 NC)

Plants raised from the 37 mother bushes of selections were planted in a randomized block design, in two replicates. After-care operations were being supervised. The trial is in progress.

S.I.Vitarana, A.K. Prematunga, R. St E. Pererea and
D. Warusavitharana (Superintendent, Hapugastenna Estate)

LE 81– Hapugastenne Estate, UWK Division

Screening of 4000 series clones for resistance to L.C.L.W.T. commenced in a randomized block design with two replicates. The test clones include TRI 4036, 4004, 4089, 4003, 4019, 4046, 4088, 4053, 4052, 4020, 4015 and 4024, with TRI 2026 as the standard for comparison. The experiment is in progress.

S.I. Vitarana, R. St. E. Perera and A.K. Prematunge

4.2 Clonal selection for resistance to insect pests, inclusive of low-country live wood termites (LCLWT) and shot-hole borer (SHB)

LE 83– Field No. 5B, Maratenna Division, Balangoda Group

By November, 100 bushes were selected from old seedling bushes and 72 of the best were selected out for propagation in December. The main criteria used were good growth parameters, drought resistance and callusing properties. Clonal cuttings were established in the estate nursery at Maratenna Division. Generation of cuttings from a mother bush varied from 10 to 270. The experiment is in progress.

S.I. Vitarana, K. Munaweerahettie, R. St. E. Perera and A.K. Prematunge

LE 84- Millakanda Estate, Bulathsinghala

Selection work commenced in April 1997. Thirty-five bushes resistant to termites and having good bush character were selected. Mother bushes were pruned to propagate the clones for screening purposes. Cuttings were put out in the estate nursery in December.

S.I. Vitarana, R. St. E. Perera, A.K. Prematunge and
L.H.Fernanado (Director, Horana Plantations Ltd.)

4.3 Studies on biochemical basis of plant resistance to the low-country live- wood termites

LE 80b- Bio assaying of plant extracts for their kairomonal and allomonal activity

Clones TRI 2023 and 3063, known for their susceptibility to the termites, were extracted with different solvents, such as hexane, dichloromethane and methanol using different methods. Dichloromethane extracts exhibited the highest activity in attracting the alatae into the test channel. In view of this property, further analysis was carried out with this fraction. Extractions were made of clones known for their susceptibility/resistance using cold extraction method and simultaneous distillation and extraction methods. The extracts were bioassayed using olfactometers. Both crude volatile and non-volatile fractions were found to be active on the alatae (primary reproductives) of the termites. For each extract, 18 replicates were assayed. The relative attractancy was recorded. (Table 16)

TABLE 16 - *Attractiveness of the stem extracts*

Type of Clone	Test material and Clone	X^2 Value Cal	X^2 Critical Value	Attractiveness
Termite susceptible clone	Crude extract (Volatile+ non-volatile fractions) of TRI 2023	40.96	At 1%=6.635	** Highly attractive
(do)	Non-volatile fraction of TRI 2023	46.28	At 1%=6.635	** Highly attractive
Termite tolerent clone	TRI 2027	14.82	At 1%=6.635	** Attractive
Least susceptible to termite	TRI 2016	4.562	At 5% =3.84	*Poorly attractive

Vacuum liquid chromatography (VLC) method was employed as an improvement over the previous methods and the extracts were tested by bioassaying VLC extracts using olfactometers to identify the most biologically active fraction for further analysis. In each clone, 18 replicates were used. Bioassay results are given in Tables 17 and 18.

TABLE 17 - *Attractiveness of the TRI 2023 VLC Fractions to the alatae*

CLONE	VLC fraction No.	X^2 Value	Significance	Attractiveness
2023	1.	–	–	Discarded
	2.	3.85	N.S.	No
	3.	9.01	**	Yes(H)
	4.	1.846	N.S.	No
	5.	9.529	**	Yes(H)
	6.	2.723	N.S.	No
	7.	1.4152	N.S.	No
	8.	14.93	**	Yes(H)
	9.	6.516	*	Yes
	10.	14.82	**	Yes
	11.	3.160	N.S.	No
	12.	0.145	N.S.	No
	13.	5.158	*	Yes

TABLE 18 - *Attractiveness of the TRI 3063 VLC Fractions to the alatae*

CLONE	VLC fraction	X^2 Value	Significance	Attractiveness
3063	1.	0.0260	N.S.	No
	2.	0.0243	N.S.	No
	3.	0.609	N.S.	No
	4.	0.6163	N.S.	No
	5.	10.858	**	Yes(H)
	6.	4.11	*	Yes(H)
	7.	3.49	N.S.	No
	8.	22.131	**	Yes(H)
	9.	5.345	*	Yes
	10.	13.2	**	Yes(H)
	11.	0.05	N.S.	No
	12.	6.19	*	Yes
	13.	0.011	N.S.	No

NS – values not statistically significant
H – highly attractive

It was observed that the 8th, 9th and 10th VLC fractions of TRI 2023 could be combined as they gave similar compounds on TLC. MPLC method was employed for further purification and identification of active fractions.

It could be concluded that clone TRI 3063 is more attractive than clone TRI 2023. This is in keeping with the field observations on the behaviour of these two clones in termite active areas. This confirmed the correctness of the study techniques used for the biochemical screening of tea clones for their susceptibility to termites. It also provides a faster method of screening tea clones for termite resistance.

The study was in progress on identification of the active fractions, using the olfactometers as well as petri-dish couplets. The latter was employed for identification of moderately resistant and susceptible and immune clones. Other techniques employed in the study included flash chromatography.

S.M. Samarasinghe, I.S.B. Abeysinghe (Biochemistry Division), V. Kumar, (Chemistry Department, University of Peradeniya) and S.I.Vitarana

5.0 Project C/NEMA- Analytical Service for assessment of root feeding nematodes

Project Leader - Sushila I. Vitarana

Twentysix soil and 2 root samples from the estates and 144 soil samples for research purposes were checked for nematode infestation. Each analysis was followed by a report.

S.I. Vitarana, D.D. Liyanage, N. Navaratna, U.B. Herath, P. Udumulla and B. Sureshkumar and P.K. Jayawickrema

6.0 Project D/ENTO- Divisional Activities

Project Leader - Sushila I. Vitarana

6.1.2. Biological control of tea mites

a. Studies on classical biological control using exotic predators

Properly designed trials in relation to dosages, time of release, radius of activity and their residual activity were carried out since 1996.

E 272-Ladurdale Estate, Rakwana

Survival and activity of *Phytoseiulus persimilis* and *Amblyseius californicus* on *Olygonychus coffeae,* the Red Spider Mite of tea, was being studied. Monthly assessments were carried out. The introduced predators could be recovered in very small numbers indicating their survival in the field. There was no outbreak of the spider mite this year in the treated areas, whereas the untreated areas were attacked during the mite season, though for a short period. Observations will continue until heavy outbreaks of the pest occur.

S.I. Vitarana, A.K. Prematunge, R. St. E. Perera and H.D. Kumarasena,
Superintendent, Lauderdale -Deveronside Estates, Rakwana

E 273- Deveronside Estate, Ittakanda, Rakwana

Survival and activity of *Phytoseiulus persimilis* and *Amblyseius californicus* on *Olygonychus coffeae,* the Red Spider Mite of tea, was being studied. Observations were similar to the case of E 272. The study is continuing.

S.I. Vitarana, A.K. Prematunge, R. St. E. Perera and H.D. Kumerasena
(Superintendent, Lauderdale -Deveronside Estates, Rakwana)

b. Studies on Natural Biological Control

Hantane Estate, Kandy and Shawlands Estate, Passara (1996-1998)

Studies carried out in relation to natural biological control agents of tea mites included the following aspects:

i. Sampling techniques
ii. Effect of temperature on mite development – at controlled temperatures
iii. Influence of the environmental factors on mite development
iv. Dispersal and migratory habits of the mites
v. Survey for natural enemies
vi. Feeding activity of natural predators
vii. Occurrence of natural diseases on mites
viii. Inter-specific competition between different species of predators, and intra- specific competition within predatory species
ix. Evaluation of predation on mite pest populations

Data has been collected for analysis and will be presented in the form of a thesis for a post-graduate degree.

S.M. Nagahaulla and W. Danthanarayana
(University of New England, Australia)

6.2 Management of scavenging termites on tea lands

E 268- Screening of chemical termiticides to manage scavenging termites Field No. 10, Loolgama Division, Duckwari Estate

Monthly observations were made on reinfestation of the bushes by the return of scavenging termites after application of treatments in the second cycle. Data is given in Table 19.

TABLE 19 - *Total no. of bushes affected based on activity of scavengers*

Treatment	Data from January to December 1998					
	Whole bush damage		Fresh scavenger activity (runways)		Presence of live scavenging termites	
	R1	R2	R1	R2	R1	R2
T1	90	90	76	89	06	10
T2	71	24	71	21	05	21
T3	23	88	20	85	01	16
T4	116	49	117	66	18	12
T5	132	107	149	139	25	32

T1 = chlopyrifos @ 0. 1%
T2 = imidachloprid 0.05%
T3 = imidachloprid 0.03%
T4 = common salt 12.52 /l
T5 = Control

Blocks that received treatments T1, T2 and T3 continued to exhibit lower termite activity than the block that was treated with common salt and the untreated control block. The experiment is in progress and is scheduled to be completed during the current pruning cycle.

S.I.Vitarana, S.Yatawatte (Advisory Division) and L.S.Abeysinghe

Expt. ME – 4: Screening of chemical termiticides to manage the scavenging Termites Field No. 5C and Field No. 12 , Hagalle Estate

A new termiticide, fipronil ("Regent EC"), was compared with chlopyrifos MackfosEC") and imidachloprid ("Admire 200 SL") in a completely randomized block design. Monthly observations were made on the reinfestation of the bushes by scavenging termites after application of treatments in the first cycle. Data is given in Table 20.

TABLE 20 - *Total no. of bushes affected according to activity of scavengers*

Data recorded from January to December 1998

Treatment	Whole bush damage			Fresh scavenger activity			Presence of live scavengers		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
T1	53	27	39	38	31	46	02	03	00
T2	176	146	189	159	113	171	22	17	24
T3	112	62	138	92	51	140	06	01	10
T4	221	180	184	254	129	184	40	33	38

T1 = fipronil @ 200g / ha
T2 = chlopyrifos @ 2l / ha (0.1%)
T3 = imidachloprid @ 2l / ha (0.05%)
T4 = Control (untreated)

Fipronil consistantly gave lower scavenger activity compared to the untreated control as well as the other chemicals. The experiment is in progress.

S.I. Vitarana, S. Yatawatte (Advisory Division) and L.S. Abeysinghe

6.3 Management of soil dwelling ants
LE 85- Galdola, Waralla, Deniyaya

Plots were treated with Diazinon Flowable ("Knox out") at 4 dosages and with Carbary ('Sevin' 85% WP). Assessments commenced from 14th October 1998. The trial is in progress.

S.I. Vitarana, A.K. Prematunge, R. St. E. Perera and S. Jayasinghe (Advisory Division)

6.4 Miscellaneous studies

6.4.1 Formulating a composite method of characterizing tea clones in relation to their susceptibility to a pest, taking shot-hole borer as the example, TRI Low-Country Station, Ratnapura

A study was carried out to quantify the damage caused by the activity of the shot-hole borer of tea in relation to the difference in the susceptibility of clones to the borer. The objective was to formulate a composite method of characterizing the clones. The parameters studied were as follows:

1. Gallery percentage (G%) calculated as the percentage of galleried units in a sample of 25 standard units
2. Incidence of galleries in the branch samples (BG%) calculated as the percentage of galleried branches in a sample of 10 primary branch samples
3. Severity of infestation calculated as the galleries per unit length of wood x100
4. Density of different type of galleries (open, healed, other, occupied) in the samples

5. Average of live stages per sample
6. Branch breakage (BB) as a percentage of broken branches
7. Occurrence of wood rot, measured in terms of length of stem tissue in association with a gallery that had undergone decay (indicated by purple/ brown discolouration)

It was found that G% as described in TRI Advisory Circular I 3 is not sufficient to define the damage due to shot-hole borer. The other six parameters referred to in this study also proved insufficient for the purpose when taken independently. Some of them, if not all, need to be used in combination. Although hardness of wood was not measured through observations based on qualitative assessment of wood hardness, it has been noted that wood-rot originating with the borer attack is inversely proportional to hardness of wood. The exact correlation between the above parameters could not be elucidated by the end of the year. However, the following relationship could be deduced:

$$\text{SHB damage OC} \propto \frac{G\% \times WR \times BB}{\text{Hardness of wood}}$$

The study is in progress.

S.I. Vitarana and D.N.I. Dahanayake (Faculty of Agriculture, University of Peradeniya)

7.0 Advisory Circulars and other publications

The following Advisory Circulars were revised and submitted for editing:

Circular No I-1	-	The behaviour of termites on low grown tea
Circular No I-2	-	Management of live-wood termites in the low-country
Circular No I-3	-	Sampling a tea field for shot-hole borer infestation
Circular No N-1	-	Soil and root sampling for eelworm analysis for diagnostic purposes This circular is to replace the 2 earlier circulars, N1 and N8
Circular No.N- 3	-	Contamination of nursery plants with eelworm through irrigation water.

"Guidelines to tea growers for the Management of Shot-hole Borer" was issued in September.

8.0 Training Courses, Seminars, Field Days and Conferences

8.1 Seminars / Conferences

Mrs. S.I. Vitarana presented a paper titled "Effect of Exotic Predatory Mites on Tea Red Spider Mite" at the 196th meeting of the Experiments and Extension Forum in January.

Mrs. S.I. Vitarana addressed the participants of the Regional Scientific Committees on the subjects of "Management of Dry weather pests in the Low-country" and "Integrated Pest Management – Insect, Mite and Nematode Pests of tea in the Mid country" in October and November respectively.

8.2. Training Programmes

Mrs. S.I. Vitarana participated at the "Training Workshop on Monitoring and Management of Heavy Metals, Pesticides, PCBs, Dyes and Pigments" under the project "Chemical Research and Environmental Needs", 7th – 12th June in Islamabad, Pakistan. She presented the country paper for Sri Lanka at the workshop which was conducted by the Commonwealth Science Council, UK. Her scholarship was funded by the Commenwealth Secretariat.

Dr. L.D. Amarasinghe and Mrs. S.I. Vitarana conducted lectures and practical sessions for the Ninth Diploma in Plantation Management – Tea module.

Mrs. S.I. Vitarana supervised the dissertation of a trainee for the Eighth Diploma in Plantation Management – Tea module. She also supervised a project carried out in part fulfilment of the requirements for the B.Sc. degree of the Faculty of Agriculture, Peradeniya. (The project is reported under item 6.4.1. above)

PLANT PATHOLOGY DIVISION

Acting Head - A Balasuriya

1. General

Two NDT trainees, Ms H.W.Prabhakumari and Ms D.G.G.Janakie (Kuliyapitiya), completed their training in March.

Ms D Pallemulla was transferred to Hantana on a temporary basis with effect from 29th June.

Mr J Kalaichelvam, an undergraduate trainee from the Faculty of Agriculture, University of Jaffna, commenced work on his project work. One NDT trainee, Mr N Karunarathne, from the Hardy Institute, Ampara, who was assigned to the Division in September, moved out to Peradeniya shortly thereafter.

The staff position improved following the joining of Ms Pradeepa (Grade II) and Mr Jayasundara (Grade IV) in October and November, respectively. Mr A Balasuriya completed his PhD degree programme from the University of Peradeniya in October.

2. Project D/PLPA - *Divisional Activities*

2.1 Leaf Diseases - Blister Blight

2.1.1 P/BB1/98 - Testing of residue levels in made tea after spraying with Bumper fungicide, St.Coombs Estate, Talawakelle

Objective: The systemic fungicide Bumper (Propiconazole) was found to be effective in controlling Blister Blight in tea. However, prior to recommending a new systemic fungicide, it is necessary to test the residue levels in made tea when used at TRI recommended rates.

An area was marked out for the testing of residues. After spraying three rounds of fungicides (Bumper) at two concentrations, the samples from the experimental plots were processed, using the miniature manufacturing facility at the Technology Division. These were dispatched to the CISIR through Mackwoods Ltd., for the analysis of residues (Propiconazole).

2.1.2 P/BB2/98 - Effect of resting and blister blight control prior to pruning, on recovery - Collaborative study, Labookelle Estate, Nuwara-Eliya

Objective: To test the effect of TRI recommendation of resting of bushes for prior to pruning for the control of Blister Blight on the recovery of pruned bushes

A plot trial (about 750 bushes) with two replicates was selected. There were four treatments as follows:

1) Rested and sprayed for blister prior to pruning
3) Rested but not sprayed for blister prior to pruning
2) Not rested but sprayed for blister prior to pruning
4) Not rested and not sprayed for blister prior to pruning

The treatments were completed and the trial area was pruned in November. The tipping weights will be recorded during the first quarter of 1999.

A.Balasuriya, A.Ratnayake and N.K.Karunatillake

2.1.3 P/BB3/98 - Monitoring the use of NaCl for the control of Blister Blight disease; where does it retain, St.Coombs Estate, Talawakelle, Field 09- collaborative study with SPND

Objective: In a previous experiment (P/BB4/97), the ability of ordinary salt (NaCl) to control Blister Blight was identified. In this study, the efficacy of the NaCl used with time is being evaluated.

Two rates of NaCl (2.5 and 5.0%) were sprayed onto the flush and sampled taken at two hourly intervals (four rounds) to test the residues of Na in the flush. Both retention and absorption of Na were tested by analyzing them separately before and after washing.

TABLE 1 - *Percent Na absorbed by the flush (washed), at different intervals from initial spraying of NaCl*

Duration (hrs)	Control	2.5%	5.0%	Mean
2	0.053	0.113	0.143	0.103
4	0.037	0.113	0.190	0.112
6	0.050	0.110	0.173	0.111
8	0.040	0.170	0.213	0.141
Mean	0.045	0.125	0.180	

SE mean: Duration - 0.018; Treatments - 0.072
LSD (P=0.05) - 0.036; - 0.031
CV% = 31.67

TABLE 2 - *Percent Na, both absorbed and retained by the flush (not washed), at different intervals from initial spraying of NaCl*

Duration (hrs)	Control	2.5%	5.0%	Mean
2	0.043	0.203	0.577	0.274
4	0.046	0.197	0.493	0.246
6	0.037	0.167	0.313	0.172
8	0.037	0.147	0.220	0.134
Mean	0.041	0.178	0.401	

SE mean: Duration - 0.009; Treatments - 0.008
LSD (P=0.05) - 0.019; - 0.016
CV% = 9.18

This exercise was completed with the assistance from SPND. Some interesting trends were noted on the absorption and retention of Na. More Na was absorbed by the flush with time from the NaCl sprayed (Table 1). Similarly, more Na was lost from the flush, possibly due to translocation (Table 2). In order to confirm this

result, it was decided to repeat this trial using two parameters (two-hourly during the day and daily over four days).The results are pending.

A.Balasuriya, G.P.Gunaratne and N.K.Karunatillake

2.1.4 P/BB4/98 - Study of leaf surface micro-organisms in relation to their antagonistic and/or synergistic effects on the germinability of blister blight spores; *in vitro* study

Objective: To study the naturally-occurring microflora of the tea phylloplane and their influence on the performance of blister blight causing fungus, *Exobasidium vexans*

Mr J Kalaichelvam, an undergraduate trainee, isolated 9 different fungi and 10 different bacteria in association with the flush of four (two susceptible and two resistant to blister) tea clones.

All isolates were tested for their synergistic/antagonistic activity on germination and the extension of the germ tube of blister blight spores (*E. vexans*) on artificial culture media. All 10 bacterial isolates encouraged blister spore germination and the subsequent germ tube extension. Of the 9 fungal isolates, 4 promoted germ tube extension, 3 affected germ tube extension, 1 showed very good inhibition of blister spore germination while 1 fungal isolate totally inhibited spore germination during the test period of 36 hours (Table 3).

TABLE 3 - *Response of E. vexans spores to extracts of naturally occurring phylloplane fungal isolates, from different tea clones*

Fungal isolate/tea clone	Average germination %	Average germ tube length (m)
3L1 / TRI 3015	0	0
3L2 / TRI 3015	99.9	12.9
3L6 / TRI 3015	99.9	7.3
LD1 / DT1	13.0	2.4
LN4 / N2	99.9	3.7
LN1 / N2	99.9	4.7
LN2 / N2	99.9	13.7
LN8 / N2	99.9	3.3
L1 / TRI 2025	99.9	11.8
Control	99.9	5.0

A.Balasuriya and J.Kalaichelvam

2.2 Stem Diseases - Wood Rots

2.2.1 Hypoxylon Wood Rot

2.2.1.1 P/WRH4/96 - Observational experiment on training of bush frame, Nuwara Eliya Estate, Oliphant Division

Objective: To discourage any shoots arising at or near ground level of susceptible bushes, by periodic removal of them, when they are still tender. The aim is to

maintain a clearance from ground to the branching off point (neck effect), so that in the event of future infection by *Nemania diffusa*, the total infection could be removed from the bush through what is known as 'rejuvenation pruning' and still save the bush.

This trial was visited on 5 occasions during the year and the basal branch removals effected, when necessary.

A.Balasuriya, A.Ratnayake and N.K.Karunatillake

2.2.1.2 P/WRH1/98 - Use of naturally occurring microbial antagonists (fungi and bacteria) and systemic fungicides in the control of Hypoxylon wood rot and its causal organism, *invitro* study

Objective: To harness the ability of naturally occurring fungi in the control of *Nemania diffusa* and wood decay caused by the same organism in tea stem wood

From the natural infection sites of *Nemania diffusa,* a few potentially active biological control agents were isolated: *Aspergillus niger, Trichoderma viride, Penicillium* sp. and the bacterium *Bacillus* sp.

Invitro antagonism of *Penicillium* sp. and *T. viride* was very clear whether there was 1 or 4 introduced colonies. None of them allowed *N. diffusa* to start any visible growth. There was total inhibition by both the potential antagonists occupying the entire agar surface in a little less than 1 week.

A. niger behaved differently. When *A. niger* was introduced subsequent to *N. diffusa*, it did not totally inhibit the latter. But the rate of growth was found to be proportional to the number of introduced colonies of *A. niger* in one plate. However, by the 11th day, a single colony by itself did not have a big influence, apart from changing the shape of *N. diffusa* colony. Others while influencing the shape of *N. diffusa* colony to a greater extent reduced the rate of spread as well. Four colonies of *A. niger* completely blocked the expansion of *N. diffusa* by the 11th day. There was no overlapping growth at any of the stages (Table 4).

TABLE 4 - *Response of N. diffusa to A. niger grown on the PDA medium*

No. of *A.niger* colonies	Fungal colony diameter (cm)				
	7 days	8 days	9 days	10 days	11 days
1	3.78	4.28	4.80	5.43	5.80
2	3.65	3.95	4.15	4.15	4.25
3	2.98	3.10	3.15	3.25	3.18
4	2.87	2.90	2.93	2.95	2.98
Control	4.20	4.90	5.30	5.70	5.80

When the culture filtrates of *A. niger* were incorporated to the Potato Dextrose Agar (PDA) in the form of Czapek Dox Broth (CDB) and Malt Extract Broth (MEB), there was growth inhibition of *N. diffusa* in proportion to the concentrations tested. CDB culture filtrate incorporated medium did not support any visible *A.*

niger colonies while with the MEB culture filtrate incorporated medium, increasing number of micro-*A. niger* colonies were developed, the highest being at 30%. In the latter, *A. niger* growth was seen as discrete impregnated bodies, uniformly distributed throughout the medium. This last concentration did not allow any *N. diffusa* growth during two weeks of observation.

When the bacterium *Bacillus* was growing along the periphery of the plate *N. diffusa* continued its growth for some distance and then stopped any further extension about a distance of 1.5 cm away. When the bacterium was introduced in the wells, it soon grew over the medium and reached the *N. diffusa* inoculum to affect a total inhibition. In the experiment where the bacterium was incorporated into the PDA medium, a similar appearance to the test with MEB extract was experienced. The three initial concentrations gave uniformly distributed discrete bacterial colonies with an increasing density. All of them totally prevented the growth of *N. diffusa* on PDA even after one week.

2.2.1.3 P/WRH2/98 - Test of systemic fungicides in the control of *N. diffusa* and the naturally occurring biocontrol organisms, *invitro* study

Objective: To test the efficacy of some of the currently recommended systemic fungicides in the control of *N. diffusa* and of other biocontrol agents

Bitertanol (Baycor) and Cyproconazole (Atemi) did not inhibit the growth of *N. diffusa* at all three concentrations of the product tested (Table 5). Hexaconazole (Contaf-F) showed an ability to reduce radial growth with increasing concentrations. The other three fungicides, Propiconazole (Tilt), Tebuconazole (Folicur) and Tridemorph (Calixin), totally inhibited fungal growth at all concentrations; there was no change even after one month. Hexaconazole at 1500 ppm also did not allow any fungal growth at the end of one month.

TABLE 5 - *Response of N. diffusa to different systemic fungicides at varying concentrations of the product*

Fungicide	Linear growth, after 2 weeks (cm)		
	500 ppm	1000 ppm	1500 ppm
Bitertanol	4.7±0.23	5.3±0.19	5.3±0.15
Cyproconazole	5.0±0.43	4.8±0.38	4.5±0.12
Hexaconazole	3.8±0.25	0.6±0.85	0.0
Propiconazole	0.0	0.0	0.0
Tebuconazole	0.0	0.0	0.0
Tridemorph	0.0	0.0	0.0
Control	7.3±0.63	7.5±0.63	7.5±0.63

TABLE 6 - *Response of A. niger to different systemic fungicides at varying concentrations of the product*

Fungicide	Colony growth, after 1 week		
	500 ppm	1000 ppm	1500 ppm
Bitertanol	++	++	++
Cyproconazole	+++	++	++
Hexaconazole	+++	++	++
Propiconazole	++	++	+
Tebuconazole	–	–	–
Tridemorph	+++	+++	+++
Control	+++++*		

* +++++ scattered colony growth covering most of the surface (9 cm)
– zero growth

The fungicide Tebuconazole (Folicur) totally inhibited growth of *A. niger* at all concentrations tested. The other fungicides had some effect on the growth of the fungus. Cyproconazole and Hexaconazole showed higher reductions in growth with increasing concentrations. The least effect was shown by Tridemorph (Table 6).

Bitertanol, Cyproconazole and Hexaconazole did not affect radial growth of the fungus, *T. viride* very much, at all concentrations tested. Propiconazole had a mild effect while Tebuconazole and Tridemorph were capable of completely inhibiting the growth at increased concentrations (Table 7).

TABLE 7 - *Response of T. viride to different systemic fungicides at varying concentrations of the product*

Fungicide	Linear growth, after 1 week		
	500 ppm	1000 ppm	1500 ppm
Bitertanol	++++	++++	+++
Cyproconazole	+++++	+++++	+++++
Hexaconazole	+++++	++++	++++
Propiconazole	++	++	++
Tebuconazole	+	–	–
Tridemorph	++	–	–
Control	+++++*		

* +++++ maximum colony growth (radial) covering most of the surface (9 cm)
– zero growth

TABLE 8 - *Response of Penicillium sp. to different systemic fungicides at varying concentrations of the product*

Fungicide	Colony growth, after 1 week		
	500 ppm	1000 ppm	1500 ppm
Bitertanol	++	++	++
Cyproconazole	+++	+++	++
Hexaconazole	++	++	++
Propiconazole	–	–	–
Tebuconazole	–	–	–
Tridemorph	++	++	++
Control	+++++*		

* +++++ scattered colony growth covering most of the surface (9 cm)
– zero growth

The growth of *Penicillium* sp. was totally inhibited by Propiconazole and Tridemorph at all concentrations tested. The other fungicides, though found to be capable of reducing the activity of the fungus, did not completely inhibit its growth (Table 8).

These observations suggest the judicious use of systemic fungicides in the control of numerous fungal diseases if the maximum benefit is to be harnessed from naturally occurring fungal antagonists.

A.Balasuriya and K.Vijayalaxmi

Based on the above experimental evidence, the three potentially antagonistic fungi viz: *Aspergillus niger*, *Trichoderma viride* and a *Penicillium* species, were used on wood blocks, to test their ability in reducing the decay potential of wood by *Nemania diffusa, in vitro*. Miniature wood blocks of one susceptible and one resistant clone were used as the test samples. This study is in progress.

A.Balasuriya and P.Liyanage

2.3 SHB - Ambrosia Control Studies

2.3.1 P/AMB1/98 - Efficiency of systemic fungicides as an indirect measure of controlling SHB damage, Hantana Station

This is a repeat of the experiment carried out at the Passara station in 1997, with a few modifications. Treatments included two fungicides (Folicur and Contaf), at two concentrations (0.5 and 2.5%) applied by two methods (foliar and root-drench) plus a control. There are three replicates in each treatment. Altogether, 6 rounds of treatments were completed during the year. The Entomology Division undertook the introduction and assessment of SHB populations under different treatments.

No significant trends were found in the SHB populations with any of the treatments.

2.4 Macrophoma Canker

2.4.1 P/MC1/98 - Screening for *Macrophoma* canker, St. Joachim Estate, Ratnapura

Objective: To screen new tea clones for the tolerance/susceptibility to *Macrophoma* canker disease at an early stage in the process of releasing new clones

A new screening experiment was commenced using the Plant Breeding Division's LVP 74 (phase I) trial at St. Joachim Estate. Thirty lines were assessed with 7 bushes each. This will be completed in the coming year.

A.Balasuriya, D.Pallemulla and A.Ratnayake

2.5 Root Diseases - Poria

2.5.1 P/POR1/98 - Screening of new clones for the resistance/susceptibility of Poria root disease, St. Coombs Estate, Talawakelle.

Objective: To screen new tea clones for the tolerance/susceptibility to *Poria* root disease at an early stage in the process of releasing them by the Plant Breeding Division

For this purpose, newly constructed inoculation pits were filled with top soil and treated with nematicide. Poria inoculum was then introduced into all the 3 pits.

These pits were planted with 5 clones, namely, TRI 2025, 3057, 3072, 4052 and 4072, in August. In each pit, there were 5 clones replicated 5 times i.e. a total of 25 plants. The same combination was repeated 3 times to include a total of 75 plants. This is a continuing trial.

A.Balasuriya, A.Ratnayake and N.K.Karunatillake

2.6 Mycorrhiza

2.6.1 P/VAM1/98 - Multiplication of VAM spores *in vivo*, Glass House study

Objective: The advantages of VAM spores in the health of a given crop is multifaceted. By multiplying them in a suitable medium, they can be introduced into the planting hole at the time of planting tea, for added benefits.

Several attempts were made to grow VAM spores *in vitro* using filter paper and water agar medium enriched with micro-nutrients without success.

A pot experiment was commenced with soybean seeds in different potting media for the multiplication of Vesicular Arbuscular Mycorrhiza (VAM) spores, *in vivo*. VAM spores obtained from tea soils had already been introduced. The assessment of VAM counts is due in January 1999.

A.Balasuriya and A.Ratnayake

2.7 Miscellaneous

2.7.1 P/MISC1/98 - Selection of bushes with good callusing properties from old seedling teas (OST); Collaborative with Hapugastenne Estate, Ratnapura

Objective: To select seedling bushes with very good callusing properties that are considered to be tolerant to *Macrophoma* canker, a trait which could be used in breeding for resistance to this disease

About 20 seedling tea bushes were earmarked at Hapugastenne Estate for further evaluation. This will be assessed in the coming year.

A.Balasuriya, D.Pallemulla and A.Ratnayake

2.7.1 P/MISC2/98 - Microbial contamination of made tea (in collaboration with Technology Division)

Objective: To make an attempt to establish standards for microbial counts for the Sri Lankan black tea

Preliminary studies were undertaken aimed at establishing a protocol for the testing of made tea. The following were found to be acceptable:

Medium for extracting	-	Sterile Distilled Water
Duration of shaking	-	15 minutes
Incubation period	-	1 week
Concentration of medium	-	2×10^{-2} (g ml^{-1})

It was not immediately possible to distinguish between bacteria and yeasts. Steps are being taken to separate them.

Based on the above protocol at 5.75% moisture, the microbial counts were:

Aerobes and yeasts	-	1175 per g
Mould	-	175 per g

This is compared with the following standards for instant tea established by Unilever Ltd.:

Total Aerobes	-	3000 per gram
Total Mould	-	1000 per gram
E.coli Type I	-	absent

Based on the standards for instant teas by Unilever Ltd., at 5.75% moisture, the total aerobe and mould counts found in black tea (St. Coombs) can be considered to be very low. This will be confirmed with further experimentation.

A.Balasuriya and K.Jayasundara

2.7.2 Identification of Organisms

Ten isolates (6 fungal and 4 bacterial), collected during the last quarter of the year, were dispatched to the CABI Bioscience Centre in the UK for identification. These isloates comprised:

Fungal synergists/antagonist to blister blight	- 4
Bacterial synergists/antagonist to blister blight	- 2
Fungal contaminant in made tea (St. Coombs)	- 2
Bacterial isolate from High Forest Xylem sap	- 1
Fungal isolate from infected bark from Willie Gp.	- 1

A fungal isolate collected by Dr A Balasuriya in 1992 from Stonycliff Estate was found to be effective in parasitizing tea tortrix larvae of tea. On sending to CABI Bioscience of UK (IMI then), this was identified as *Paecilomyces fumosoroseus,* an entomopathogenic fungus, and preserved for their culture collection. However, a sample of it has recently been retrieved from the CABI Bioscience Centre and its efficacy has been tested on tortrix larvae with positive results.

An *in vitro* study was undertaken to test the effect of some commonly used systemic fungicides on this fungus. The results are given in Table 9. At the rates of systemic fungicides recommended by the TRI (in the control of blister blight), it is possible that this fungus, which was found to occur naturally, will not be badly affected. Moreover the fungicide, Tridemorph (Calixin), appeared to be the most favourable for *P. fumosoroseus*.

TABLE 9 - *Response of P. fumosoroseus to different systemic fungicides at varying concentrations of the product*

Fungicide	Colony growth, after 4 days		
	0.05%	0.1%	1%
Bitertanol	++	+	-
Tebuconazole	++	+	-
Tridemorph	++++	+++	-
Control	+++++*		

* +++++ scattered colony growth covering most of the surface (9 cm)
- zero growth

A.Balasuriya and P.Liyanage

2.7.3 Biological weed control

The incidence of *Ustilago digitariae* fungal infection on the weed, *Panicum repens,* was observed to be of seasonal occurrence. A plot of *P. repens* was marked out with the intention of maintaining an inoculum hot-spot under natural conditions.

2.8 Reports

Two forward programmes were prepared for the five-year period (1998-2002) with budget proposals one of which was to be funded by an increase in the tea cess allocation.

Seven reports were sent to estates on the diagnosis of problems following visits or after studying the diseased samples sent by the estates/Advisory Officers.

Two reports were prepared for the TRB and the National Science Foundation (NSF). The latter was a follow-up on the participation of Dr A Balasuriya at the ICPP98 in Edinburgh, UK, in August.

2.9 Routine Work

Micro-organisms from infected material (including different kinds of wood rots) received/brought at/to the Division and their sub-culturing were isolated in order to preserve any new organisms. These samples were sent/collected by/from Sommerset, Dunsinane, Gouravilla, Aislaby, Galaboda, Laxapana (*Botriodiplodia*) and Liddesdale Estates (Thorny Stem Blight and *Phomopsis* canker) and Talawakelle, Ratnapura, Passara and Deniyaya stations.

2.10 Estate Visits

The following estates were visited during the year by Dr A Balasuriya (Pathologist), on request:

Sommerset (violet root disease), Yuillefield (wood rot in 'Raja Maram'), Galaboda (die back problem in *Eucalyptus*), Frotoft (heavy leaf variegation), Mountjean and Loolkondera (*Poria* root disease), Laxapana (death of K 145 bushes) Estates and Aislabey Farm (bush debilitation)

Frotoft, Hapugastenne, Labookelle, Hulandawa, Ensalwatte and Lethenty Estates were also visited to meet and plan collaborative studies with the respective Superintendents. The visit further covered a smallholding in Ekneligoda, Kuruwita (death of TRI 2026 in poor soil conditions).

2.11 Other Visits

Two visits each were made to Hantane (in connection with SHB/IPM trial) and to Ratnapura (in connection with smallholder E&E and canker trial) and one visit each to Deniyaya (collaborative research) and Kottawa (third E&E for the smallholders).

2.12 Seminars/Workshops/Lectures

The Divisional staff participated at the 196th and 197th E&E Forums as well as the 1st, 2nd and 3rd meetings of the smallholders (Ratnapura, Gannoruwa and Walahanduwa), besides the RSC-I seminar and the workshops on Olfactometry and of the Soil Science Society of Sri Lanka conducted at Talawakelle. They also

attended a full day session on 'Training for Trainers', conducted by the NIPM, and a lecture discussion at Talawakelle by Dr D Keerithisinghe on the role of CARP.

Participation was extended to the workshops on acid rain monitoring (20-23rd April) and a mini-symposium on algal toxins (24th April) held in Kandy, as also a workshop on LIFE (Lanka International Forum on Environment and Sustainable Development) at Hotel Ceylon Intercontinental, Colombo (7-8th May).

Dr A Balasuriya presented a poster at the 7th International Congress of Plant Pathology from 9th - 16th August in Scotland, UK.

The following meetings or gatherings were attended /addressed by Dr A Balasuriya.

- RSC-Kandy seminar on integrated disease control.
- Discussions on the revision of 5-year cooperate plan budget.
- Lecture on tea diseases and their control for the 9th NIPM module.

2.13 Visitors/Trainees

The following personnel visited the Division during the year under review:

- Two Botany Special students from the University of Colombo, Ms U.N.Manage and Ms R.R.Weerasinghe
- Three trainee Asst. Superintendents to familiarise them with the Divisional work
- Mr Yoram Axelrod of Makhteshim, accompanied by Mr C P Wicramarathne of Mackwoods Ltd., to discuss about the fungicide, Bumper
- Mr M Surendra Mohan, Agricultural Advisor, Watawala Plantations Ltd., in connection with the use of Hexaconazole
- Two officers from the Agricultural Insurance Policy (Ministry of Agriculture) on a fact finding mission
- Two NDT trainees were examined on completion of their training in the Division.

PLANT PHYSIOLOGY DIVISION

Acting Head - A.Anandacoomaraswamy

1. Studies on Photosynthesis and Dry Matter Partitioning

1.1 Partitioning of assimilates in relation to ageing of clonal tea in a pruning cycle, St Coombs Estate - (1992)

The objective of this study is to estimate the amount of assimilates partitioned to the harvest during a pruning cycle. 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*
Years after pruning		
1	1274	1771
2	1478	1848
3	1566	1789
4	1103	928
SE	76.3	84.5
CV %	12.6	11.9
LSD(P=0.05)	235	260

The fourth year yield was only from January to October. The yield was relatively lower compared to previous years because of the dry weather experienced during the early part of the year and trade union action by the workers in May. More assimilates are partitioned towards the harvest during the 2nd and 3rd year of the pruning cycle.

V.Sithakaran

1.2 Effect of resting before pruning on root starch and recovery of clonal tea (TRI 2025), St Coombs Estate – (1998)

The aim of this investigation is to monitor the effect of resting before pruning on root starch and recovery after pruning.

The following treatments were tested in a RCBD design with four replications:

Continuous hard plucking till pruning
Resting for one month
Resting for two months
Fine plucking for one month before pruning
Fine plucking for two months before pruning
Pre-pluck records are being maintained.

D.M.S Navaratne

2.Tea Physiology and Potassium Nutrition

2.1. Effect of potassium on recovery from pruning, St Coombs Estate-(1993)

The objective of the experiment is to test the effect of applying fertilizer with varying N:K ratios at different times of pruning. There was no significant difference in yield between the time of fertilizer application and various N:K ratios.

This experiment was terminated.

V. Sithakaran

2.2. C^{14} studies

No studies were conducted under this project.

V. Shanmugarajah

3. Drought Mitigation

3.1.Drought mitigation in mature tea, (TRI 2025) - St CoombsEstate-(1995)

The objective of this experiment is to compare the effect of ' Green Miracle' (an antitranspirant) on the yield of mature tea plants. The yield is presented in Table 2.

TABLE 2 - *Yield (kg MT ha^{-1})*

Treatments	*Yield*
1. Control(Water spray)	4293
2. Green Miracle(1%)	4205
3. Green Miracle(1%) + Potassium chloride (1%) + Urea (2%)	3934
4. Potassium chloride (1%) + Urea (2%)	4238
SE	117
CV%	5.6

There was no significance difference between the treatments.

A.Anandacoomaraswamy and V.Sithakaran

3.2 Effect of foliar application of Sulphate of Potash, Murate of Potash and Kaolin on the yield of clonal tea, (TRI 2025) St Coombs Estate-(1998)

An experiment was initiated to compare the foliar application of different levels of potassium sulphate, potassium chloride and kaolin during dry weather on the yield of tea. Nine treatments were replicated four times. The yield for the period January – December is presented in Table 3.

TABLE 3 - *Yield of tea*

Treatments	*Yield (kg MT ha^{-1})*
Control	2050
Water spray	2288
2% Potassium sulphate	2277
2% Potassium chloride	2129
1% Potassium sulphate	2384
1% Potassium chloride	2452
5% Kaolin	2429
10% Kaolin	2125
Green Miracle	2254
SE	92.1
CV(%)	8.1

Potassium sulphate (1%), Potassium chloride (1%) and Kaolin (5%) gave significantly higher yields than the rest of the treatments. The results also suggest the beneficial effects of water spray.

A.Anandacoomaraswamy and V.Sithakaran

4. Effect of retention of Crow's Feet (Mudichchis) on yield of tea (TRI 2025)- St Coombs Estate-(1997)

The objective of the study is to ascertain whether the removal of Crow's feet enhances the yield. This experiment was repeated during the current year. Crow's feet were removed in November.

The yield obtained confirms the earlier findings that removal of Crow's feet does not improve yield.

A.Anandacoomaraswamy and V.Sithakaran

5. Modeling tea yield from weather data

Intensive weather measurements using automatic weather sensors continued at St Coombs Estate, Court Lodge Estate and Uva High Lands Estate. A tea model was built using MACROS at the Institute for Meteorology and Physics, University of Agricultural Sciences BOKU, Austria.

A. Anandacoomarasamy, Josef Eitzinger and D.M.S. Navaratne

PLANT PROPAGATION AND PLANT BREEDING DIVISION

Officer-in-Charge - V. Shanmugarajah

Project A/CLON - The development of new clones

The objective is to augment the list of clones available for planting by developing clones of yields higher than those attainable at present with greater adaptability.

Project Leader - V. Shanmugarajah

1. Polyclonal/ Biclonal seed

1.1 VP 64 - *Evaluation of polyclonal seeds from Urumiwela and Karandupona at Venture Estate, Norwood - (1992)*

Bushes were plucked by the estate and are due for pruning in 1999.

1.2 VP 65 - *Evaluation of polyclonal seeds from Urumiwela and Karandupona at Carolina Estate, Watawala - (1992)*

1.3 VP 66 – *Evaluation of polyclonal seeds from Urumiwela and Karandupona at Luckyland Estate, Udapussellawa - (1992)*

Bushes have been pruned.

1.4 VP 78 – *Evaluation of Biclonal / polyclonal seeds from El- Teb, Halpe and St.Coombs Estates in Field No.12, St. Coombs Estate, Talawakele – (1996)*

This was abandoned due to very high casualties.

V.Shanmugarajah, M.Ratnayake, S.W.Gunadasa and B.A.Rathnagoda

1.5 LVP 53 - *Evaluation of polyclonal seeds from Urumiwela and Karandupona at Hapugastenne Estate - (1991)*

Bushes were plucked by the estate.

1.6 LVP 6 9 - *Evaluation of polyclonal seeds from Karandupona seed gardens in Field No. 2A, St. Joachim Estate, Ratnapura - (1994) and Biclonal (DN x 2025) seeds from Hugoland seed garden in Field No. 2A, St. Joachim Estate, Ratnapura - (1994)*

Yields of the seedling progenies of different sources, planted separately in blocks, are given in Table 1.

TABLE 1 – *Yields of the seedling progenies (kg ha^{-1} yr^{-1})*

Parentage	*Yield*
K 2023 (polyclonal)	2861
K DG 39(polyclonal)	1969
K 2016 (polyclonal)	1787
2025 x DN	1628
K 2021 (polyclonal)	1737
K DN (polyclonal)	1312
K 2025 (polyclonal)	1319

A.K.M.Jayasena, J.H.N.Piyasundara and V.Shanmugarajah

1.7 VP 74 - *Evaluation of biclonal seed (DN x 2025) from El-Teb seed garden in Uva and polyclonal seed from Sapumalkande seed garden in Field No. 14, St.Coombs Estate, Talawakelle - (1995)*

Growth of the plants was monitored and these were given two cuts at 15 and 18 inches.

1.8 *TRI 3072 at Venture Estate, Norwood, and seeds received from abroad in Field No. 12, St. Coombs Estate, Talawakelle – (1998)*

Location:	(near Sports Club)
Field No.:	12
Number of seedlings:	100 (in 10 rows) – from Poonagala
	10 – raised from the seeds obtained from abroad
	25 – from TRI 3072
Control:	TRI 2025
Date of planting:	July 1998

V.Shanmugarajah, S.W.Gunadasa, M.Ratnayake, B.A.Rathnagoda and R.Paskarathevan

2. Controlled Hybridisation Experiments

2.1 Interspecific hybridisation

Interspecific crosses between *Camellia sasanqua* (seedlings) and diploids and triploids of *Camellia sinensis* were carried out. The details of the crosses made are given below:

Cross	*No. of flowers pollinated*
C. sasanqua x 2023	79
China jat x *C. sasanqua*	74
C. japonica x *C. sasanqua*	18
HS10 x *C. sasanqua*	20
C. sasanqua x DG 39	19

S.Umah and V.Shanmugarajah

2.2 *In vitro* germination of pollen

A reliable pollen viability assay would be useful, in many cases, to avoid inefficient pollen parents in the hybridisation programme. Furthermore, this assay could be used to assess the quality of the pollen in storage studies. Although it is more accurate to use *in vivo* test to assess the viability of pollen, those methods are time consuming. On the other hand, assessments based on pollen germination and pollen tube growth are rapid and provide results within a few hours.

Under this study, therefore, attempts are made to develop a suitable pollen germination medium and to use it for the evaluation of several pollen storage conditions in order to find the suitable conditions for short / long-term storage of tea pollen.

2.2.1 Development of culture medium for germination of pollen *in vitro* to provide an assay for pollen viability

With a view to assessing pollen quality / viability of different tea clones, studies were carried out to develop a suitable nutrient medium for *in vitro* germination of pollen. The effect of various media constituents such as sucrose, boron, calcium and their concentrations on pollen germination was investigated to obtain optimal response. Four clones, viz. TRI 777, TRI 2025, ASM 4/10 and DT 1, were initially used to test the effect of above constituents on pollen germination. Pollen was collected from excised mature anthers i.e. just before anther dehiscence. Pollen grains were suspended in a drop of liquid medium and cultured as hanging drops. The response of cultured pollen grains was assessed as percentage pollen germination after 2 hours of culture. Pollen counts were made in five randomly selected microscopic fields for each replicate. Each treatment consisted of 3 replicates and the experiment was repeated 3 times.

Among the different levels of sucrose tested, the highest germination percentage was observed with 10% sucrose in all the clones tested. This was markedly different from the germination observed in distilled water (Table 2). Below the optimum sucrose concentration (10%), there was a clear drop in germination percentage and at higher concentration, especially at 20%, a slight inhibitory effect was apparent. No clonal variation was found in relation to the trend observed in germination due to different sucrose concentrations.

TABLE 2 - *Effect of sucrose on pollen germination (%) of four clones*

Clone	Sucrose % (w/v)				Control (Distilled water)
	5	10	15	20	
TRI 777	34.67± 0.63	47.36± 1.00	24.85± 1.16	13.42± 0.79	30.86± 1.09
TRI 2025	27.09± 0.84	41.82± 1.20	23.07± 1.25	12.89± 0.67	25.34± 0.91
ASM 4/10	26.29± 1.08	36.9 ± 1.18	24.72± 1.5	14.45±1.32	22.67±1.22
DT1	25.44± 1.02	43.32±1.62	32.54± 0.85	15.17± 0.84	26.49± 1.17

Data are based on means ± standard error (S.E) of mean of 4 independent experiments each with 3 replicates per treatment.

Inclusion of boric acid, in the range of 2.5-100ppm, in 10% sucrose increased the germination remarkably. On the other hand, no difference in germination was found between control (i.e. 10% sucrose only) and highest boric acid concentration tested (250ppm) in combination with 10% sucrose. Among the concentrations tested, the optimum boric acid concentration was 5ppm, which gave the maximum pollen germination in all clones (Table 3).

TABLE 3 - *Effect of sucrose (10%) in combination with boric acid at different concentrations on pollen germination (%) of four clones*

Clone	Boric acid (ppm)					Control (10% sucrose)
	2.5	5	10	100	250	
TRI 777	74.00± 1.3	76.29± 0.96	72.58± 1.01	64.35± 1.33	47.06± 1.34	45.67 ±1.17
TRI 2025	56.37±0.89	67.80± 1.10	57.29± 2.46	44.49± 1.33	36.47± 1.01	40.24± 0.92
ASM 4/10	60.26±2.69	67.88 ±2.88	64.35± 1.49	50.56± 2.44	35.78± 1.95	39.13 ±1.86
DT1	64.13±3.31	74.13 ±2.98	69.77± 2.71	58.49± 1.81	48.59± 1.75	47.89± 2.5

Data are based on means ± standard error (S.E) of mean of 4 independent experiments each with 3 replicates per treatment

Addition of $CaCl_2$ to the optimum concentrations of sucrose and boric acid (10% and 5ppm respectively) further increased the ability of germination. The average germination percentage was 42 with 10% sucrose alone and when 5ppm boric acid was added to this, it increased up to 71%. It was possible to further increase germination up to 82% by incorporating 5ppm $CaCl_2$ to the culture medium containing optimum concentrations of sucrose and boric acid (Table 4). Although no adverse effect on germination was found when $CaCl_2$ was added at a concentration ranging from 2.5 – 50ppm, $CaCl_2$ at 100ppm had a strong inhibitory effect on germination. Furthermore, considerable differences in germination was found between the control (10% sucrose + 5ppm boric acid) and 100ppm $CaCl_2$, indicating the harmful effect on pollen germination at higher $CaCl_2$ levels.

TABLE 4 - *Effect of sucrose (10%) and boric acid (5ppm) in combination with $CaCl_2$ at different concentrations on pollen germination (%) of four clones*

Clone	$CaCl_2$ (ppm)					Control (10% sucrose + 5ppm boric acid)
	2.5	5	10	50	100	
TRI 777	80.69± 2.06	85.26± 1.71	76.92± 2.48	66.41± 2.26	51.29± 2.26	75.80± 2.05
TRI 2025	71.68± 2.69	78.20± 2.96	73.45± 2.51	58.50± 2.97	45.53± 2.21	66.06± 1.94
ASM 4/10	69.65± 0.65	82.47± 3.14	75.79± 2.37	60.47± 2.05	47.23± 2.11	67.08± 2.62
DT1	78.93±2.12	84.10± 2.06	77.13± 2.27	61.68± 3.06	48.33± 3.00	75.46±1.83

Data are based on means ± standard error (S.E) of mean of 4 independent experiments each with 3 replicates per treatment

K. Gunasekare and G. Tirukumaren
(Undergraduate student, University of Jaffna)

2.2.2 The effect of different constituents of the pollen germination medium on pollen tube growth

Effects of different medium constituents, viz., sucrose, boron and calcium, were studied to obtain maximum pollen tube length. The length of pollen tube was measured using a calibrated ocular micrometer. Fifteen to twenty pollen tubes from 3 randomly selected microscopic fields per treatment were used for scoring average pollen tube length after 4 hours of culture.

In all clones tested, pollen tube growth did not progress after 4 hours of culture, irrespective of the nutrient medium composition. Pollen from clone TRI 2025 showed least tube length as compared with clone TRI 777 which showed a considerable increase in tube length even with 10% sucrose alone. Incorporation of boric acid and $CaCl_2$, both at a concentration of 5ppm, to 10% sucrose enhanced the pollen tube length considerably. This was more than a two fold increase in all clones tested (Tables 5, 6 and 7). As with highest pollen germination, the maximum pollen tube length was also found when the medium was supplemented with 10% sucrose, 5ppm boric acid and 5ppm $CaCl_2$ (Table 7).

Therefore, based on both pollen germination and pollen tube length performance, the optimum nutrient medium should consist of 10% sucrose in combination with 5ppm boric acid and 5ppm $CaCl_2$. Using this medium, it was possible to obtain 78 – 85% germination with an average tube length ranging from 1980 – 2130 microns, depending on the clone.

TABLE 5 - *Effect of sucrose on pollen tube length (μ) of four clones*

Clone	Sucrose % (w/v)				Control (Distilled water)
	5	10	15	20	
TRI 777	605	837	485	307	580
TRI 2025	478	530	385	298	415
ASM 4/10	503	575	463	320	485
DT1	540	615	518	370	525

Data are based on average pollen tube length of 15-20 pollen tubes selected randomly from 3 microscopic fields.

TABLE 6 - *Effect of sucrose (10%) in combination with boric acid at different concentrations on pollen tube length (μ) of 4 clones*

Clone	Boric acid (ppm)					Control (10% sucrose)
	2.5	5	10	100	250	
TRI 777	1250	1518	1428	843	653	758
TRI 2025	955	1258	953	665	490	498
ASM 4/10	1240	1453	1285	600	495	585
DT1	1140	1458	1408	603	480	648

Data are based on average pollen tube length of 15-20 pollen tubes selected randomly from 3 microscopic fields.

TABLE 7 - *Effect of sucrose (10%) and boric acid (5ppm) in combination with $CaCl_2$ at different concentrations on pollen tube length (μ) of four clones*

Clone	$CaCl_2$ (ppm)					Control (10% sucrose + 5ppm boric acid)
	2.5	5	10	50	100	
TRI 777	1855	2135	1825	1595	1298	1420
TRI 2025	1500	1988	1818	1120	920	1165
ASM 4/10	1738	2060	1920	1393	915	1330
DT1	1770	2070	1923	1443	1052	1443

Data are based on average pollen tube length of 15-20 pollen tubes selected randomly from 3 microscopic fields.

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2.3 Development of conditions suitable for storage of pollen

Satisfactory methods for storage of tea pollen for extended periods would enable the use of pollen for crosses in parents showing non-synchronous flowering pattern. Further, this would avoid the necessity of daily collection of pollen for hybridisation programme and ensures the availability of pollen throughout the year. With the development of medium for pollen germination (Experiment 2.2) to assess pollen viability *in vitro*, it now becomes possible to study the effects of storage conditions on pollen quality.

2.3.1 Development of conditions suitable for short to medium term pollen storage

2.3.1.1.Effects of temperature and relative humidity (RH) on viability of stored pollen

Pollen collected from mature anthers were stored under different environmental conditions, especially under low temperature and low humidity. Pollen samples

were kept in small glass vials and plugged with non-absorbent cotton wool. These vials were then placed in enclosed air-tight chambers containing a suitable desiccating substance or appropriate salts to obtain desired RH (see Table 8). Each of these containers having same RH group was kept at 3 different temperatures; at room temperature (ca. 20°C), in refrigerator (ca. 5 °C) and in freezer (ca. -10°C). Pollen samples were stored in multiple sets i.e. each set comprising sufficient pollen for use once for viability test using the method developed in experiment 2.2.1.

TABLE 8 - RH conditions obtained with different salts

Substance	Approximate RH (%) achieved
$CaCl_2$	0.00
$CaCl_2.2H_2O$	20.0
$MgCl_2.7H_2O$	40.0
NH_4Cl	80.0

Viability (as assessed by *in vitro* germination test) of pollen (clone DT1) stored at different temperature regimes and RH conditions are given in Table 9. Viability of the stored pollen is being assessed periodically (10 day intervals) from storage. This experiment is in progress.

TABLE 9 - *Effect of temperature and relative humidity (RH) on pollen germination (%) at different time intervals after storage*

Temperature (°C)	RH (%)	Time interval (days)				Before Storage
Room temperature		10	20	30	40	
	0	62.14	52.34	41.24	25.34	
	20	58.42	45.63	39.36	21.42	
	40	38.64	20.52	18.43	8.43	76.29
	80	11.23	5.23	1.23	0.00	
Refrigerator						
	0	76.11	65.42	60.60	59.34	
	20	67.22	59.42	59.40	57.84	
	40	64.42	51.01	41.82	40.12	
	80	46.41	17.24	13.14	5.32	
Freezer						
	0	70.24	54.23	38.42	23.64	
	20	64.56	48.42	32.44	26.24	
	40	51.21	22.46	10.52	5.24	
	80	21.43	3.24	1.11	NT*	

Data are based on means of 3 replicates per treatment in a single experiment

* NT – not tested.

K.Gunasekare and G. Tirukumaren
(Undergraduate student, University of Jaffna)

2.3.2 Long-term storage of pollen

In order to develop a method for storage of pollen for longer period than the storage conditions developed in Experiment 2.3.1, without any appreciable loss of viability, freeze drying of pollen samples before storage was attempted. Bulk samples of pollen collected from excised mature anthers of clones TRI 777, TRI 1114, TRI 2043 and TRI 2142 were subjected to freeze drying, either directly or by exposing them to different pre-treatments prior to freeze drying.

Pre-treatments:

1. Air drying for 6 hrs
2. Placed in a desiccator over dry silica at room temperature for 6 hrs
3. Placed in a desiccator over dry silica at 5^0C for 6 hrs
4. Placed in a desiccator over dry silica at -10^0C for 6 hrs

Pollen samples were frozen at -48^0C and lyophilised under vacuum at 250 x 10^3 m bar for 8 hours in a freeze drier. Glass vials containing freeze-dried pollen were placed in lidded bottles and covered with parafilm to prevent absorption of water. These bottles were kept at room temperature.

2.3.2.1. Testing of viability of stored pollen *in vitro*

The viability of the stored pollen need to be monitored periodically (monthly intervals) on the basis of their germination percentage by culturing stored pollen on the optimised culture medium developed in experiment 2.2.1. This study is in progress. In addition, different freeze drying conditions (temperature and vacuum) will be tested to improve the viability of the pollen.

2.3.2.2. Testing of fertility of stored pollen *in vivo*

Pollen fertility is the ability of pollen to effect fertilisation and subsequent development of fruit and seeds. Therefore, freeze dried pollen will be used to make crosses in controlled hybridisation programmes in the next season, when sufficient flowers are available, in order to asses the fertility of freeze dried pollen, *in vivo*.

K. Gunasekare

3. Development of clones for the up-country

Objective: Development of high yielding clones for the up-country, preferably with high quality and having resistance to shot-hole borer (SHB), stem canker (*Phomopsis*), blister blight (BB), up country live wood termite (ULWT) and *Poria*.

3.1 Up-country – Clonal Evaluation Trials - Phase I

3.1.1 VP (VP 65/UC/I) - *Evaluation of selections from Urumiwela and Karandupona polyclonal seeds at Carolina Estate, Watawala (1992) in Field No.12, St.Coombs Estate, Talawakelle – (1998)*

Date of Planting:	July 1998
Location:	Field No. 12
Number of selections:	130
Number of plants per selection:	7
Control:	TRI 2025
No. of replicates:	2

One application of fertilizer was given.

3.1.2 Source : VP 37 – Evaluation of seedlings obtained by open pollination of clones TRI 777, TRI 2025, DT 1and TRI 2043

3.1.2.1 VP 60 (VP 37/UC/I) - Evaluation of clones from VP 37, Field No. 10, St. Coombs – (1992)

Cuttings of promising selections have been propagated in the nursery for Phase II trial.

3.1.2.2 VP 63 (VP 37/UC-1/NOR/I) - *Evaluation of clones developed from VP 37 and from Aislaby seed. Venture Estate, Norwood - (1992)*

Cuttings of the selections have been propagated in the nursery.

3.1.3 VP 38: - Evaluation of seedlings raised from seeds from seed garden at Aislaby, Hugoland and Hantane Estates

Sources of seeds are given below:

Hugoland	- 2024 * 2025
Hugoland	- 2025 * 2024
Hantane	- 2023 * DG 39
Hantane	- 2025 * DG 39
Aislaby	- open pollinated

3.1.3.1 VP 55 and VP 56 (VP 38/UC/I) - *Evaluation of clonal selections from Aislaby, Hugoland and Hantane seed (VP 38). Field No.9, St. Coombs Estate, Talawakelle -(1991)*

Refer under Phase II.

3.1.4 Source : VP 47 – Evaluation of introduced seeds brought from India and variety "Yabukita" raised from seed brought from Japan.

3.1.4.1 VP 61 (ASM.INT.88/UC.1/I)- *Evaluation of clones from ASM 1988 Introduced Seed. Field No. 10. St. Coombs Estate, Talawakelle - (1992)*

Cuttings of promising selections have been propagated in the nursery.

3.1.4.2 VP 69 (ASM.INT.88/UC.2/I) - *Evaluation of clones developed from ASM 1988 introduction seed in Field No.10 St.Coombs Estate, Talawakelle – (1993)*

None of the selections was statistically significant in yield to the control TRI 2025. However, clone 14D yielded 11.6% higher than 2025 (Table 10).

TABLE 10 - *Yield of selections (kg MT ha^{-1} an^{-1})*

Clone	Yield
14D	1478.9
2025 (control)	1324.8
23D	1318.6
34D	1235.1
30D	1198.1
25D	1153.2
18D	1142.6
16D	1082.0
5D	962.2
LSD (P=0.05)	355.56
CV %	30.3

3.1.5 Source : VP 39 – Evaluation of seedlings obtained from the crosses of 1980/1981

3.1.5.1 VP 67 (VP 39/UC 1/I) - *Evaluation of clones from VP 39 in Field No. 10, St.Coombs Estate, Talawakelle - (1993)*

None of the clones yielded significantly higher than the control TRI 2025. However, their yields are 0.15 - 36% higher than that of the control (Table 11).

TABE 11 - *Cycle yield 1996-98 (kg MT ha^{-1} an^{-1})*

Selection No.	Yield
295	1778
265	1660
288	1607
316	1584
279	1581
332	1576
322	1487
318	1479
254	1476
28	1464
267	1445

20	1438
268	1361
278	1359
296	1330
191	1326
292	1310
130	1309
281	1309
2025 (control)	1307
LSD	683.8
CV %	35.1

3.1.5.2 VP 70 (VP 39/UC - NOR/I)- *Evaluation of clones from VP 39 in Venture Estate, Norwood - (1993)*

Plucking was discontinued as there were no promising selections.

3.1.5.3 VP 71 (VP 39/UC 2/I) - *Evaluation of clones from VP 39 in Field No.14, St.Coombs Estate, Talawakelle - (1994)*

Clones 244 and 38 yielded significantly higher than the control TRI 2023. They yielded 25.6 and 5.6% respectively higher than that of 2025 (Table 12).

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

Selection No.	Yield
244	1821
38	1532
251	1469
2025 (control)	1450
31	1394
139	1372
2027 (control)	1360
150	1359
39	1349
267	1337
299	1279
26	1270
333	1205
218	1210
112	1203
149	1193
238	1173
245	1173
262	1149

216	1158
258	1153
342	1121
105	1106
346	1097
41	1088
144	1068
474	1055
237	1041
222	1036
2023 (control)	1019
LSD (P=0.05)	455.2
CV %	24.3

3.1.6. Source : VP 43 - Evaluation of seedlings obtained from the crosses of 1982/1983

3.1.6.1 VP 72 (VP 43/UC/I) - *Evaluation of clones from VP 43 in Field No. 14, St.Coombs Estate, Talawakelle - (1994)*

Clones 814, 613 and 700 yielded significantly higher than the control TRI 2025. However, all the 23 clones have yielded 3.0 - 62.5% higher more the control (Table 13).

TABLE 13 – *Yield of selections (kg MT ha^{-1} an^{-1})*

Selection No.	Yield
814	1823
613	1768
700	1643
558	1588
571	1560
624	1534
626	1493
598	1462
699	1331
570	1299
568	1276
743	1259
735	1265
581	1265
840	1232
708	1222
561	1201
757	1200

813	1190
710	1190
586	1185
504	1165
685	1156
2025 (control)	1122
LSD (P=0.05)	484.3
CV %	27.7

3.1.7 Source : VP 44 - Evaluation of seedlings obtained from the crosses of 1984

3.1.7.1 VP 73 (VP 44/UC/I) - *Evaluation of clones from VP 44 in Field No.14, St.Coombs Estate, Talawakelle - (1994)*

Clones 1034, 963 and 1035 yielded significantly higher than the control TRI 2023. However, all the 20 clones have yielded 0.8 - 60.1% more than the control 2023 (Table 14).

TABLE 14 – *Yield of selections (kg MT ha^{-1} an^{-1})*

Selection No.	Yield
1034	1888
963	1873
1035	1762
956	1658
909	1617
982	1528
935	1390
950	1389
906	1360
968	1360
2027 (control)	1348
930	1325
932	1315
993	1278
971	1263
948	1260
1056	1257
955	1262
926	1267
964	1241
1008	1189
2023 (control)	1179
LSD (P=0.05)	522.16
CV %	25.5

3.1.8 Source : VP 45 - Evaluation of seedlings from the crosses and selfs of 1985/1986

3.1.8.1 VP 75 (VP 45/UC/I) – *Evluation of clones from VP 45 in Field No. 14, St. Coombs Estate, Talawakelle – (1995)*

Bushes were given a cut at 18".

3.1.9 Source : VP 52 - Evaluation of polyclonal seed from the seed gardens at Karandupona and Urumiwella
(For more information, see Ann. Rep 1990, page 95)

3.1.9.1 VP 76 (VP 52/UC/I) – Evaluation of clonal selections from polyclonal seed from the seed gardens at Karandupona and Urumiwella (VP 52) in *Field No.14, St. Coombs Estate, Talawakelle – (1995)*

Bushes were given a cut at 18".

3.1.10 Source : VP 58 - Evaluation of polyclonal seed from the seed gardens at Karandupona and Urumiwella

3.1.10.1 VP 77 (VP58/UC/I) – *Evaluation of clones from polyclonal seed from the seed gardens at Karandupona and Urumiwella (VP 58) in Field No. 12, St. Coombs Estate, Talawakelle – (1996)*

Bushes were given a cut at 18".

3.1.10.2 VP 79 (LVP 49/UC/I) - *Evaluation of clones from polyclonal seed from the seed gardens at Karandupona and Urumiwella (LVP 49) in Field No.12, St. Coombs Estate, Talawakelle – (1996)*

Bushes were given a cut at 18".

3.2 Up country – Clonal Evaluation Trials - Phase II

3.2.1 VP 41 and VP 42 - *Testing 60 clones at St. Coombs Estate, Talawakelle - (1984)* Shoots harvested from these plots were issued to estates and smallholders for establishing 4000 series multiplication plots.

3.2.2 VP 62 - *Testing ten 4000 series clones at St. Coombs Estate, Talawakelle* Plots are being used as mother bushes.

3.2.3 Source : VP 37 – Evaluation of seedlings obtained by open pollination of clones TRI 777, TRI 2025, DT 1and TRI 2043

3.2.3.1 VP 80 (VP 37/UC/II) - *Evaluation of clones from VP 37, Lamiliere Division, St. Coombs Estate in Field No. 12, St. Coombs Estate, Talawakelle – (1996)*

The plants were centered at 18".

3.2.4 Source: VP 55 and VP 56 (VP 38/UC/I) - Evaluation of clonal selections from Aislaby, Hugoland and Hantane seed (VP 38). Field No.9, St. Coombs Estate, Talawakelle -(1991)

3.2.4.1 VP (VP 38/UC/II) – *Testing 30 selections from VP 55 and VP 56 in Field No. 12, St. Coombs Estate, Talawakelle – (1998)*

Date of planting:	July 1998
Location:	Field No.12
Number of selections:	30
Plot size:	24 plants
Replicates:	2

V.Shanmugarajah, M.Ratnayake, S.W.Gunadasa, R.Paskarathevan and B.A.Rathnagoda

3.3 Up-country - Clonal Evaluation Trials - Phase III

3.3.1 VP 50 - *St. Coombs Estate, Lamiliere Division - (1990)*

Shoots harvested from these plots were issued to estates and smallholdings.

S.W.Gunadasa, V.Shanmugarajah and B.A.Rathnagoda

3.3.2 *Stockholm Estate, Nissanka Uyana - (1991)*

The bushes were pruned, weight of prunings taken and plucking commenced again in June, for the second cycle.

Of the 10 clones evaluated, six clones TRI 3020, 3016, 3015, 3019, 3013 and 3018 yielded 7 - 50% more than the control TRI 2025, the highest yielder being 3020 (Table 15).

TABLE 15 - *Yield of clones (Kg MT ha^{-1} an^{-1})*

Clone	Yield
3020	4201
3016	3627
3015	3606
3019	3548
3013	3305
3018	3001

2025	2806
3048	2715
3069	2536
3017	2190
3014	2585
SE	448
CV %	21.37

3.3.3 *Gordon Estate, Udapussellawa - (1991)*

The bushes were pruned and weight of prunings taken. The estate obtained shoots from these bushes for propagation.

3.3.4 VP 59 - *St. Coombs Estate, Field No. 10 - (1992)*

Bushes were pruned and are to be used as mother bushes.

3.3.5 *Venture Estate, Norwood. Field No. 6A - (1993)*

All the six clones evaluated have yielded 2.3 - 157% higher than the control TRI 2025, the highest yielder being 4071 (Table 16).

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

Clone	Yield
4071	3241
3072	3050
3016	2370
4063	1898
3073	1650
3019	1288
2025 (Control)	1259

3.3.6 *Sheen Group, Pundaluoya. Field No.3 NC 5A -(1992)*

The bushes were pruned and weight of prunings taken. The estate obtained shoots from these bushes for propagation.

S.W.Gunadasa, R.Paskarathevan B.A.Rathnagoda,
M.Ratnayake and V.Shanmugarajah

4. Development of Clones for the Mid-country wet zone

Objective: Development of high yielding clones for the mid-country wet zone having resistance to shot-hole borer (SHB) and blister blight (BB)

Note: There are no Phase I and Phase II trials in the mid-country wet zone.

4.1 Mid-country wet zone – Clonal Evaluation Trials- Phase III

4.1.1. *Hantane Estate - (1991)*

4.1.2 *Smallholdings in Ukuwela, Danture, Teldeniya, Dodanwela and TSHDA nursery, Muruthalawa.*

Of the 11 clones evaluated, 10 yielded significantly higher than the control clone DG 39. TRI 4046, 3018, 3013 and 4006 have yielded 0.4 - 44.4% more than the control TRI 2025, the highest yielder being 4046 Table 17).

TABLE 17 – *Yield of clones (kg MT ha^{-1} an^{-1}), Muruthalawa*

Clone	Yield
4046	4478
3018	3493
3013	3347
4006	3115
2025 (control)	3102
3015	3086
4042	3048
3014	2956
3019	2952
4053	2834
3020	2775
4047	2137
DG39 (control)	1894
LSD (P=0.05)	794
CV %	18.6

S.Umah, H.M.S.S.K.Herath TSHDA, Muruthalawa and V.Shanmugarajah

4.1.3 *Hantane Station , Field No. 3 – (1996)*

Bushes were brought into plucking in August and 22 plucks were done till the end of December. Yield and other observations are given in Table 18.

TABLE 18 - Yield of clones, No. of active and banji shoots in 50 g flush and weight of randomly selected active shoots during the 22 plucks

Clone	*Yield (kg MT ha^{-1} an^{-1})*	*No. of shoots in 50 g sample*		*Weight (g) of five active shoots*
		Active	Banji	
3019	1292	29.36	21.09	5.67
3069	751	17.50	17.91	8.28
4006	2802	22.64	15.00	6.53
4046	1472	21.86	23.14	6.13
4049	1891	28.23	16.45	6.25
4053	1008	27.18	18.23	6.50

4070	949	28.45	17.59	6.21
4071	1376	25.41	17.41	5.88
4078	1130	27.23	19.45	5.19

Umah Sritharan, V.Shanmugarajah and P.B. Ekanayake

5. Development of clones for Uva

Objective: Development of high yielding clones for the mid-country semi-dry zone (Uva) with high quality and having resistance to drought (DRO), shot-hole borer (SHB) and blister blight (BB)

5.1 Uva – Clonal Evaluation Trials - Phase I

5.1.1 UVP 8 – *Evaluation of clones from ASM 1988 Introduction seed from St. Coombs Estate, at TRI Uva station, Passara – (1993)*

5.1.2 UVP 10 (VP 65/UVA/1) - *Evaluation of clones from VP 65 in Field No.4, TRI Uva Station, Passara - (1998)*

Location:	TRI station, Passara
Field No.:	4
Date of planting:	12.11.1998
No. of selections:	37
No. of plants per selection:	7
Reps:	2
Control clones:	TRI 2025, 4078, 4052, 3016

5.2 Uva - Clonal EvaluaionTrials - Phase II

5.2.1 UVP 7 - *Testing 38 clones at TRI Uva station, Passara (Pelagahatenne)*
Shoots harvested from these plots were issued to estates and smallholdings for establishing 4000 series multiplication plots.

M.B.A. Perera and V.Shanmugarajah

5.2.2 UVP 9 (VP 37/UVP/II)

Location:	TRI station, Passara
Field No.:	4
Date of planting:	12.11.1998
No. of selections:	21
No. of plants per selection:	25
Reps:	2
Control clones:	TRI 2025, 4078, 4052, 3016

V.Shanmugarajah, M.Ratnayake, S.W.Gunadasa,
M.B.A.Perera, R.Paskarathevan and B.A.Rathnagoda

5.3 Uva – Phase III Trials

5.3.1 *Verellapatana Estate - Doomo Division - 1988*

The bushes have been pruned and plucked by the estate.

5.3.2 *Smallholdings in Bandarawela, Hali-ela and Boralanda - (1992)*

5.3.3 *TSHDA - Hali-Ela - (1992)*

Bushes are being plucked by the TSHDA.

M.Ratnayake, S.W.Gunadasa and B.A.Rathnaagoda

6. Development of clones for the low-country

Objective: Development of high yielding clones for the low-country, preferably with dark green leaves and having resistance to drought (DRO), low-country live wood termite (LLWT), stem canker (Macrophoma) (CAN) and amenable to mechanical harvesting

6.1 Low-country – Clonal Evaluation Trials - Phase I

6.1.1 LVP 61 (LVP42/LC/I)- *Evaluation of clones from polyclonal seed established on Parambe (LVP 42), in Field No. 2A & 5N St. Joachim Estate, Ratnapura - (1993)*

Cuttings of the promising selections have been planted in the nursery for Phase II trial.

6.1.2 LVP 62 (LVP 45 & LVP46/LC/I)- *Evaluation of clones from polyclonal seed established on St.Joachim Estate (LVP 45, 1989 & LVP 46, 1990), in Field No. 2A &5N St. Joachim Estate, Ratnapura - (1993)*

Cuttings of the promising selections have been planted in the nursery for Phase II trial.

6.1.3 LVP 63 - *Evaluation of clones developed from biclonal seed (2026 x DN) established on Pettigala Estate in Field No. 2A & 5N, St. Joachim Estate, Ratnapura -(1993)*

Cuttings of the promising selections have been planted in the nursery for Phase II trial.

6.1.4 LVP 64 (ASM.INT.88/LC/I) - *Evaluation of clones from ASM 1988 Introduction seed in Field No. 2A, St.Joachim Estate, Ratnapura – (1993)*

Cuttings of the promising selections have been planted in the nursery for Phase II trial.

6.1.5 Source : VP 39 – Evaluation of seedlings obtained from the crosses of 1980/1981

6.1.5.1 LVP 66 (VP 39/LC/I)- *Evaluation of clones from VP 39 in Field No.2A, St.Joachim Estate - (1994)*

Number of clones tested: 78

The yield of 12 clones was 0.22 - 49% more than that of control clone TRI 2025. Clone 95 has yielded significantly higher than the control TRI 2025 (Table 19).

TABLE 19 - *Yield of clones (kg MT ha^{-1} an^{-1})*

Clone	Yield
2023 (control)	4967.04
95	4756.52
139	4289.44
113	4208.19
2027 (control)	4158.83
2026 (control)	4126.67
38	3723.00
42	3648.25
222	3617.63
238	3493.31
244	3409.67
237	3400.09
274	3311.99
33	3211.47
26	3202.61
2025 (control)	3196.60
299	3155.71
53	3075.26
216	3072.06
LSD (P=0.05)	1204.45
CV %	23.4

6.1.6 LVP 67 (VP 43/LC/I)- *Evaluation of clones from VP 43 in Field No. 2A, St.Joachim Estate, Ratnapura - (1994)*

Of the 102 clones evaluated, 15 clones yielded significantly more than the control TRI 2026, clone 710 being the highest yielder. However, none of the clones has yielded more than TRI 2023 or 2027 (Table 20).

TABLE 20 - *Yield of clones (kg MT ha^{-1} an^{-1})*

Clone	Yield
2023 (control)	4571.6
2027 (control)	4409.3
710	4331.2
708	4244.8
2025 (control)	4136.2
768	4034.6
619	3959.9
617	3958.9
702	3887.2
757	3811.3
626	3785.8
613	3775.9
571	3768.2
810	3691.2
709	3645.1
621	3640.0
624	3590.3
657	3577.8
2026 (control)	1670.3
LSD (P=0.05)	1346.9
CV %	26.6

6.1.7 LVP 68 (VP 44/LC/I)- *Evaluation of clones from VP 44 in Field No.2A, St.Joachim Estate - (1994)*

Of the 76 clones evaluated, clone 1021 only yielded more that the control TRI 2026. However, seven clones yielded 1.3 - 65.8% more than TRI 2026 (Table 21).

TABLE 21 - *Yield of clones (kg MT ha^{-1} an^{-1})*

Clone	Yield
1021	5477.7
2023 (control)	4359.8
2027 (control)	4148.6
917	4097.6
2025 (control)	3953.7
1034	3910.7
959	3683.2
950	3618.4
935	3512.5
1037	3350.1
2026 (control)	3303.9

927	3261.4
970	3251.4
1045	3167.7
912	2866.3
1035	2854.8
920	2802.4
1048	2740.3
901	2732.9
LSD (P=0.05)	1110.35
CV %	24.10

6.1.8 LVP 71 (LVP 45 and LVP 46/LC/I) - *Evaluation of clones from polyclonal seed LVP 45 and LVP 46, in Field No. 2A & 5N, St. Joachim Estate, Ratnapura - (1994)*

None of the 43 clones evaluated yielded significantly higher than the control TRI 2026. However, eight clones yielded 0.8 - 31.4% more than 2026 (Table 22).

TABLE 22 - *Yield of clones (kg MT ha^{-1} an^{-1})*

Clone	Yield
3/12	5691.9
4/16	5481.0
6/28	4701.6
1/09	4579.6
14/51	4578.8
14/52	4556.4
6/2	4423.3
6/38	4369.8
2026 (control)	4333.2
5/38	4327.6
4/4	4223.6
3/2	4187.9
5/35	4159.7
11/6	4110.0
7/33	4067.6
15/40	3097.9
LSD (P0 = 0.05)	1371.9
CV %	18.4

6.1.9 LVP 72 (VP 39/LC/I)- *Evaluation of clones from VP 39 in Field No.2A, St.Joachim Estate, Ratnapura - (1994)*

Clones 300 and 52 have yielded significantly higher than control TRI 2027. However, fourteen clones yielded 9 - 61.4% more than the same control (Table 23).

TABLE 23 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone	Yield
300	3538.66
52	3430.05
2023 (control)	2999.40
20	2954.45
122	2859.30
2025 (control)	2817.78
48	2750.47
57	2696.62
273	2675.16
181	2634.09
36	2582.07
40	2573.86
232	2561.64
189	2441.53
76	2405.24
22	2389.72
2027 (control)	2192.82
LSD (P = 0.05)	1014.62
CV %	24.60

6.1.10 LVP 73 (LVP 49/LC/I) – *Evaluation of clonal selections from Karandupona and Urumiwela (LVP 49) in Field No. 1, St Joachim Estate, Ratnapura – (1996)*

The yield of the highest yielding clones, along with that of controls in the different sections of the trial area, is given in Table 24.

TABLE 24 - Y*ield of clones (kg MT ha^{-1} an^{-1})*
Section 1.

Clone No.	Yield
A-9	5415
A-5	5381
A-16	4845
2026 (control)	4571
2025 (control)	3566
LSD (P = 0.05)	2180
CV %	28.3

Section 2.

A-39	5148
A-47	5135
A-55	5039
A-41	4840
A-67	4558
A-54	4464
A-40	4342
2025 (control)	4335
2026 (control)	4288
LSD (P = 0.05)	1479
CV %	19.9

Section 3.

2026 (control)	4320
A-88	4467
A-76	3698
A-75	2926
A-80	3586
A73	3580
2027 (control)	3575
LSD (P = 0.05)	2348
CV %	37.1

Section 4.

A-108	5950
A-101	5782
A-111	4674
A-115	4618
2026 (control)	4433
LSD (P = 0.05)	2427
CV %	34.4

Section 5.

A-130	6180
A-143	3935
2026 (control)	3940
LSD (P = 0.05)	2019
CV %	30.2

Section 6.

A-169	6522
A-168	5986
A181	5954
2027 (control)	5316
2026 (control)	5852
LSD (P = 0.05)	2253
CV %	22.7

Section 7.		
	B-8	6460
	B-14	6023
	B-26	5920
	2025 (control)	5804
	LSD (P = 0.05)	1903
	CV %	18.7
Section 8.		
	B-36	6842
	B-47	6716
	2026 (control)	5526
	LSD (P = 0.05)	2052
	CV %	19.1
Section 9.		
	2027(control)	6112
	B-61	5880
	LSD (P = 0.05)	2734
	CV %	32.5
Section 10.		
	B-92	6171
	C-1	6026
	2026 (control)	4195
	LSD (P = 0.05)	2706
	CV %	33.1
Section 11.		
	2026 (control)	7665
	C-31	7016
	LSD (P = 0.05)	2007
	CV %	18.1
Section12.		
	C-62	7314
	C-69	7107
	C-48	7042
	2025 (control)	5572
	LSD (P = 0.05)	2008
	CV %	19.1
Section 13.		
	D-16	4493
	2025 (control)	4490
	LSD (P = 0.05)	2307
	CV %	41.7
Section 14.		
	2026 (control)	5509
	E-12	4955
	LSD (P = 0.05)	2248
	CV %	27.4

Section 15.		
	2026 (control)	6857
	G-15	6843
	LSD (P = 0.05)	2242
	CV %	20.9
Section 16.		
	H-16	7121
	H-18	6956
	2027 (control)	6397
	LSD (P = 0.05)	1724
	CV %	18.4
Section 17.		
	I-19	6257
	H-37	5513
	2026 (control)	3568
	LSD (P = 0.05)	1861
	CV %	28.7
Section 18.		
	J-9	5081
	2026 (control)	3481
	LSD (P = 0.05)	1385
	CV %	27.2

V.Shanmugarajah, A.K.M.Jayasena, J.H.N.Piyasundara, M.Ratnayake, S.W. Gunadasa and S. Dhason

6.2 Low-country – Clonal EvaluationTrials - Phase II

6.2.1 LVP 43 - *Testing 42 clones of the 4000 series on Diyadawa Estate, Deniyaya - (1990)*

The plots are being used as multiplication plots.

6.2.2 LVP 60 - *Testing nine clones of the 4000 series at Golinda Estate, Kegalle*

The trial was concluded after clones TRI 4014, 4042 and 4083 were found to be promising for the Kegalle district. Using the same plots, the Agronomy Division has started a mechanical pruning trial.

6.2.3 Source: Evaluation of clones from Aislaby and Hugoland seed (LVP 30, Deniyaya – 1983) on Handford Estate, Deniyaya – (1991)

6.2.3.1 LVP 74 (LVP 30/LC/II) – *Evaluation of clones of LVP 55 in Handford Estate, Deniyaya at TRI – Deniyaya station – (1997)*

Infilling was done and bushes were centered at 18".

M.Ratnayake, S.W.Gunadasa, J.A.S.K.V.Jayasinghe, V.Shanmugarajah, R.Paskarathevan and B.A.Rathnagoda

6.2.4 Sources

LVP 56 (VP 37/LC/I) – *Evaluation of clones from VP 37 (St. Coombs) in Field No. 5, St. Joachim Estate, Ratnapura – (1992)*

LVP 57 (LVP 42/LC/1) - *Evaluation of clones from polyclonal seeds of Urumiwela and Karandupona seed gardens, established on Parambe (LVP 42), in Field No. 5 St. Joachim Estate, Ratnapura – (1992)*

LVP 58 (LVP 28/LC/I)- *Evaluation of clones from Aislaby seed (LVP 28, St.Joachim Estate) in Field No. 5, St. Joachim Estate, Ratnapura – (1992)*

LVP 59 -*Evaluation of clones developed from biclonal seed (2026 x DN) established on Pettigala Estate in Field No. 5, St. Joachim Estate, Ratnapura - (1992)*

6.2.4.1 LVP 75 (LVP 56, 57, 58, 59/LC/II) – *Evaluation of clones of LVP 56, 57, 58 and 59 of Field No.5, St. Joachim Estate in Field No. 1 of St. Joachim Estate, Ratnapura – (1997)*

Infilling was done and bushes were centered at 18".

A.K.M.Jayasena, J.H.N.Piyasundara M.Ratnayake,
S.W.Gunadasa and V.Shanmugarajah

6.3 Low-country – Phase III Trials

6.3.1 *Smallholding at Dehiowita*

The bushes were rested and pruned in June.

6.3.2 LVP 65 - *St.Joachim Estate, Ratnapura - Multiplication rows of 4000 series and estate clones*

Cuttings from these plots were issued to estates and smallholdings.

A.K.M. Jayasena, J.H.N.Piyasundara and V.Shanmugarajah

7. Supply of clonal cuttings

Cuttings of 3000 and 4000 series clones were supplied to estates and smallholdings in the Up-country, Uva, Mid-country wet zone and Low-country for the purpose of establishment of mother bushes and for evaluation trials. Details of the issues are given below.

7.1 Up-country

Name Company	Clones	No. of shoots
1.Brookeside Estate	3014, 3016, 3017 3018, 3020, 3049 3069 4006, 4042 4053 4079 4085	 75 each 100 150 50 200 25
2.Theresia Estate, Bogawantalawa	3013, 3014 3016 3017, 3020, 3031 3049 3048 4052, 4053, 4078	200 each 50 100 each 150 100 each
3.Palmerston Estate, Talawakelle	3014, 3020, 3048 3049, 3052, 3072 4052, 4053, 4078 4079	 200 each 200 each
4.Concordia, Estate, Kandapola	3013, 3043, 3052 3072, 3073 4053, 4063 4052, 4071, 4078 4079	100 each 200 each 100 each 200 each
5.Court Lodge, Kandapola	3013, 3043, 3052 3072, 3073 4053, 4063 4052, 4071, 4078 4079	100 each 200 each 100 each 200 each
6.Kenilworth, Estate, Ginigathena	3013, 3014, 3015 3016, 3017, 3018 3019, 3020, 3069 3072, 3073 4006,.4042,.4046 4052, 4053	 75 each 50 each 100 each
7.Waldemar, Estate, Udapussellawa	3015, 3016, 3018 3047	 175 each

	4052, 4053	100 each
	4071, 4078	200 each
8.Gouravilla, Estate,	3017, 3018, 3020	
Up-Country	3047	25 each
	3072, 3073	100 each
9.Campion Estate,		
Bogawantalawa	3013, 3014, 3016	
	3017, 3018, 3019	
	3020	50 each
	3069, 3072, 3073	100 each
10.Kataboola Estate	4047, 4053	50 each
Kataboola	4078, 4085	150 each
11.TRI, Hantane	3069	50 each
	4006, 4052, 4053	
	4063, 4067, 4070	
	4071, 4078, 4079	
	4085	50 each
12.Meddekumbura Estate,		
Talawakelle	3049, 3073	200 each
	3072	150
	4052, 4071	200 each
	4053, 4078	100 each
13.Ury Group,		
Passara	3047, 3072, 3073	250 each
	4071, 4078, 4079	250 each
14.Greenwood Estate	3072, 3073	100 each
Nawalapitiya	4047, 4067	100 each
	4046	50

Small Holding Authorities and Societies

T.S.H.D.A., Gampola	3013	150
	3016	100
	3022	30
	3061, 3072, 3073	200 each
	4053	50

Individuals and Private Estates

1.Sri Krishna	3046	100
	3047	150
	3048, 3072, 3073	200 each
	4006	100
	4033	250
	4052, 4071	500 each
	4078, 4079	200 each

2.Palm Foundation	3015, 3072, 3073	100 each
	4015, 4042, 4046	
	4052, 4053	100 each
3.Salahudeen	3014, 3025, 3041	150 each
	4042, 4046, 4047	
	4078	150 each
4.S.D.M.Laffeer	3013, 3015, 3016	
	3018, 3019, 3020	
	3069, 3072, 3073	50 each
	3014	100
5.Laffeer	3016, 3018, 3019	50 each
	3069	100
	4046	50
6.Tissa Nanayakkara	4006	200
7.Wickramage	3013, 3019, 3020	
	3049, 3072, 3073	100 each
	3014	25
	3016, 3069	50 each
	4006	50
	4042, 4046	25 each
	4052, 4053, 4071	
	4078	100 each
8.Wasanth Wickramage	3014	25
	3016, 3069	50 each
	3020	75
	3072, 3073	100 each
	4006	50
	4042, 4046	25 each
	4052	75
9.Ireby Estate	3072, 3073	500 each

7.2 Low-country

Name	*Clones*	*No. of Shoots*
Company		
1.Urumewella Estate	3014, 3052, 3055	
	3058	50 each
	4043, 4053, 4054	
	4061	50 each
2.Poronuwa Estate	3014, 3019, 3025	
	3053, 3055, 3058	50 each
	4014, 4042, 4046	
	4049, 4061, 4075	50 each

3.Hunuwela Estate	3014, 3025, 3046,	
	3055, 3058	50 each
	4042, 4047, 4049	
	4053, 4059, 4061	
	4062	50 each
4.Endane Estate	3014, 3025, 3046	
	3055, 3060	50 each
	4006, 4014, 4042	
	4049, 4061, 4097	50 each
5.Pelawatte Estate	3014, 3025, 3046	
	3056,	50 each
	4048, 4049, 4053	
	4056, 4059, 4061	50 each
6.Panawatte Estate	4006, 4014, 4042	
	4047, 4049, 4053	
	4055, 4056, 4059	
	4061	50 each
7.Rye/Wikiliya Estate	4006, 4014, 4042	
	4047, 4049, 4053	
	4055, 4059, 4061	50 each

Small Holding Authorities and Societies

1.T.S.H.D.A.,	3014, 3025, 3046	
Kegalle	3047, 3055	50 each
	4045, 4053, 4054	
	4061	50 each
2.T.S.H.D.A,		
Matugama		
Kumara Welgama, MP	3057	200
	4006, 4014, 4042	
	4044, 4045, 4046	200 each
	4047, 4061, 4075	100 each
3. 'Tea Sakthi',	3014	350
Gilimale	3029	150
	4047, 4059, 4061	100 each
	4049	200

Individuals and Private Estates

1.Newton Perera	3025, 3046, 3055	100 each
2.Gamage	3014, 3025, 3046	
(Nivitigala)	3055, 3058	50 each
3.N. Ranasinghe	3014, 3025, 3055	50 each

	4042, 4047, 4049	
	4053, 4061	50 each
4.L.A.Weerakoon	3014, 3046, 3055	50 each
	4014, 4042, 4046	
	4049	50 each
5.D.L.Samaratunga	3014, 3046, 3047,	
	3055, 3057	50 each
	4014, 4046, 4047	
	4049, 4055, 4061	50 each
6.Sunil Fernando	3014	100
	4049, 4053	50 each
7.D.de Silva	3014, 3025, 3046	
	3047	50 each
	4002, 4006, 4014	
	4042, 4046, 4061	50 each
	4062, 4075	100 each
8.B. Wilson	3014, 3047	50 each
	4047, 4061	50 each
9.R. Jayalal	3014, 3025, 3041	
	3058	50 each
	4014, 4042, 4043	
	4048	50 each
10.Fernando	3014, 3047, 3052	
	3055, 3058	25 each
	4042, 4046, 4047	
	4048, 4049, 4059	
	4061, 4083	25 each
11.Pathira[illegible]	3014, 3025, 3046	
	3047	50 each
12.Chandrakanthi	3014, 3025, 3046	
	3048	50 each
	4014, 4042, 4043	
	4049, 4059	50 each
13.Sooriyarachchi	3014	50
	4014, 4042, 4045	
	4046, 4047, 4049	
	4056, 4061, 4062	50 each
14.M.C.Gunatilaka	3014, 3025, 3046	
	3055	50 each
	4002, 4014, 4042	
	4049, 4059, 4061	50 each
15.P.D.Pathirana	4042, 4047, 4061	50 each
16.S.M.Sarath	4042, 4046, 4059	
	4061, 4062	50 each
17.I.D.Subasinghe	4047, 4049, 4059	

	4061, 4062	50 each
18.Abapala	4047, 4049, 4053	
	4059, 4061	50 each
19.K.M.K.Perera	4042, 4052, 4055	
	4061, 4097	150 each
	4049	100 each
20.Upali	4052, 4055	100 each
21.N.Chandrasiri	4052, 4053, 4061	
	4075, 4097	100 each
22.Jayawardena	4024, 4033, 4048	250 each
	4006, 4052	100 each
	4042, 4046	200 each
23.N.Perera	4042, 4046, 4049	100 each

8. Divisional activities

8.1 Nursery Trial - Effect of different sizes of bags on the growth of the cuttings in the nursery

In an observation trial with different sizes of bags, better plant growth was seen in smaller bags (11.5 x 12.5 cm) as well compared to standard size bags. Therefore, a proper trial was laid down to study the effect of different sizes of bags on the growth of plants in the nursery. Besides the different sizes of bags, the treatments included sealing of the bottom of bags and leaving unsealed, keeping the bags over a layer of polythene and on the nursery bed (soil) itself at two different levels of fertilizer.

Treatments:

Size of bags:	11.5 x 12.5 cm (4.5" x 5")
	23 x 12.5 cm (9" x 5")
	11.5 x 15 cm (4.5 x 6")
	23 x 15 cm (9" x 6")
Bags:	Sealed/ not sealed
	Left over soil/ over a layer of polythene
Fertilizer:	2 levels
Clone used:	TRI 2025
Replicates:	2

S.W.Gunadasa, M.Ratnayake, B.A.Rathnagoda and V.Shanmugarajah

8.2 Establishment of Seed Garden - Sorana Estate, Horana

An isolated polyclonal seed garden was established at Sorana Estate, Horana, which is a rubber estate.

Date of Planting:	September, 1998
Field No:	7

Planting system: Double triangle

Clones	*No. of plants*
TRI 4046	56
TRI 4049	55
TRI 2027	60
H 1/58	57
TRI 4042	55
TRI 4006	57
TRI 3055	53

V.Shanmugarajah, S.W.Gunadasa, M.Ratnayake, R.Paskarathevan, B.A.Rathnagoda and Superintendent, Sorana Estate

8.3 Observation trials

8.3.1 Field performance of plants raised in different sizes of bags

Plants of clone TRI 2025 raised in different sizes of bags have been planted in fields at Norwood and St. Coombs Estates to ascertain their performance in the field.

Size of bags: 23 x 12.5 cm (9 x 5")
11.5 x 12.5cm (4.5" x 5")

Norwood Estate:

Field No.: NC 3 A
Date of planting: July 1998
Number of plants: 100 per treatment
The treatments were not replicated.

St. Coombs Estate:

Field No.: 12
Date of planting: July 1998
Number of plants: 25 per treatment
Number of replicates: 4

Passara Station:

Field No.: 4
Date of planting: November 1998
Number of plants: 25 per treatment
Number of replicates: 2

8.3.2 Spacing for clones of different growth habit

Plants of clones with different growth habit were planted at two spacings in St. Coombs Estate to ascertaina the time taken by them to provide a good ground cover.

Field No.: 12 (near Sports Club)
Spacing: 1.2 x 0.6 m (4' x 2')

	0.9 x 0.75 m (3' x 2.5')
Clones:	TRI 3072 (erect type)
	TRI 3073 („)
	TRI 4075 („)
	TRI 2025 (spreading type)
No. of replicates:	2

S.W.Gunadasa, B.A.Rathnagoda,
M.Ratnayake and V.Shanmugarajah

8.4 Germplasm Bank

Bushes in the germplasm bank at the Head Office were pruned and 100 cuttings each obtained from 303 clones have been planted in the nursery. These plants will be used to establish a germplasm bank at the TRI stations at Hantane, Passara and at Talgampola and also to extend the existing germplasm bank at Ratnapura station.

V.Shanmugarajah, M.Ratnayake,
S.W.Gunadasa and B.A.Rathnagoda

8. 5 Canker Assessment

Along with staff of the Pathology Division, canker assessment was carried out in all Phase I trials at the low-country station, Ratnapura.

A.K.M.Jayasena and J.H.N.Piyasundara

8.6 Quality Assessment

Flush of some of the 3000 and 4000 series clones was collected and supplied to the Biochemistry and Technology Divisions for assessment of quality of the made tea. Flush was obtained from the following estates:

Sheen Group, Pundaluoya - TRI 4052, 4071, 4078, 4079
Venture Estate, Norwood - TRI 3016, 3018, 3072, 3073, 4052, 4053, 4063
Stockholm Estate, Upcot - TRI 3015, 3016, 3018, 3019, 3020, 3048

S.W.Gunadasa, R.Paskaratheven B.A.Rathnagoda and V.Shanmugarajah

8.7 Large scale planting

At Norwood Estate, 3900 and 2800 plants of clones TRI 3073 and 4006 respectively were planted in Field No. NC 3 A in August for evaluation on a large scale.

8.8 Workshop on characterisation of clones

A workshop on the above, organised on 15th October by the Division, was co-ordinated by Dr (Mrs) M.T.K. Gunasekare. All Grade I and II staff of the other Divisions took part and a tentative selection of clones was made for establishing multiplication blocks on large scale by year 2000.

8.9 Staff Seminar

Mr. S.W. Gunadasa presented a seminar on the "Effect of different size of bags on the growth of nursery plants" on 7th May.

Project B/TC – Tissue Culture
Project Leader – S.K.Sathyapala

The objective of this project is to supplement the ongoing conventional breeding programme.

9. Induction of homozygous double haploids through anther and pollen culture and subsequent inclusion of them in tea breeding programme

This project was initiated in collaboration with the IFS during the latter part of 1997. The experiments carried out under this project are given below.

9.1 Effect of pretreatment of anthers on callus formation

Pretreatments:

i. Sugar starvation with 0.3M-0.1M manitol solution
ii. Exposure of anthers to 32-35°C heat for 3-5 days
iii. Treatment with colchicine 1g-10g prior to culturing them on different growth media

Results: Sugar starvation had a negative effect on callus formation.

Further investigation on the other two pretreatments is in progress.

9.2 *Effect of different culture media (MS, B5 and N6) and different plant growth regulators on embryogenesis and callus induction in pollen of tea and other Camellia species*

No difference was seen in callus formation in the three media. Four plant growth regulators - 2,4-D, IAA, BAP and kinetin were tested. A high rate of callus formation was observed with anthers cultured in medium supplemented with 2,4 -D. However, embryogenesis was not observed in any of the treatments.

Further investigations on the effect of different combinations of plant growth regulators on embryo genesis and callus formation are in progress.

9.3 *Effect of clonal variation on the induction of embryogenesis and callus formation in anthers*

Clones TRI 2025, TRI 2043 and DG7 were tested.

Results: No embryogenesis was observed in any of the clones used and the results on callus formation were inconsistent. Further studies with clones of different origin are in progress.

9.4 *Induction of embryogenesis in microspore cultures of tea and other Camellia species*

This study was initiated to induce direct embryogenesis from microspores.

S. K.Sathyapala, K. Sarathchandra,
H. Jayaweera and M.C.M. Iqbal (IFS)

10. Somatic hybridization through protoplast culture in tea and other related species

10.1 *Induction of callus and embryogenic cell suspension for isolation of protoplasts*

Embryogenic callus was induced from leaf, stem and cotyledon explants in order to develop embryogenic cell suspension which could be used for isolation of protoplast, *in vitro* mutant selection and genetic transformations.

Callus was induced in different organs of tea (TRI 4006, China jat), *C. sasanqua* and *C. japonica* and cultured in the liquid medium. The suspension was subcultured every ten days and the fresh weight taken (Table 25). Browning was high in stem and leaf callus. Therefore, cotyledon callus was selected for development of embryogenic cell suspension.

TABLE 25 - *Growth of cell suspensions of tea and Camellia sasanqua during 30 days of culture.*[1]

Clone/species	Mean fresh weight (mg) of cells at each subculturing[2]		
	1	2	3
TRI 2025	0.68	0.71	0.74
C. sasanqua	0.59	0.64	0.68

[1] Initial weight of the callus: 0.5 g
n=3 for mean fresh weight [2] The subculturing was done every 10 days.

10.2 *Effect of different growth regulators on growth of the suspension cultures of Camelllia sasanqua and TRI 2025*

In previous experiments where high 2,4-D and kinetin were used (1-2mg/l), a large number of highly vacuolated cells was observed. Therefore, a new experiment was initiated with low concentrations of plant growth regulators.

Treatments: MS medium supplemented with

1. 2,4-D - 0.5mg/l and 10% coconut water
2. 2,4-D - 0.5mg/l and 0.5mg/l kinetin
3. 10% coconut water
4. 0.5mg/l kinetin

The cell suspensions will be used for isolation of protoplast and subsequent somatic hybridization.

S.K.Sathyapala, P.D.Upali and T. M. Sarathchandra

11. Direct and indirect somatic embryogenesis for clonal multiplication and screening of variants for biotic and abiotic stresses

Somatic embryos are much valued in clonal multiplication, somaclonal variation, artificial seed production and cryopreservation for the establishment of gene banks. This study was initiated to improve the induction of morphologically normal somatic embryos and their germination into viable plants.

11.1 *Somatic embryogenesis in cotyledon of tea and Camellia sasanqua*

Embryos were produced in MS medium supplemented with BAP and IAA and transferred to hormone free medium for further growth. Only morphologically normal embryos produced intact plantlets (Table 26).

TABLE 26 - *Somatic embryogenesis in cotyledon explants of TRI 2025 and Camellia sasanqua in MS medium supplemented with BAP and IAA*

Treatment	Embryo formation mean [1] No.	Morphologically normal embryos %
TRI 2025	24.3±0.47	17.9
C. sasanqua	13.25±0.44	28.1

1. Mean number of embryos per 20 explants ±SD

The effect of the different plant growth regulators on the improvement of the rate of embryo formation is being investigated.

S.K. Sathyapala and P.D.Upali

11.2 *Somatic embryogenesis in leaf and stem explants of tea and other Camellia species*

In previous experiments for the induction of somatic embryogenesis where BAP, IBA and Zeatin were used, leaf and stem explants of tea did not show direct embryogenesis. The attempt to induce callus was successful for both the explants. Of the leaf callus, 80% produced roots while stem callus showed embryoid like structures. In *C. japonica,* leaf explants cultured in MS medium supplemented with BAP 1-2mg/l showed somatic embryogenesis.

Further investigations with different combinations of plant growth regulators are in progress to induce direct embryogenesis and organogenesis in the form of shoot formation in both callus types.

S.K.Sathyapala and T.M. Sarathchandra

12 Micropropagation using shoot tips and axillary buds for multiplication of selected clones and rare genotypes

12.1 *Micropropagation of selected clones for field planting*

The multiplication of TRI 4006 and of TRI 4052 is being continued at the tissue culture laboratories at Talawakelle and Hantane. In accordance with the MOU between TRI and Oasis Biotech, culture media and 40 *in vitro* grown shoots were supplied to Oasis Biotech for commercial scale micropropagation.

P.D.Upali, T. M. Sarathchandra, R.Paskarathevan, K.Sarathchandra and H. Jayaweera

12.2 *Studies on effect of different surface sterilents and methods of sterilization as an alternative to the surface sterilent $HgCl_2$*

The effect of several surface sterilents (sodium hypochloride, calcium hypochloride, lysol, domex) was investigated to establish harmless sterilization method as an alternative for highly poisonous $HgCl_2$. These experiments are in progress.

S.K.Sathyapala, T.M.Sarathchandra, P.D. Upali , K. Sarathchandra and H. Jayaweera

12.3 *Use of commercial bleach as surface sterilant to obtain optimum conditions to initiate aseptic cultures in vitro*

A new commercial bleach, "Domex" [Active ingredient – sodium hypochlorite 0.5% (w/w), Unilever Ceylon Ltd], was compared with "Clorox" [Active ingredient - sodium hypochlorite 5.25 % (w/v), Clorox Co. Oakland, USA] in order to reduce the contamination in stem and leaf explant cultures.

The control used was 20% (v/v) Clorox with Tween 20 (1drop per 100ml) and explants were exposed to this solution for 1hr. Prior to exposing to the treatments, the explants were immersed in 70% ethanol for 2-3min (Table 27).

TABLE 27 - *Effect of different types of commercial bleaches and their concentrations on per cent contamination and percentage explants producing callus on (a) Leaf explants and (b) Stem explants*

(a) Leaf explants

Treatment [Concentration % (v/v) and exposure time]	% contamination	% explants producing callus
20 % Clorox for 1 hour – CONTROL	90	10
40 % Clorox for 1 hour	60	30

60 % Clorox for 1 hour	50	30
80 % Clorox for 1 hour	40	20
100 % Clorox for 1 hour	10	40
20 % Domex for 1 hour	10	70
40 % Domex for 1 hour	10	40
60 % Domex for 1 hour	0	10
80 % Domex for 1 hour	60	20
100 % Domex for 1 hour	0	0

(b) Stem explants

Treatment	% contamination	% callusing and (browning)
20 % Clorox for 30 minutes	100	0 (0)
100 % Domex for 30 minutes	0	0 (100)

Each treatment consisted of 10 replicates and the experiment was carried out only once. Cultures were scored for callusing and contamination after 6 weeks of culture.

This experiment needs to be repeated to assess the reproducibility of the observations. Experiments will also be carried out to further reduce the rate of contamination and to increase the survival of explants by incorporating Domex and Clorox at different concentrations in combination with different exposure times.

R. Paskarathevan, S. Dhason and K.Gunasekare

12.4 *Identification of contaminants in in vitro cultures of tea*

A systematic study was initiated for the identification of bacterial contaminants. The contaminants were isolated and samples were sent to Japan for further identification. The major systemic contaminant was gram positive bacteria and a few gram negative bacteria were also identified. Further studies on antibiotic sensitivity are in progress.

S.K.Sathyapala and T.M.Sarathchandra

12.5 *Development of improved direct rooting method for in vitro multiplied shoots*

Rooting ability of *in vitro* multiplied shoots of tea has been low and induction of roots was mainly carried out under aseptic conditions. This has indirectly affected the acclimatization process, resulting in a large number of causalties after transfering them to the field. To minimize causalties during acclimatization, investigations were carried out to induce rooting after multiplication directly in the soil.

Treatments:

1. Shoots dipped in root inducing hormone mixture (liquid) before planting in soil
2. Shoots cultured in liquid rooting medium for one week and planted in the soil
3. Shoots dipped in root inducing mixture(powder) before planting in soil
4. Shoots cultured in the rooting medium (solid) under aseptic conditions

This experiment is in progress.

S.K.Sathyapala and U. Sritharan

12.6 *Studies on the field performance of tissue cultured plants*

TRI 2023 *in vitro* grown plants were planted in the field at Hantane with conventionally propagated (vegetatively propagated) plants of TRI 2023 as controls. Periodic growth assessments are being carried out to determine the variations. Shoot growth of these plants and yield and the fresh and dry weights of the flush are being monitored. This study will be continued for three cycles.

S.K.Sathyapala, P.D.Upali and U. Sritharan

13. Preliminary investigations on encapsulation of plant material for preservation under *in vitro* conditions

The need to store or preserve plant material long term in a pure, viable and stable condition is of increasing importance in plant breeding programmes, especially in germplasm conservation. Storage *in vitro* at low temperature and encapsulating plant material with suitable protective coating to provide physical protection to plant material has been considered to be one of the most applicable methods for this purpose. Therefore, under this study, experiments are being carried out to find a suitable encapsulating matrix and to find the response of encapsulated embryos during storage at low temperature.

13.1 *Testing of different gel matrices to find their suitability for encapsulation of mature zygotic embryos of tea*

Embryonic axes excised from mature tea seeds (Clone TRI 2026 –open pollinated seeds) were surface sterilised and encapsulated using following gel matrices to find matrix suitability to form capsules.

1. Bacto-Agar (Pharmacia)
2. Bacto-Agar (Difco)
3. Phytagar (GIBCO)
4. Agar (Fluka)
5. Agarose (Type VII, low gelling temperature, Sigma)

All matrices were prepared at 5% (w/v) concentration. Gel matrices were sterilised and encapsulation of single isolated zygotic embryos was carried out under aseptic conditions when matrix temperature was around 40-45 ^{0}C.

No capsule formation occurred when matrix 5 was used for encapsulation, whereas all the other matrices formed capsules. Variation in the gel matrix changed the firmness and texture of the capsule considerably. The firmness of the gel capsules formed with matrix 2 was unsatisfactory for handling. Capsules formed with matrices 1, 3 and 4 were soft and showed sufficient strength during handling. However, embryos encapsulated in matrix 1 and 3 turned brown in 3-5 days after encapsulation, whereas those coated with matrix 4 gradually turned greenish yellow in colour, confirming their viability after a week. Therefore, in the subsequent experiments, matrix 4, i.e. Agar from Fluka, was used as an encapsulation matrix. Suitability of these different gel-matrices for encapsulation of plant material was tested as an alternative to alginic acid. Therefore, use of alginic acid for encapsulating embryos and shoot apices will be attempted.

13.2 *Effect of encapsulation and low temperature storage on viability of zygotic embryos and their subsequent germination*

Encapsulated embryos (in Agar – Fluka) were blotted dry and stored in sterile dry Petri-dishes sealed with parafilm. The ability of germination of encapsulated embryos was tested after 30 days storage at temperatures of 25± 2 ^{0}C and 10 ±2 ^{0}C., by inoculating them on MS medium supplemented with 2mg/l BAP and 0.1mg/l IBA. As a control, freshly isolated zygotic embryos was also inoculated in the same culture medium. All cultures were then maintained at 25^{0}C.

The frequency of *in vitro* germination of encapsulated embryos stored at 25^{0}C was comparable to that of embryos stored at 10^{0}C, which were 46.4 % and 43.0 % respectively. Non-encapsulated embryos showed 52.0% germination, which was not markedly different from the germination capacity of the encapsulated embryos, stored at both temperatures. The germinated encapsulated as well as non-encapsulated embryos developed shoots and roots 4 –5 weeks after inoculation on the culture medium. Therefore, encapsulation and storage of embryos at low temperature does not negatively affect the maintenance of germination competence. Studies are in progress to assess the ability of germination and conversion into plants of encapsulated material after long-term storage (more than 30 days) at low temperature.

K. Gunasekare

14. Miscellaneous projects

14.1 *Induction of useful secondary metabolites in cell suspensions of tea*

This experiment was initiated for the identification and isolation of useful secondary metabolites produced in cell cultures of tea.

Preliminary investigations on induction of secondary metabolites in cell suspensions under high, medium and low sucrose concentrations are in progress.

S.K.Sathyapala and T.M Sarathchandra

14.2 *Application of embryo culture technique to overcome the early embryo abortion in inter specific hybridization in genus Camellia*

Low seed setting is one of the major problems in tea breeding. Early embryo abortion in inter specific hybridization could be avoided by culturing immature zygotic embryos under *in vitro* conditions. This experiment was initiated to study the above and the following crosses were carried out for isolation of embryos at different developmental stages.

TABLE 28 - *No. of crosses carried out*

Cross	*No. of flowers pollinated*
1. 4053 x Poonagala1	126
2. 4078 x Poonagala2	5
3. *C japonica* x Poonagala3	44
4. 4049 x Poonagala 4	26
5. China jat x Poonagala5	79
6. 3015 x Poonagala6	31
7. 4046 x Poonagala7	30
Total	341

The experiment is in progress.

S.K.Sathyapala, U. Sritharan and P.D. Upali

14.3 *High Forest die back problem*

This study was carried out to determine the cause for the die back of TRI 2025 bushes at the High Forest Estate.

Xylem sap of the affected and healthy tea bushes of TRI 2025 was collected and bioassy experiment was carried out using *in vitro* shoots of TRI 2025.

Treatments:

1. Shoot base was wounded by a needle- control
2. Inoculation of sterile distilled water to the base of the shoot
3. Inoculation of healthy xylem sap without filtration
4. Inoculation of healthy xylem sap after filtration through 0.8um mesh
5. Inoculation of healthy xylem sap after filtration through 0.1um mesh
6. Inoculation of infected xylem sap without filtration
7. Inoculation of infected xylem sap after filtration through 0.8um mesh
8. Inoculation of infected xylem sap after filtration through 0.1um mesh

For each treatment, 6 shoots were used and the treatments were replicated twice.

TABLE 29 - *Percentage of the shoots with die back symptoms 5 days after culture*

Treatment	*Shoots with die back symptoms %*
1	0
2	0
3	0
4	6.25
5	6.0
6	50
7	37.5
8	18.75

As per the results it was evident that the xylem sap of the bushes with die back symptoms contain toxin or similar substance which caused similar symptoms in *in vitro* grown shoots. Further analysis of the xylem sap is in progress in colloboration with the Biochemistry Division.

N.Iddagoda (IFS), P.D. Upali and S.K.Sathyapala, (IFS)

14.4 *Micropropagation of shade and fuel trees*

A protocol was developed for micropropagation of eucalyptus. Although the experiment on micropropagation was terminated in 1997, growth assessments of field planted eucalyptus continue at Hantane station.

S.K.Sathyapala and P.D.Upali

15. Visitors/ Trainees

1. Dr. E. Hamaya from Japan visited the Tissue Culture laboratory at Hantane and carried out an experiment on bacterial contamination presence in tissue cultures of tea. He presented 500 autoclavable culture tubes and several plant growth hormones to the laboratory.
2. Visitors from Ranfer Teas (Pvt) Ltd. – 13th January
3. Two batches of Diploma students from Aquinas College – 3rd/4th March
4. Agriculture students from Eastern University of Sri Lanka – May
5. Agriculture students from Sabaragamuwa University 14th – 21st July
6. Two Indian Planters – 21st August
7. Students from Advanced Technical Institute, Nawala 29th September
8. Scientists from Tata Tea Ltd – 8th December
9. Director and Deputy Director of Agriculture Insurance Board – 22nd December
10. Mr. Tetsuji Saba from Japan
11. Mr. Arjan Otter
12. Two Trainee Assistants from Talawakelle Plantations – 19th August
13. Two Trainees from Hellbode Estate, Katukitula, – 6th October
14. Three Trainees from Hautville Estate, Agrapatana, – 5th November

15. Two Planter Trainees from Maskeliya Plantations 5 – th November
16. Planter Trainee from Malwatte Valley Plantation Company, – 11th November
17. Assistant Superintendents from Mayfield Estate, – 30th November
18. Two Trainees from Mackwood Plantations (Pvt.) Limited

16. Seminars/ Workshops/ Training Programmes/ Meetings

Dr M.T.K.Gunasekare

- Practical Course on Application of Genetic Engineering in Agriculture at National Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad, Pakistan (16th - 27th Feb.)
- Workshop on Training of Trainers at TRI, Talawakelle (10th March)
- Workshop on Accessing Information organised by National Science Foundation (25th July)
- Workshop on 'Use of Biodiversity in Agriculture', at PGIA, Peradeniya (15th Sep.)
- PGIA 10th Annual Congress at PGRC (19th-20th Nov.)

Dr S.K.Sathyapala

- Workshop on Training of Trainers at TRI, Talawakelle (10th March)
- Seminar on "Conservation and Sustainable Management of Biological Diversity in Sri Lanka: Implementation Strategies"– SLASS Auditorium, Colombo (5th June)
- workshop on Accessing information conducted by SLASS (25th July)
- Seminar on "Use of Bio diversity in Agriculture" at the PGIA (6th September)
- 18th Annual Sessions of Institute of Biology (18th November)

Mr M.Ratnayake

- Workshop on "Olfactometry and Trapping" (organised by the TRI and University of Peradeniya) at TRI, Talawakelle (19th - 21st March)

Mr V Shanmugarajah

- Workshop on Training of Trainers at TRI, Talawakelle (10th March)
- Participated in the RSC meeting at Hantane and addressed the participants on 'Clones for replanting and infilling in mid-country'
- Workshop on Training of Trainers (organised by the NIPM in Colombo, regarding plucking), 16th July
- Workshop on 'Use of Biodiversity in Agriculture', at PGIA, Peradeniya (15th Sep.)
- PGIA 10th Annual Congress at PGRC (19th-20th Nov.)
- Meetings of the Plant Breeders, Tissue Culturists and Biotechnologists

Mr. P.D.Upali

- 18th Annual Sessions of Institute of Biology 18th November

17. Presentation of Papers

Dr. M.T.K. Gunasekare presented a paper titled "Isolation of protoplasts from leaf tissue of tea (*Camellia sinensis* L.): Factors affecting protoplast yield and viability", at the PGIA 10th Annual Congress held on 19-20 Nov. 1998.

Dr. S.K.Sathyapala presented the following papers:

" Isolation and Characterization of Pollen protoplast of tea (*Camellia sinensis* L.)" at the 58th Annual Sessions of Sri Lanka Association for the Advancement of Science, December 1998.

"Development of *In vitro* Propagation method for *Eucalyptus robusta"* at the 18th Annual Sessions of the Institute of Biology Sri Lanka.

"Ultra Structural Features of Tea [Camellia sinensis(L.) O. Kuntz.] pollen" at the PGIA 10th Annual Congress held on 19th-20th Nov.

18. Publications

Gunasekare M.T.K and Evans P.K. (1998). Isolation of protoplasts from leaf tissue of tea *(Camellia sinensis* L.): Factors affecting protoplast yield and viability. Tropical Agric. Res., 10: 1-11.

Sathyapala, S. K. and Upali, P.D. (1998). Development of *In vitro* Propagation method for *Eucalyptus robusta* Proc.18th Annual Sessions of the Institute of Biology Sri Lanka. P1.

Sathyapala, S. K., Guan, L.M. and Adachi, T. (1998). Ultra Structural Features of Tea [*Camellia sinensis*(L.) O. Kuntz.] pollen. Tropical Agric. Res. (10) 254 -263.

Sathyapala S. K. (1998). Isolation and Characterization of Pollen protoplast of tea

(*Camellia sinensis* L.) Presented at the 58th Annual Sessions of Sri Lanka Association for the Advancement of Science, December 1998.

Seran, T.H., Hirimburegama, K. and Shanmugarajah, V. (1998). Regeneration of Plantlets from Cultured Anthers of Tea [Camellia sinensis (L.) O.Kuntz.]. Tropical Agric. Res., Vol 10, 1998, 271 - 281

19. Papers submitted

Gunasekare M.T.K. and Evans P.K.

Isolation and culture of mesophyll protoplasts from tea (*Camellia sinensis* L.)

20. Correspondence

There were 191 correspondences on various matters, including issue of cuttings.

21. Advisory visits

Messrs M.Ratnayake and S.W.Gunadasa assisted in the identification of clones in 10 estates. Messrs. A.K.M.Jayasena and J.H.N.Piyasundara helped in the identification of clones in 3 estates.

22. Training programmes

The Division took part in the residential training programmes held at the Institute for the Assistant Superintendents.Messrs.M.Ratnayake and S.W.Gunadasa participated in the training programme of the NIPM students on identification of clones.

Mr. V. Shanmugarjah addressed the NIPM students on 'Clonal Selection'.

SOILS AND PLANT NUTRITION DIVISION

Acting Head - L.S.K. Hettiarachchi

1. Project B/FERT - *Improvement and maintenance of fertility and productivity of tea soils*
Project Leader - L.S.K. Hettiarachchi

The overall research objective of this Division is to improve soil fertility of tea lands in Sri Lanka by efficient use and/or control of both organic and inorganic fertilizers and to thereby maximize their productivity and profitability.

The field experiments carried out are reported under B/FERT while the laboratory and glasshouse experiments appear under D/AGCH. The developments in relation to soil and plant chemical aspects and the soil, plant and fertilizer analyses undertaken are reported under C/ANAL.

1.1. Soil and Fertilizer Nitrogen Studies

1.1.1 Application of different proportions of sulphate of ammonia and urea on soil/plant sulphur status and yield of tea - clone TRI 2025, St.Coombs Estate, Talawakelle - (May 1979)

The yield obtained during the 2nd year of the 5th cycle is given in Table 1.

TABLE 1 - *Effect of different proportions of SA/Urea on the yield (kg MT ha^{-1} yr^{-1}) of mature tea*

	Level of N (kg ha^{-1} yr^{-1})			
Proportions (%) SA/Urea	240	360	Mean	
100:0	3025	3204	3115	
75:25	2871	3147	3009	
50:50	2873	3114	2993	SE 137.6
25:75	2832	2955	2894	
0:100	2925	2895	2910	
Mean	2905	3063	2984	
	SE 87.0			SE 194.5(18 df)
CV 11.3%				

Application of N at 360 kg ha^{-1} yr^{-1} gave 158 kg more made tea than the 240 kg ha^{-1} yr^{-1}, but this difference was not quite significant. The effects of SA/Urea ratio and the interaction on yield were non-significant.

The effect of application of SA and Urea on soil pH and sulphate sulphur levels (0-15 and 15-30 cm) and leaf sulphur concentrations are given in Tables 2, 3 and 4 respectively.

TABLE 2 - *Effect of application of different proportions of SA/Urea on soil pH at 0-15 and 15-30 cm depths*

Proportions (%)	*Soil pH*	
SA/Urea	*0-15 cm*	*15-30 cm*
100:0	4.08	4.23
75:25	4.30	4.26
50:50	4.34	4.28
25:75	4.49	4.42
0:100	4.70	4.57
SE	0.100	0.107
LSD (P=0.05)	0.297	0.318
CV %	5.6	6.0
Level of N		
(kg ha^{-1} yr^{-1})		
240	4.56	4.43
360	4.21	4.28
SE	0.063	0.068
LSD (P=0.05)	0.187	NS

Soil pH levels at both depths increased linearly as the proportion of Urea increased in SA + Urea combinations, significant for 0-15 cm, but not for 15-30 cm, probably due to lesser extent of chemical reactions taking place at the latter depth. This was even after the application of dolomitic limestone at 1000 kg ha^{-1} at pruning time in June 1996. This year, application of N at 360 kg ha^{-1} yr^{-1} resulted in significantly lower soil pH levels than 240 kg ha^{-1} yr^{-1}, at 0-15 cm depth but not at 15-30 cm. This was despite the fact that in the previous year, there was no significant difference in soil pH levels between 240 and 360 kg of N ha^{-1} yr^{-1} at 0-15cm, which was attributed to dolomitic limestone applications in June 1996.

TABLE 3 - *Effect of application of different proportions of SA and Urea on soil sulphate sulphur levels at 0-15 and 15-30 cm depths*

Proportions (%)	*$(SO_4)^{2-}$-S (mg kg^{-1})*	
SA/Urea	*0-15 cm*	*15-30 cm*
100:0	263	349
75:25	236	291
50:50	228	312
25:75	181	265
0:100	97	156
SE	36.5	36.2
LSD (P=0.05)	108.3	107.5
CV %	44.5	32.3
Level of N		
(kg ha^{-1} yr^{-1})		
240	188	262
360	214	287
SE	23.1	22.9
LSD (P=0.05)	NS	NS

TABLE 4 - *Effect of application of different proportions of SA and Urea on total leaf sulphur concentration*

Proportions (%) SA/Urea	*Total S (%)*
100:0	0.363
75:25	0.365
50:50	0.373
25:75	0.354
0:100	0.354
SE	0.015
LSD (P=0.05)	NS
CV %	10.1
Level of N (kg ha^{-1} yr^{-1})	
240	0.367
360	0.357
SE	0.037
LSD (P=0.05)	NS

No significant differences in soil sulphate sulphur levels were found between the two N rates, at either depth. However, there was a significant linear reduction in soil sulphate sulphur as the proportion of Urea increased in the combinations, at both depths. But leaf sulphur concentrations were not affected so far, as can be seen from Table 4. This experiment is in progress.

S. Ananthacumaraswamy and L.S.K. Hettiarachchi

1.1.2 Application of very high levels of urea and sulphate of ammonia on soil/plant nutrient status and yield of tea - clone TRI 2025, St.Coombs Estate, Talawakelle - (December 1990)

This is an observation trial established in December 1990 to study the ill effects of high levels of nitrogen. The yields obtained for the period July 1997 to June 1998, i.e. the 2nd year of the 2nd cycle, are given in Table 5.

TABLE 5 - *Effect of application of very high levels of SA and urea on yield of tea*

Nitrogen (kg ha^{-1} yr^{-1})	*Yield (kg MT ha^{-1} yr^{-1})*	
	Urea	*S/A*
0	1844	1955
300	1928	1915
600	1928	2323
900	2873	2650
1200	2892	2978
1500	2930	3045

During the 2nd year after pruning, no consistent trends in yield were observed with increasing N rates and the two different forms. This experiment is in progress.

G.P. Gunaratne and L.S.K. Hettiarachchi

1.1.3 Improvement of soil organic matter status and efficiency of uptake of inorganic fertilizer nutrients by incorporation of different sources of organic manure - clone TRI 2025, Bearwell Estate, Talawakelle - (1990)

The yields obtained in the 3rd year of the 2nd cycle, and soil pH levels at 0-15 and 15-30 cm depths are given in Tables 6, 7 and 8 respectively.

This year, there was no effect of N on yield, although previously there had been such an effect. The source and level of organic manure has had no effect so far.

TABLE 6 - *Effect of different organic manures at 5 and 10 t/ha, and N at 0 and 240 kg ha^{-1} yr^{-1} on the yield of tea (kg MT ha^{-1} yr^{-1}) - Main effects only*

Grand mean	2384				
N	0	240			
	2388	2380	SE 6.1		
Organic Manure	Compost	Cow dung	Mana grass	Guatemala grass	
	2396	2368	2390	2381	SE 8.7
Rates	5t/ha	10t/ha			
	2383	2384			SE 6.1
CV% 1.3					

TABLE 7 - *Effect of different organic manures at 5 and 10 t/ha, and N at 0 and 240 kg ha^{-1} yr^{-1} on soil pH at 0-15 cm depth - Main effects only.*

Grand mean	4.59				
N	0	240			
	4.71	4.47	SE 0.05		
Organic Manure	Compost	Cow dung	Mana grass	Guatemala grass	
	4.67	4.47	4.57	4.64	SE 0.07
Rates	5t/ha	10t/ha			
	4.57	4.60			SE 0.05
CV% 5.4					

TABLE 8 - *Effect of different organic manures at 5 and 10 t/ha, and N at 0 and 240 kg ha^{-1} yr^{-1} on soil pH at 15-30 cm depth - Main effects only.*

Grand mean	4.64				
N	0	240			
	4.76	4.52	SE 0.05		
Organic	Compost	Cow	Mana	Guatemala	
	Manure	dung	grass	grass	
	4.66	4.63	4.61	4.66	SE 0.07
	Rates	5t/ha	10t/ha		
		4.61	4.67		SE 0.05
CV% 5.6					

As seen previously, soil pH levels at both depths decreased significantly at 240 kg N ha^{-1} yr^{-1} compared to zero. The source and level of organic manure has had no effect so far.

S.M. Dissanayake, A.K.N. Zoysa and L.S.K. Hettiarachchi

1.1.4. Effect of seven different levels of nitrogen (0 to 720 kg ha^{-1} yr^{-1}) with compost manure (at 0 and 5 t ha^{-1} yr^{-1}) on soil/plant N status and yield of tea - clone DT1, St.Coombs Estate, Talawakelle - (1992)

The yields obtained during the period December 1997 to July 1998 (prior to prune in end July 1998) of the 1st cycle, soil pH and potassium levels at 0-15 cm depth are given in Tables 9, 10 and 11 respectively.

Although yields obtained in previous years significantly increased curvi-linearly with increasing rates of N towards 480 kg and then flattened out, yields obtained during this last lap prior to pruning, in end July 1998, did not significantly increase in a similar pattern. Compost had no overall effect, nor was there an interaction.

As expected, soil pH levels at 0-15 cm depth significantly decreased as the N rates increased. A significant quadratic pattern of decrease was also found.

Although soil potassium levels in general are expected to drop when nitrogen is applied excessively to soil, at this site, no such trends have so far been observed. This experiment is in progress.

TABLE 9 - *Effect of different levels of nitrogen with and without compost on yield*

Treatments *N level*	*Yield (MT kg ha^{-1})*			
	Compost			
	Nil	5t	Mean	
N				
0	1092	1180	1136	
120	1136	1159	1147	
240	1271	1308	1289	
360	1345	1441	1393	SE 62.6
480	1319	1278	1298	
600	1128	1249	1188	
720	1316	1200	1258	
Mean	1229	1259	1244	
				SE 33.5 SE 88.5
CV% 10.1				

TABLE 10 - *Effect of different levels of nitrogen with and without compost on soil pH*

Treatments *N level*	*Soil pH*			
	Compost			
	Nil	5t	Mean	
N				
0	4.35	4.30	4.33	
120	3.85	3.80	3.83	
240	3.70	3.82	3.75	
360	3.85	3.85	3.85	SE 0.132
480	3.70	3.65	3.68	
600	3.90	3.50	3.70	
720	4.00	3.95	3.95	
Mean	3.91	3.84	3.87	
	SE 0.07			SE 0.186
				LSD (P=0.05) 0.568
CV% 6.8				

TABLE 11 - *Effect of different levels of nitrogen with and without compost on soil exch. K*

Treatments *N level*	*Soil exch. K (mg kg^{-1})*			
	Compost			
	Nil	5t	Means	
N				
0	134	113	123	
120	243	245	244	
240	153	215	184	
360	203	238	220	SE 21.51
480	300	250	275	
600	248	223	235	
720	220	233	226	
Means	214.1	216.4	215.3	
	SE 11.5			SE 30.41
				LSD (P=0.05) 92.89
CV% 20.0				

R.G.A. Wijayawardhana and L.S.K. Hettiarachchi

1.1.5 Effects of different rates of N (240-600 kg ha^{-1} yr^{-1} N at 180kg N increments) and K (120-480 kg ha^{-1} yr^{-1} K at 180 kg K increments), and frequencies (6, 8 and 12 weekly intervals) on soil/plant nutrient status and yield - clone TC9, Brunswick Estate, Maskeliya - (1998)

This trial commenced as a collaborative study with the Manager of Brunswick Estate in January 1998. The primary objective of this trial is to investigate the effects of application of high levels of nitrogen along with potassium at different

frequencies on a high yielder such as TC9 in the Maskeliya region. The yields obtained from June to November 1998 are presented in Table 12.

Even within the 6 months of this study, yield increased significantly with increasing rates of N, and the pattern was linear. However, no effects were so far found either in relation to increasing rates of K or different frequencies. This experiment is in progress.

TABLE 12 - *Effects of different rates of N and K applied at different frequencies on the yield of tea (MT kg ha^{-1}) - Main effects only.*

N Level (kg ha^{-1} yr^{-1} N)	K level (kg ha^{-1} yr^{-1} K_2O) 120	300	480	Mean	
240	1533	1561	1560	1551	
420	1571	1679	1604	1618	SE 50.1
600	1598	1924	1800	1774	
Mean	1567	1721	1655		
			SE 50.1		SE 86.7
N Level	Frequency (weekly interval)				
(kg ha^{-1} yr^{-1} N)	6	8	12	Mean	
240	1524	1463	1667	1551	
420	1611	1606	1636	1618	SE 50.1
600	1659	1722	1942	1774	
					SE 86.7
K Level	Frequency (weekly interval)				
(kg ha^{-1} yr^{-1} K_2O)	6	8	12	Mean	
120	1550	1551	1600	1567	
300	1591	1632	1941	1721	SE 86.7
480	1653	1608	1703	1655	

S. Ananthacumaraswamy and L.S.K. Hettiarachchi

1.2. Soil and Fertilizer Potassium Studies

1.2.1 Split application of nitrogen and potassium fertilizer in mature tea in relation to N/K antagonism - clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

The yields obtained in the 2nd year of the 2nd cycle, and soil exch. potassium levels at 0-15 cm depth are presented in Tables 13 and 14 respectively.

TABLE 13 - *Effect of split application of potassium on yield of tea (kg MT ha^{-1} yr^{-1})*

% K fertilizer applied		*Rate of K (kg K_2O ha^{-1} yr^{-1})*			
Initially	*6 weeks after*	*120*	*240*	*Means*	
100	0	2799	2788	2793	
80	20	2877	2768	2822	
60	40	2921	2839	2880	SE 35.9
40	60	2700	2764	2732	

20	80	2688	2828	2758	
0	100	2718	2883	2801	
Mean		2784	2811	2798	
			SE 62.3		SE 88.0
					LSD (P=0.05) NS
CV %	6.3				

As in previous years, no significant differences in yield were observed either due to split applications or to K fertilizer rates.

TABLE 14 - *Effect of split application of potassium on soil exch. K (mg kg^{-1})*

% K fertilizer applied		*Rate of K (kg K_2O ha^{-1} yr^{-1})*			
Initially	*6 weeks after*	*120*	*240*	*Means*	
100	0	198	238	218	
80	20	190	258	224	
60	40	190	178	184	SE 9.66
40	60	146	150	148	
20	80	166	203	184	
0	100	171	135	120	
Mean		177	193	185	
		SE 16.73			SE 23.66
					LSD (P=0.05) 68.1
CV % 25.6					

Soil exchangeable K levels estimated after 5 1/2 years of application of potash and N along with split application of potash indicated that soil exch. K levels tend to drop due to split potash application, although such a trend was not to be observed in general. This experiment is in progress.

G.P. Gunaratne and L.S.K. Hettiarachchi

1.2.2 Effect 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 soil/plant K and Mg status and yield of tea - clone TRI 2025, Halgolla Estate, Yatiyantota - (1984)

After the completion of the third pruning cycle and assessments of data, investigations were concluded. Part of the data was presented at the 195th E and E Forum, and the overall results will be published as a paper.

G.P. Gunaratne and L.S.K. Hettiarachchi

1.2.3 The effect 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) on soil/plant K/Mg status and yield of tea – clone TRI 2025, Glenanore Estate, Haputale - (1991)

The yields obtained in the 3rd year of the 2nd cycle are given in Table 15.

TABLE 15 - *Effect of different N:K_2O ratios and MgO on yield of tea (kg MT ha^{-1} yr^{-1})*

(all plots received 240 kg ha^{-1} yr^{-1} of N)

K_2O	*N:K_2O ratio*	*MgO Nil*	*MgO 60kg*	Mean	
48	5:1	2325	2345	2335	
60	4:1	2304	2250	2277	
80	3:1	2331	2320	2326	SE 36.7
120	2:1	2319	2294	2307	
240	1:1	2393	2241	2317	
360	2:3	2329	2337	2333	
480	1:2	2357	2299	2328	
Mean		2337	2298	2317	
		SE 19.6			SE 51.8
					LSD (P=0.05) NS
CV % 5.0					

As seen in previous years, no significant differences in yield have been observed due to different potash or MgO rates.

The effect of N:K_2O ratios and of MgO on soil K and Mg status are given in Tables 16 and 17 respectively.

TABLE 16 - *Effect of different N:K_2O ratios and MgO on soil exch. K status (mg kg^{-1}) at two soil depths*

K_2O	*N:K_2O ratio*	*MgO Nil*	*MgO 60kg*	*Nil 0-15 cm*	*60kg 15-30 cm*
48	5:1	130	124	142	117
60	4:1	150	127	145	152
80	3:1	120	132	132	162
120	2:1	160	159	170	170
240	1:1	240	207	232	220
360	2:3	210	190	227	205
480	1:2	307	224	315	205
SE (52 df)		24.2		22.1	
Mean		188	166	195	176
SE		9.14		8.36	
CV %		30.5		26.7	

TABLE 17 - *Effect of different N:K_2O ratios and MgO on soil exch. Mg status (mg kg^{-1}) at two soil depths*

K_2O	N:K_2O ratio	MgO Nil	MgO 60kg	Nil 0-15 cm	60kg 15-30 cm
48	5:1	162	182	140	176
60	4:1	167	196	198	199
80	3:1	177	213	181	213
120	2:1	180	213	169	183
240	1:1	211	181	163	200
360	2:3	188	209	158	201
480	1:2	197	190	200	227
SE (52 df)		25.8		29.5	
Mean		183	198	173	200
SE		9.73		11.2	
CV %		30.2		35.4	

As expected, there was a significantly increasing trend in soil K level with increasing ground K fertilizer rates, at both depths. There was no effect of Mg fertilizer application at either depth.

As far as this year's soil exch. Mg levels are concerned, there were some differences between treatments with and without Mg, but no consistent pattern was observed, as in previous years.

The effect of N:K_2O ratios and MgO on leaf Mg and K is given in Table 18.

TABLE 18 - *Effect of different N:K_2O ratios and MgO on leaf Mg and K (%)*

K_2O	N:K_2O ratio	MgO Nil	MgO 60kg	Nil Leaf Mg	60kg Leaf K
48	5:1	0.24	0.27	1.33	1.45
60	4:1	0.24	0.27	1.39	1.42
80	3:1	0.27	0.26	1.40	1.38
120	2:1	0.24	0.26	1.41	1.22
240	1:1	0.24	0.25	1.47	1.34
360	2:3	0.23	0.24	1.55	1.43
480	1:2	0.23	0.24	1.45	1.57
SE (52 df)		0.010		0.075	
Mean		0.24	0.26	1.43	1.40
SE		0.004		0.028	
CV %		9.2		11.8	

As observed previously, leaf magnesium concentration significantly increased due to ground Mg fertilizer application at 60kg ha^{-1} yr^{-1}. There was a linear increase in leaf K concentration with increasing rates of soil applied K. This experiment is in progress.

R.G.A. Wijayawardhana, G.P. Gunaratne and L.S.K. Hettiarachchi

1.2.5 The effect of increasing levels of potash (in 200kg increments) with N (in 100kg increments) fertilizer, on soil/plant N/K status and yield of tea - clone TRI 2025, St.James Estate, Hali Ela - (1990)

The yields obtained in the third year of the 2nd cycle are given in Table 19.

TABLE 19 - *Effect of increasing levels of potash with N on yield of tea*

	Yield(kg MT ha^{-1} yr^{-1})				
	K_2O(kg ha^{-1} yr^{-1})				
N	100	300	500	Mean	
(kg ha^{-1} yr^{-1})					
100	1528	1549	1558	1545	
200	1578	1675	1634	1629	
300	1575	1645	1556	1592	SE 34.0
400	1635	1618	1695	1649	
500	1616	1694	1597	1636	
Mean	1586	1636	1608	1610	
			SE 26.3		SE 58.9
					LSD (P=0.05) NS
CV % 9.0					

So far, no differences in yield have been observed due to soil applications of N and K fertilizers with different N:K_2O ratios. However, an incremental rate of 17kg MT in yield per 100kg N, was observed due to the fitted linear response, although not quite significant.

The effects of N and potash ground applications on soil K status, and leaf N and K are given in Tables 20 and 21 respectively.

TABLE 20 - *Effect of increasing levels of potash with N on soil exch. K status at two depths (main effects only)*

Level of N (kg ha^{-1} yr^{-1})	*Soil exch. K (mg kg^{-1})*	
	0-15 cm	*15-30 cm*
100	199	188
200	199	184
300	179	192
400	183	172
500	178	182
SE	9.4	10.1

Level of K_2O (kg ha^{-1} yr^{-1})		
100	135	144
300	192	184
500	236	222
SE	7.3	7.8
CV %	21.3	23.4

TABLE 21 - *Effect of increasing levels of potash with N on leaf N and K status*

Level of N (kg ha^{-1} yr^{-1})	*Leaf nutrient (%)*	
	N	*K*
100	3.39	1.52
200	3.40	1.53
300	3.49	1.49
400	3.43	1.48
500	3.56	1.46
SE	0.040	0.021
Level of K_2O (kg ha^{-1} yr^{-1})		
100	3.44	1.48
300	3.46	1.50
500	3.45	1.51
SE	0.031	0.017
CV %	5.0	6.0

As expected, soil K levels increased significantly with increasing potash rates at both depths, but not with increasing N rates, although the K levels estimated in last year appeared to decrease with N rates. As in the previous years, leaf N concentration significantly increased linearly with the increasing N rates while K concentration remained unaffected this year. Leaf N concentration was unaffected by higher rates of K, while K concentration tended to increase. This experiment is in progress.

R.G.A. Wijayawardhana, G.P. Gunaratne and L.S.K. Hettiarachchi

1.3 Soil and Fertilizer Phosphorus Studies

1.3.1 Application of increasing levels of phosphate (0 to 120 kg P_2O_5 ha^{-1} yr^{-1} at 20 kg increments) fertilizer on soil/plant P status and yield of tea - clone TRI 2025, St.Coombs Estate, Talawakelle - (1989)

The yield obtained in the 4th year of the 2nd cycle and soil P levels are given in Tables 22 and 23 respectively.

TABLE 22 - *Effect of increasing levels of phosphate fertilizer on yield*

Level of P fertilizer (kg ha^{-1} yr^{-1} P_2O_5)	*Yield (MT kg ha^{-1} yr^{-1})*
0	2843
20	2758
40	2746
60	2855
80	2684
100	2625
120	2732
Mean	2749
SE	78.8
CV %	6.4

As seen in previous years, no significant increases in yield were found with the increasing rates of P from ERP.

TABLE 23 - *Effect of increasing levels of phosphate fertilizer on soil extractable P*

Level of P fertilizer (kg ha^{-1} yr^{-1} P_2O_5)	*Soil extractable P (mg kg^{-1})*	
	0-15 cm	*15-30 cm*
0	9.3	16.7
20	31.7	15.3
40	30.0	18.5
60	52.7	55.3
80	42.2	64.5
100	50.0	56.4
120	57.5	49.6
Mean	39.1	39.5
SE	9.01	9.66
LSD (P=0.05)	17.54	28.20
CV %	51.60	54.70

In general, soil P levels at both depths, extracted from borax solution (pH=1.5) increased linearly with the increasing rates of phosphorus from ERP. However, coefficients of variation were fairly high, probably due to uneven mobility of soil applied phosphorus from ERP. This experiment is in progress.

H.A.P. Warnasiri, A.K.N. Zoysa and L.S.K. Hettiarachchi

1.3.2 Application of increasing levels of phosphate fertilizer with two methods of application (Broadcast and Incorporated) on soil/plant P status and yield of tea -clone TRI 2025, Walahanduwa Estate, Galle - (1994)

The yield obtained in the 1st year of the 2nd cycle and soil extractable P levels from 0-15cm depth are given in Tables 24 and 25 respectively.

TABLE 24 - *Effect of increasing levels of surface applied and soil incorporated ERP on yield*

Levels of P fertilizer (kg ha^{-1} yr^{-1} P_2O_5)	*Yield (MT tea kg ha^{-1} yr^{-1})*			
	Surface applied	*Soil Incorporated*	*Mean*	
0	1652	1834	1743	
20	1696	1619	1657	
40	1933	1576	1755	
60	1765	1701	1733	SE 79.5
80	1634	1434	1534	
100	1747	1689	1718	
120	1723	1823	1773	
Mean	1668	1736	1702	SE 112.4
	SE 42.5			LSD (P=0.05) 326.8
CV %	11.4			

TABLE 25 - *Effect of increasing levels of surface applied and soil incorporated ERP on soil extractable P*

Levels of P fertilizer (kg ha^{-1} yr^{-1} P_2O_5)	*Soil extractable P (mg kg^{-1})*			
	Surface applied	*Soil Incorporated*	*Mean*	
0	2.1	12.3	7.2	
20	6.4	4.1	5.3	
40	9.1	11.8	10.4	
60	21.8	5.9	13.9	SE 4.46
80	29.7	14.8	22.3	
100	11.1	16.0	13.6	
120	16.2	19.7	18.0	
Mean	13.8	12.1	12.9	SE 6.31
	SE 2.39			LSD (P=0.05) 18.38
CV % 84.5				

So far, no significant differences in yield have been observed due to either the rates of P or mode of application, nor soil extractable P levels from 0-15cm depth. This experiment is in progress.

H.A.P. Warnasiri, A.K.N. Zoysa and L.S.K. Hettiarachchi

1.3.3 Effect of foliar application of phosphorus (0,1,2,3 and 4% DAP and TSP) on plant P status, quality (biochemical parameters) and yield of tea - clones DT 1 and CY9, St.Coombs Estate, Talawakele - (1992)

The yields obtained in the 5th year of the 1st cycle for CY9 and DT1 clones are presented in Tables 26 and 27 respectively.

TABLE 26 - *Effect of foliar application of phosphate on yield of clone CY9*

Treatments	*Yield (MT kg ha^{-1} yr^{-1})*			
Control (water)		1331		
	Type of P fertilizer			
	TSP	DAP	Mean	
P concentration (%)				
1	1307	1300	1304	
2	1444	1417	1431	SE 33.5
3	1293	1386	1340	
4	1397	1347	1372	
Mean	1360	1363		
	SE 23.7			SE 47.4 (8 df)
				CV % 4.9

TABLE 27 - *Effect of foliar application of phosphate on yield of clone DT1*

Treatments	*Yield (MT kg ha^{-1} yr^{-1})*			
Control (water)		1395		
	Type of P fertilizer			
	TSP	DAP	Mean	
P concentration (%)				
1	1438	1379	1409	
2	1341	1480	1411	SE 43.9
3	1377	1275	1326	
4	1371	1355	1363	
Mean	1382	1373		
	SE 31.0			SE 62.0 (8 df)
				CV % 6.4

So far, no significant differences in yield have been observed either for type of P fertilizer sprays or concentrations. Plans are under way to test the effects for clone TRI 2025. This experiment is in progress.

R.G.A. Wijayawardhana and L.S.K. Hettiarachchi

1.4 Soil and Fertilizer Magnesium Studies

1.4.1 Application of increasing levels of kieserite on soil/plant nutrient status and yield of tea - clone TRI 2025, St.Coombs Estate, Talawakelle - (1990)

The yield obtained in the 2nd year of the 2nd cycle and the effect of kieserite on soil pH levels are given in Tables 28 and 29 respectively.

TABLE 28 - *Effect of increasing levels of kieserite application on yield*

Level of kieserite (kg ha^{-1} yr^{-1} MgO)	*Yield (MT kg ha^{-1} yr^{-1})*
0	2905
15	2653
30	2807
45	2721
60	2646
75	2704
SE	92.3
CV %	6.7

As seen in previous years, no significant differences in yield were observed due to different kieserite fertilizer rates.

TABLE 29 - *Effect of increasing levels of kieserite on soil pH at two soil depths*

Level of kieserite (kg ha^{-1} yr^{-1} MgO)	*Soil pH*	
	0-15 cm	*15-30 cm*
0	4.63	4.48
15	4.53	4.73
30	4.48	4.58
45	4.60	4.80
60	4.60	4.78
75	4.60	4.80
SE	0.104	0.103
CV %	4.6	4.4

So far, no significant differences were observed in soil pH levels at both depths, due to different kieserite fertilizer rates. This experiment is in progress.

H.A.P. Warnasiri and L.S.K. Hettiarachchi

1.4.2. Application of increasing levels of dolomite fertilizer at three frequencies (Cycle, Mid and Yearly basis) on soil/plant nutrient status and yield of tea - clone TC 9, Field No.4, St.Coombs Estate, Talawakelle - (1989)

The yields obtained in the 4th year of the 2nd cycle are given in Table 30.

TABLE 30 - *Effect of increasing level of dolomite application on yield of tea*

Level of dolomite (kg ha^{-1} pruning cycle^{-1})	*Yield (MT kg ha^{-1} yr^{-1}) Frequency of dolomite application*				
	Cycle	*Mid-cycle*	*Yearly*	*Mean*	
Control	2081	–	–	–	
1250	2051	2102	2116	2090	
2500	2083	2109	2137	2110	SE 38.5
5000	2046	1966	1931	1981	
10000	1761	1976	–	1869	SE 47.1
Mean	1985	2038	2061		
SE	33.3	33.3	38.5		SE 66.2 (44 df)
CV % 13.8					

The yields decreased significantly with increasing rates of dolomite, and the pattern of decrease was linear. This is particularly so beyond 5000 kg ha^{-1} pruning-$cycle^{-1}$ application. As seen previously, a lower yield was again observed in the plots that received dolomite at the rate of 10,000 kg ha^{-1}, at cycle frequency during the period January to December 1998 as well. But no influence was found due to the frequency of application. This experiment is in progress.

H.A.P. Warnasiri and L.S.K. Hettiarachchi

1.4.3 Application of increasing levels of dolomite fertilizer at three frequencies (Cycle, Mid and Yearly basis) on soil/plant nutrient status and yield of tea - clone TRI 2025, Field No.2, Morogolla Estate, Imaduwa - (1990)

The yield obtained in the 2nd year of the 3rd cycle is given in Table 31.

TABLE 31 - *Effect of increasing levels of dolomite application on yield of tea*

Level of dolomite (kg ha^{-1} pruning $cycle^{-1}$)	*Yield (MT kg ha^{-1} yr^{-1}) Frequency of dolomite application*				
	Cycle	*Mid-cycle*	*Yearly*	*Mean*	
Control	3298	–	–	–	
1000	3814	3525	3899	3746	
3000	4166	3487	3805	3819	SE 168.1
5000	3510	3342	3608	3487	
Mean	3830	3452	3770		
		SE 168.1			SE 291.2 (18 df)
CV % 13.8					

At this experimental site, as seen previously, no significant differences in yield were observed either due to different rates of dolomite or to frequency of application. However, a lower yield was observed again during this year on the control plots where no dolomite had been received over a period of 8 years. This experiment is in progress.

H.A.P. Warnasiri and L.S.K. Hettiarachchi

1.4.4 Effect of different particle sizes of applied dolomite fertilizer on soil pH, soil/plant Mg status and yield of tea - clone TRI 2023, Matakelle Estate, Talawakelle - (1991)

The yield obtained in the 2nd year of the 2nd cycle and soil exch. Mg levels at 0-15 and 15-30 cm depths are presented in Tables 32 and 33 respectively.

TABLE 32 - *Effect of different sizes (BS) of dolomite particles on yield of tea*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	Yield (MT kg ha^{-1} yr^{-1})				
	2379	2468	2402	2457	2454
SE	94.5 (33 df)				
CV %	7.7				

* Presently recommended particle size of dolomite fertilizer

As has been seen, no significant differences in yield were observed due to application of dolomitic limestone with different particle size combinations.

TABLE 33 - *Effect of different sizes (BS) of dolomite particle on soil exch. Mg level*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
Depth (cm)	*Soil exch. Mg (mg kg^{-1})*				
0-15	76	68	85	89	73
15-30	60	47	61	62	63
SE (0-15)	17.7 (33 df)				
	CV % 43.1				
SE (15-30)	9.6 (33 df)				
CV % 33.8					

* Presently recommended particle size of dolomite fertilizer

In general, no significant differences in soil Mg levels were found due to the application of dolomitic limestone with these different particle size combinations, at both depths. This experiment is in progress.

H.A.P. Warnasiri and L.S.K. Hettiarachchi

1.4.5 Effect of different particle sizes of applied dolomite fertilizer on soil pH, soil/plant Mg status and yield of tea - clone TRI 2025, Talangaha Estate, Nakiyadeniya - (1991)

The yield obtained in the 1st year of the 3rd cycle and soil exch. Mg levels at 0-15 and 15-30 cm depths are presented in Tables 34 and 35 respectively.

TABLE 34 - *Effect of different sizes (BS) of dolomite particles on yield of tea*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	Yield (MT kg ha^{-1} yr^{-1})				
	1680	1627	1700	1588	1687
SE 56.6 (33 df)					
CV % 6.9					

* Presently recommended particle size of dolomite fertilizer

TABLE 35 - *Effect of different sizes (BS) of dolomite particle on soil exch. Mg level*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
Depth (cm)	*Soil exch. Mg (mg kg^{-1})*				
0-15	99	97	90	100	90
15-30	79	92	91	66	53
SE (0-15)	14.5 (33 df)				
CV % 27.4					
SE (15-30)	13.1 (33 df)				
CV % 31.0					

* Presently recommended particle size of dolomite fertilizer

As has been observed, even at this site, no significant differences in yield as well as of soil Mg levels (at 0-15cm depth) were observed due to application of dolomitic limestone with different particle size combinations.

However, at this site, considerably lower Mg levels were observed at 15-30 cm depth, from 2 most grainy particle size combinations. This experiment is in progress.

H.A.P. Warnasiri and L.S.K. Hettiarachchi

1.4.6 Effects of application of potassium and/or magnesium from Sul-Po-Mag and kieserite at 2 levels of N on soil/plant nutrient status and yield of tea - clone TRI 2025, Kiruwanaganga Estate, Galle - (1993)

The yield obtained in the second year of the 2nd cycle, and the soil pH and exch. Mg levels are presented in Tables 36, 37 and 38 respectively.

TABLE 36 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield*

	Yield (made tea kg ha^{-1} yr^{-1})			
Treatments	*Level of Nitrogen (kg ha^{-1} yr^{-1})*			
	240	*360*	*Means*	
U 709 (Urea)	3712	3656	3684	
U 709 + Kieserite	3489	3606	3547	
U 750 Sul-Po-Mag	3364	3446	3405	SE 135.2
UT Mix. (Urea & SA)	3638	3311	3475	
T 1130 (SA)	3871	3496	3683	
Mean	3615	3503	3559	SE 191.2
	SE 85.5			LSD (P=0.05) NS
CV % 10.7				

So far, no significant yield differences have been observed either due to application of different fertilizer mixtures or between the two N levels.

TABLE 37 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil pH levels at 0-15 and 15-30 cm depths*

Treatments	*Soil pH at 0-15 cm* *Level of Nitrogen (kg ha^{-1} yr^{-1})*			
	240	*360*	*Mean*	
U 709 (Urea)	4.54	4.58	4.56	
U 709 + Kieserite	4.58	4.82	4.70	
U 750 Sul-Po-Mag	4.70	4.54	4.62	SE 0.104
UT Mix. (Urea & SA)	4.50	4.49	4.49	
T 1130 (SA)	4.11	4.39	4.25	
Mean	4.48	4.56	4.52	SE 0.147
	SE 0.066			LSD (P=0.05) 0.426
CV % 6.5				
	Soil pH at 15-30 cm			
U 709 (Urea)	4.42	4.53	4.47	
U 709 + Kieserite	4.39	4.64	4.52	
U 750 Sul-Po-Mag	4.52	4.41	4.46	SE 0.073
UT Mix. (Urea & SA)	4.39	4.36	4.37	
T 1130 (SA)	3.79	4.21	4.00	
Mean	4.30	4.43	4.36	SE 0.104
		SE 0.046		LSD (P=0.05) 0.302
CV % 4.8				

Application of dolomitic limestone at the rate of 1200 kg ha^{-1}, after the plots were pruned in 1996, has not caused any significant differences in soil pH levels between 240 and 360 kg N ha^{-1} yr^{-1}. However, pH levels at both depths significantly dropped where T1130 has been applied.

TABLE 38 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil exch. Mg at 0-15 and 15-30cm depths*

Treatments	*Soil exch. Mg at 0-15 cm (mg kg^{-1})* *Level of Nitrogen (kg ha^{-1} yr^{-1})*			
	240	*360*	*Mean*	
U 709 (Urea)	36.7	38.9	37.8	
U 709 + Kieserite	55.7	68.6	62.2	
U 750 Sul-Po-Mag	58.3	51.4	54.9	SE 6.87
UT Mix. (Urea & SA)	39.6	37.2	38.4	
T 1130 (SA)	21.8	41.8	31.8	
Mean	42.4	47.6	45.0	SE 9.72
SE		4.35		LSD (P=0.05) 28.17
CV % 43.2				

	Soil exch. Mg at 15-30 cm (mg kg^{-1})			
U 709 (Urea)	36.1	47.6	41.8	
U 709 + Kieserite	60.3	77.9	69.1	
U 750 Sul-Po-Mag	62.2	54.7	58.4	SE 6.51
UT Mix. (Urea & SA)	44.0	48.6	46.3	
T 1130 (SA)	31.8	54.4	43.1	
Mean	46.9	56.6	51.7	SE 9.21
SE		4.12		LSD (P=0.05) 26.70
CV % 35.6				

So far, no significant effect on soil Mg levels was found due to N levels and addition of Mg enriched NPK fertilizer mixtures, at both depths. However, exch. Mg levels appeared to have improved due to addition of Mg enriched NPK fertilizer mixtures. Also, considerably lower levels were found particularly from the plots that received T1130 mixture, which is probably due to lower soil pH values, even after dolomitic limestone application at the time of pruning compared to other plots, as can be seen from Table 37. This experiment is in progress.

S.M. Dissanayake and L.S.K. Hettiarachchi

1.4.7 Effects of application of potassium and/or magnesium from Sul-Po-Mag and kieserite with and without dolomite on soil/plant nutrient status and yield of tea - clone TRI 2025, Hopton Estate, Passara - (1993)

The yields obtained in the 4th year of the 1st cycle, and the soil pH and exchangable Mg levels are presented in Tables 39, 40 and 41 respectively.

TABLE 39 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield of tea*

	Yield (kg MT ha^{-1} yr^{-1})			
Treatments	*- dolomite*	*+ dolomite*	*Mean*	
U 709 (Urea)	3943	4020	3981	
U 709 + Kieserite	4144	3992	4068	
U 750 Sul-Po-Mag	4118	3730	3924	SE 63.0
UT Mix. (Urea & SA)	3818	3830	3824	
T 1130 (SA)	3856	3953	3905	
Mean	3976	3905	3940	
		SE 39.8		SE 89.0
				LSD (P=0.05) 258.3
CV % 4.5				

So far, no significant effect in yield has been found between these fertilizer treatments, with or without dolomite applications.

TABLE 40 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil pH levels at 0-15 and 15-30 cm depths*

Treatments	*Soil pH at 0-15 cm* *Dolomite* -	+	*Mean*	
U 709 (Urea)	4.90	4.92	4.91	
U 709 + Kieserite	4.75	4.85	4.80	
U 750 Sul-Po-Mag	4.82	4.95	4.89	SE 0.092
UT Mix. (Urea & SA)	4.62	4.75	4.69	
T 1130 (SA)	4.49	4.33	4.41	
Mean	4.72	4.76	4.74	SE 0.129
SE	0.058			LSD (P=0.05) 0.374
CV % 5.5				
	Soil pH at 15-30 cm			
U 709 (Urea)	5.12	4.88	4.99	
U 709 + Kieserite	4.79	4.85	4.82	
U 750 Sul-Po-Mag	4.69	4.93	4.81	SE 0.115
UT Mix. (Urea & SA)	4.57	4.56	4.57	
T 1130 (SA)	4.39	4.29	4.34	
Mean	4.71	4.70	4.71	SE 0.162
SE	0.073			LSD (P=0.05) 0.470
CV % 6.9				

At this site as well, pH levels at both depths significantly dropped where T1130 was applied. However, no significant effect has so far found, with and without the dolomite treatment.

TABLE 41 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil exch. Mg levels at 0-15 and 15-30 cm depths*

Treatments	*Soil exch. Mg at 0-15 cm (mg kg^{-1})* *Dolomite* -	+	*Mean*	
U 709 (Urea)	38.9	43.4	41.2	
U 709 + Kieserite	39.3	40.8	40.0	
U 750 Sul-Po-Mag	31.4	50.2	40.8	SE 4.70
UT Mix. (Urea & SA)	27.4	36.8	32.1	
T 1130 (SA)	25.1	23.3	24.2	
Mean	32.4	38.9	35.7	SE 6.65
SE		2.97		LSD (P=0.05) 19.3
CV % 37.3				

	Soil exch. Mg at 15-30cm (mg kg^{-1})			
U 709 (Urea)	53.8	45.5	49.6	
U 709 + Kieserite	42.3	39.4	40.8	
U 750 Sul-Po-Mag	34.4	57.5	45.9	SE 6.19
UT Mix. (Urea & SA)	22.1	25.6	23.8	
T 1130 (SA)	24.6	23.6	24.1	
Mean	35.4	38.3	36.9	SE 8.76
SE	3.92			LSD (P=0.05) 25.4
CV % 47.5				

So far, no significant effect on soil Mg levels has been found with and without the dolomite treatment and addition of Mg enriched NPK fertilizer mixtures, at both depths. However, considerably lower levels were found particularly from the plots that received T1130 mixture, which is probably due to lower soil pH values, as can be seen from Table 40. This experiment is in progress.

S.M. Dissanayake and L.S.K. Hettiarachchi

1.4.8 Effects of application of potassium and/or magnesium from Sul-Po-Mag and kieserite at 2 levels of N on soil/plant nutrient status and yield of tea - clone TRI 2025, Waltrim Estate, Talawakelle - (1994)

The yield obtained in the 4th year of the 1st cycle, and the soil pH levels and exch. Mg levels are presented in Tables 42, 43 and 44 respectively.

TABLE 42 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield of tea*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})* *Level of Nitrogen (kg ha^{-1} yr^{-1})*			
	240	*360*	*Mean*	
U 709 (Urea)	4524	4517	4521	
U 709 + Kieserite	4260	4572	4416	
U 750 Sul-Po-Mag	4443	4720	4582	SE 85.4
UT Mix. (Urea & SA)	4310	4619	4464	
T 1130 (SA)	4504	4715	4609	
Mean	4408	4629	4518	
	SE 54.0			SE 120.8
				LSD (P=0.05) 358.9
CV % 4.6				

TABLE 43 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil pH levels at 0-15 and 15-30cm depths*

Treatments	*Soil pH at 0-15 cm* *Level of Nitrogen (kg ha^{-1} yr^{-1})* *240*	*360*	*Mean*	
U 709 (Urea)	4.30	4.00	4.15	
U 709 + Kieserite	4.47	4.27	4.37	
U 750 Sul-Po-Mag	4.47	4.47	4.47	SE 0.083
UT Mix. (Urea & SA)	4.43	4.33	4.38	
T 1130 (SA)	4.17	4.20	4.18	
Mean	4.37	4.25	4.31	SE 0.118
SE	0.053			LSD (P=0.05) 0.351
CV % 4.7				
	Soil pH at 15-30 cm			
U 709 (Urea)	4.30	4.30	4.30	
U 709 + Kieserite	4.30	4.23	4.27	
U 750 Sul-Po-Mag	4.40	4.30	4.35	SE 0.064
UT Mix. (Urea & SA)	4.30	4.40	4.35	
T 1130 (SA)	4.17	4.13	4.15	
Mean	4.29	4.27	4.28	SE 0.090
SE	0.040			LSD (P=0.05) 0.267
CV % 3.6				

This year too, the yield significantly increased with the higher rate of N. But, there were no differences between the other fertilizer treatments.

So far, significant differences in soil pH levels were not found between 240 and 360 kg N ha^{-1} yr^{-1} at either depth, but somewhat lower levels were recorded at the higher rate of N. The pH levels at both depths significantly dropped where T1130 was applied.

TABLE 44 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil exch. Mg at 0-15 and 15-30cm depths*

Treatments	*Soil exch. Mg at 0-15 cm (mg kg^{-1})* *Level of Nitrogen (kg ha^{-1} yr^{-1})* *240*	*360*	*Mean*	
U 709 (Urea)	19.7	28.2	24.0	
U 709 + Kieserite	24.6	29.5	27.0	
U 750 Sul-Po-Mag	29.6	34.1	31.9	SE 4.78
UT Mix. (Urea & SA)	24.9	23.6	24.3	
T 1130 (SA)	17.5	17.1	17.3	
Mean	23.3	26.5	24.9	SE 6.76
SE	3.02			LSD (P=0.05) 20.09
CV % 47.1				

	Soil exch. Mg at 15-30 cm (mg kg^{-1})			
U 709 (Urea)	16.1	21.5	18.8	
U 709 + Kieserite	27.7	27.4	27.5	
U 750 Sul-Po-Mag	38.4	29.5	33.9	SE 4.68
UT Mix. (Urea & SA)	25.1	27.7	26.4	
T 1130 (SA)	16.7	18.5	17.6	
Mean	24.8	24.9	24.9	SE 6.62
SE	2.96			LSD (P=0.05) 19.67
CV % 46.1				

No significant increases in soil Mg levels were found due to the application of Mg enriched NPK mixtures such as U709 + kieserite and U750 (Sul-Po-Mag) compared to NPK mixtures, although marginal increases were observed last year. As observed previously, there was no significant difference between the two rates of N, and there was no interaction either.

S.M. Dissanayake and L.S.K. Hettiarachchi

2. IPM/SHB Experiments

In accordance with the proposals made by the SHB task force, two nursery experiments were commenced at Hantane sub-station and Attampitia Estate to test the effects of different potash (K_2O) levels on SHB infestation, using SHB resistant, susceptible and tolerant clones, with a view to testing under field conditions. The representative number of plants raised were removed after 4 - 5 and 8 - 9 months periods, and their soil and leaf samples were analyzed for the required parameters. Thereafter, the treated plants that remained on the beds after the completion of respective periods were transplanted in the field, in order to investigate the effects on immature plants in statistically designed trials. These experiments are in progress and some of the results obtained from two nursery experiments are presented.

In order to assess growth, the number of leaves, height, and leaf, stem and root dry weights of plants were measured. In addition, plant and soil nutrient status were also measured. Plant materials such as leaf, stem and twigs were analysed for N, K and Mg while soils were analysed for water soluble and exchangeable K and Mg.

Leaf K contents estimated after raising nursery plants (i.e. 8 - 9 months) for Hantane and Attampitia experiments are given in Table 45 and 46 respectively.

TABLE 45 - *Effect of different rates of K applied over the foliage on leaf K content (%) of nursery plants for Hantane experiment*

K treatment	*Leaf K content (%)*				
	Clone				
	2023	2025	DN	Mean	
T65 (recommended)	1.93	1.58	2.08	1.86	
T65 + 05 parts SOP	1.62	2.08	1.81	1.84	SE 0.147
T65 + 10 parts SOP	1.75	2.02	2.77	2.18	
T65 + 15 parts SOP	1.84	1.98	2.23	2.02	
Mean	1.79	1.92	2.22		
	SE 0.118				SE 0.249(18)
CV% 22.3					

At the Hantane experimental site, although leaf K levels were expected to increase after application over the foliage, no significant influence was found at the end nor was there any interaction between clone and K supply. However leaf K concentrations appeared to improve with the supply. Leaf nitrogen and magnesium concentrations were not affected significantly.

TABLE 46 - *Effect of different rates of K applied over the foliage on leaf K content (%) of nursery plants for Attampitia experiment*

K treatment	*Leaf K content (%)*				
	Clone				
	4070	2025	DN	Mean	
T65 (recommended)	1.96	2.08	2.24	2.09	
T65 + 05 parts SOP	2.18	2.18	2.36	2.24	SE 0.040
T65 + 10 parts SOP	2.27	2.42	2.52	2.40	
T65 + 15 parts SOP	2.23	2.40	2.60	2.41	
Mean	2.16	2.27	2.43		
	SE 0.0730				SE 0.095(18)
					CV% 5.3

At the Attampitia experimental site, leaf K contents increased significantly with increasing K supply, and the pattern was linear but there was no interaction between clone and K supply. As in the case of the Hantane experiment, leaf nitrogen and magnesium concentrations were not affected significantly. The results of these two nursery experiments will be published in due course. The trials laid down with immature plants under field conditions are in progress.

H.A.P. Warnasiri, W.M.S. Wijethunge, G.P. Gunaratne and L.S.K. Hettiarachchi

3. Project D/AGCH - Divisional activities

3.1 Characterization of soils in tea growing areas in Sri Lanka

This project commenced in early July 1995 in collaboration with the Land Use Division of the Irrigation Department. Altogether, 12 soil pits were cut from the Ratnapura district from the identified soil types in different regions. A memorandum of understanding (MOU) was drafted, but it is awaiting finalization in order to carry out the work programme effectively, with a few modifications. However, this part of the project was temporarily suspended in the wake of a decision by the TRI'S Consultative Committee on Research.

In addition, under the contract research project funded by CARP, a soil survey commenced in November 1996 in order to prepare detailed soil distribution maps through GIS software from 5 selected estates, to incorporate soil information as part of the process of land use planning for development of marginal tea lands in the mid country. The soils of West Hall, Hantane, Craighead, Galphelle and Ratwatte

Estates were surveyed and samples analysed for physico-chemical parameters. Soil series and depth maps were prepared but other physico-chemical parameters are yet to be incorporated. The operations in this project have been carried out in collaboration with a soil surveyor from the Environment and Forest Conservation Division of the Mahaweli Authority in Kandy, the Agricultural Economics Unit of the TRI and a trained assistant cartographer.

W.M.S. Wijethunge, G.P. Gunaratne and L.S.K. Hettiarachchi
R.M.S.S. Rajapaksa, M. Jayawardhane and J.A.M.M Jayakody

3.2 Adaptive fertilizer trials - TRI and TSHDA collaboration

The primary objective of these set of trials is to investigate the efficacy of supplying nitrogen from U709 and T1130 mature tea fertilizer mixtures under smallholder conditions. The field operations of these trials are being carried out in collaboration with TRI's and TSHDA's Advisory and Extension centres.

The yields obtained during the first 12 month period after pruning and expressed as made tea kg plot^{-1} yr^{-1}, from 17 sites under different agro-ecological regions where these trials are carried out, are given in Table 47. The sites were grouped for agro-ecological regions and the data analysed accordingly.

TABLE 47 - *Effect of application of U709 and T1130 fertilizer mixture on yield (1st 12 month period) on tea smallholder lands*

Agro-Ecological Region	*Location*	Yield *(made tea kg plot^{-1} yr^{-1})*				
		Site		*Regional*		
		U709	*T1130*	*U709*	*T1130*	
WL1	Baduraliya	528	510	445	465	SE 20.9
	Ingiriya	314	304			
	Hiniduma	567	503			
	Elpitiya	503	665			
	Deraniyagala	311	342			
WL2	Akuressa	646	625	646	625	SE 46.7
WM1	Kalawana	368	306	374	371	SE 23.3
	Urubokke	293	271			
	Kalugalahena	620	690			
	Nortan Bridge	215	215			
WM3	Balangoda	413	388	461	444	SE 26.9
	Menikdiwala	524	559			
	Ukuwela	445	386			
WU2	Tispane	125	106	125	106	SE 46.7
IU2	Pitamaruwa	159	116	159	116	SE 46.7
IU3	Boralanda	273	204	282	221	SE 33.0
	Kandagolla	291	238			
Mean of 17 sites		388	378			SE11.3 (df 10)
CV% 12.2						

Although premature, the results indicate that the yields obtained from both mixtures tested in WL1, WL2, WM1, WM3 and WU2 regions were almost equal. However, in IU2 and IU3 regions, the yields obtained from U709 mixture were higher.

In addition, soil and plant nutrient status was determined thrice (once prior to fertilizer application and twice thereafter). These data will be subjected to statistical computations and used in order to ascertain the benefits. These trials are in progress.

H.A.P. Warnasiri, S.M. Dissanayake, W.M.S. Wijethunge, G.P. Gunaratne and L.S.K. Hettiarachchi, and M.B.A. Perera , S.L.D. Amarathunge, P.B. Ekanayake S.T. Yatawatte, K.D. Dahanayake, J.A.S.K.V. Jayasinghe, S. Wimaladharma

3.3 High Forest Estate Problem Clone TRI 2025 - Die back of shoots

Details of the problem were given in the Annual Report for 1994.

In accordance with the proposals made by the High Forest Task Force, two micro plots (each consisting of 20 plants) were demarcated from the affected patch, in order to apply the ground and foliar fertilizers. A previously marked plot (of 20 plants) from the unaffected patch was used as the control.

During 1998, 5 applications of both ground (N, P, K, Mg & S) and foliar (N, P, K, Mg, S, B, Mo, Cu and Fe) fertilizers were given together, and the improvement in relation to general growth was observed. Experiments are in progress as per proposals.

S. Ananthacumaraswamy and L.S.K. Hettiarachchi

3.4 Soil and Plant Sulphur Survey

The work in relation to this study was completed and will be published.

S. Ananthacumaraswamy and L.S.K. Hettiarachchi

3.5 Dolomite/fertilizer Applicator

The objective of this study is to ascertain whether the presently available motorized and/or hand-operated fertilizer/granule applicators can be modified in order to broadcast dolomite and/or fertilizer mixtures in tea plantations.

The particle size distributions from a range of fertilizer mixtures that are commonly used in the tea sector were obtained, in order to prepare specifications and requirements to purchase a power-operated applicator to test for suitability. The specifications were prepared and forwarded to local agricultural machinery agencies for the submission of suitable applicators from the manufacturers. As a result, an applicator was obtained from M/s Freudenberg Industries Ltd, through the Tozai Boeki Kaisha Ltd, the Liaison Office in Sri Lanka.

Preliminary tests carried out for the purpose of examining the delivery of different tea fertilizer mixtures (both urea and sulphate of ammonia based) indicated that this machine delivers such mixtures without much of the difficulties such as clogging in the delivering system.

In order to test and confirm its delivering rates at different combinations of gear adjustments, specific tests at the Farm Machinery Research Centre, Maha-Illuppallama, were carried out. Preliminary results indicated that crushed Eppawela rock phosphates in fertilizer mixtures in particular gained uncontrolled momentum and it was difficult to place them in an area where other fertilizers are dropped. This warranted modifications to the machine. In the meantime, work in connection with the suitability for dolomite broadcasting is in progress.

S.M. Hulangamuwa, G.P. Gunaratne, A.K.N. Zoysa and L.S.K. Hettiarachchi

3.6 Effect of incorporating Sulphate of Potash Magnesia (SPM) and Kieserite to a recommended NPK mature tea fertilizer mixture on soil nitrogen availability

In the process of formulating NPK and Mg fertilizer mixtures, either Kieserite or Sulphate of Potash Magnesia (SPM) is commonly used as the source of Mg. In the event of incorporating SPM to a standard NPK mixture such as U709 which is recommended by the TRI, a part of the K supplied from MOP could be replaced by SPM, as it contains K. On the other hand, it is reported that chloride based fertilizer grades such as MOP inhibits the rate of nitrification taking place in soil, thereby reducing nitrate-nitrogen leaching losses. The urea based mature tea fertilizer mixture, namely U709, has been widely used in tea plantations. A glasshouse experiment was commenced in December to investigate the effects of incorporating Sulphate of Potash Magnesia (SPM) and Kieserite to U709 mixture on soil nitrogen availability. It is hoped to use this information to supplement the data so far obtained from field trials.

Soil profiles down to a depth of 45cm were obtained from an area of 3 x 3 m uncultivated patch of land in St Coombs Estate, by sending down PVC (gauge 1.6 mm) cylinders across profiles. Four appropriate treatments at 3 nitrogen levels have been chosen. Each treatment will be replicated 6 times. The annual rainfall will be simulated by watering daily through PVC cylinders. Three replicates will be destructively dismantled after 5 to 6 months. The leachate is expected to collect at the bottom and will be analysed for nitrate and ammonium nitrogen, and other related parameters.

W.M.S. Wijethunge, G.P. Gunaratne, L.S.K. Hettiarachchi and N. Priyantha

4. Project C/ANAL - Central Analytical Services

The number of fertilizer, soils and leaf samples analyzed for advisory purposes during 1998 are given in Table 48

TABLE 48 – *Details of analysis carried out at Talawakelle laboratory*

Element	Fertilizer	Soil	Plant	Total
Nitrogen	860	472	22	1,354
Phosphorus	753	913	327	1,993
Potassium	825	1,228	327	2,380
Magnesium	560	1,108	327	1,995
Calcium	02	08	04	14
Sodium	–	08	–	08
Zinc	42	44	411	497
Copper	–	08	23	31
Iron	–	08	04	12
Manganese	–	08	04	12
Biuret	03	-	–	03
EC	–	02	–	02
PH	–	2,504	–	2,504
O.C%	–	2,524	–	2,524
Mesh size	370	-	–	370
Total	3,415	8,835	1,449	13,699

G.P. Gunaratne, S. Ananthacumaraswamy, R.G.A. Wijayawardhana, W.M.S. Wijethunge, H.A.P. Warnasiri, S.M. Dissanayake, A.K.N.Zoysa and L.S.K. Hettiarachchi

5. Publi‹ ıtions

Zoysa, A.K.N., Loganathan, P. and Hedley, M.J. (1998) Phosphate rock dissolution and transformation in the rhizosphere of tea (Camellia sinensis L) compared with other plant species. *European Journal of Soil Science,* 49, 477-486.

Anandacoomaraswamy, A. and Ananthacumaraswamy, S. (1998) Precision management of soil organic carbon in tea lands of Sri Lanka. *International Conference on Precision Agriculture* July 19-22, 1998 St.Paul Minnesota, U.S.A. 71-76.

Dasanayake, A. and Hettiarachchi, L.S.K. (1998) Soils of the Up-country zone (Eds. Mapa, R.B., Somasiri, S, and Nagarajah, S.), Hand Book on Characterization,classification and Mapping of wet zone soils of Sri Lanka. Chapter VII, First Edition *Soil Science Society of Sri Lanka,* Special volume. In press.

TECHNOLOGY DIVISION

Deputy Director Research (Technology) - M.T. Ziyad Mohamed

1. General

During the year under review, Dr. Ziyad Mohamed continued to serve as:

- a member of the 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 advise on Tea Factory Development Subsidy Scheme for orthodox factories
- a member of the panel of the Professional Examination in Tea Manufacture and Factory Practices, appointed by the Chairman, National Institute of Plantation Management (NIPM)
- Chairman of the Technical Committee on Tea of the Sri Lanka Standards Institution
- a member of the Academic Committee of NIPM

Mr S Koneswaramoorthy, Mechanical Engineer, was transferred to Talawakelle from Ratnapura with effect from 15th December.

2. Project B/CPCO - *Continuous preconditioning*

This project was temporarily suspended.

3. Project B/EDRY - *Reduction of cost of energy for drying*

3.1 Performance of stepwise FBD - 3 compared with FBD - 4

The unit operations in black tea processing could be summarized as withering, rolling, roll breaking, fermenting, drying and grading. For drying, two types of driers are used, namely, conventional Endless Chain Pressure (ECP) type and Fluid Bed (FBD) type. TRI pioneered fluid bed drying technique for tea drying in the 1970s. The drier designed by TRI was of a flat bed type with one weir at the end of the bed and the output of the drier varied according to the number of drying sections.

Although FBD is more efficient than ECP drier for drying tea, the drying efficiency in 3rd, 4th sections are low compared to the first two sections. To improve the efficiency in the 3rd section, a stepwise FBD was designed having weirs for each section.

Trials were carried out in this drier to optimize the weir height combination with a view to improve the efficiency. Some of the data collected during the year is presented below:

TABLE 1 : *Output of FBD-3 stepwise at different weir height adjustments*

Sectional Weir height of (inches)			*Degree Input wither*	*Drier Output (kg/hr)*	*M.C.*	*Avg. corrected (%)*	*Output blowout to 3% MC (kg/hr)*	*Drier blowout (kg/hr)*	*Drier blowout corrected MC (%)*	*to 3% MC (%)*
1st	*2nd*	*3rd*								
4.5	4.0	4.0	40.50	337.6	115.68	4.9	113.31	20.45	17.3	17.5
4.0	4.5	4.5	41.25	458.0	173.9	2.9	174.0	19.3	10.5	17.9
4.0	4.0	4.0	50.06	509.0	234.5	6.2	227.2	28.0	9.4	26.2
4.0	4.5	4.5	50.80	538.1	253.7	4.2	250.7	27.0	9.4	25.3
4.0	4.0	4.0	44.60	505.2	219.5	4.3	216.4	9.9	8.8	9.1
4.0	4.0	4.5	45.56	532.0	225.4	4.6	221.7	20.5	10.6	18.9

Avg. M.C - Average Moisture Content.

The data indicate that output is enhanced when the heights are kept at 4.0, 4.5 and 4.5 inches in the 1st, 2nd 3rd sections respectively. The moisture content of drier mouth teas and the blowout were standardized to 3%. During all these trials, the opening of the main fan damper was kept constant. Based on the above results, it is intended to study the fuel consumption related to the output of the drier.

W S Botheju, S H Priyanthi, L Jayasinghe and M T Ziyad Mohamed

3.2 Solar tea drying project

Fabrication of all solar collectors and ducting was completed. The structure installed with the foundations, beams and columns supplied by one contractor collapsed. Thereafter, a fresh contract to install the foundations, columns and beams was awarded to new party and the job was completed.

The collectors were fixed on the supporting structure and the ducting and an auxiliary fan was connected. Insulation of ducting is nearing completion. It is expected to commission the system in January 1999.

M.T. Ziyad Mohamed and S.Koneswaramoorthy

3.3 Dehumidified air technique for withering

A cost-effective dehumidified unit developed by Dr R A Attelage of the University of Moratuwa was tested for withering purposes. The unit was tested, using a few samples of green leaves. Further improvements are needed and are being attended to. This is in progress.

3.4 Generation of thermal energy using a local gasifier (NERD) along with the existing air heaters for drying of tea.

The NERD gasifier was used for about 6 months with repairs carried out periodically during the year under review. However, as the unit could not be operated

continuously for three months, it was rejected and the project abandoned by the latter part of the year.

The performance of the gasifier is analyzed below :

Type of fuel wood used	-	Rubber
Average weight	-	326.5 kg / Cu. yd.
Average moisture content	-	40%
Chopped wood	-	90.86% (by weight)
Sawing & splitting	-	9.06%
Power consumption for sawing	-	0.011 Unit / kg FW
Rate of sawing & chopping	-	3.72 yd/ 3 men/ day
Average heating up time	-	1.16 hr
Total firing time	-	345.43 hr
Average moisture content of FW	-	35.5%
Made Tea	-	113 MT/ hr
Fuel consumption	-	1.31 kg FW/ kg MT
Power consumption	-	0.023 units/ kg MT
Burning rate of fuel	-	147.9 kg FW/ hr
Ash	-	0.40% (by eight)
Charcoal	-	3.12% (by eight)
Tar	-	0.23% (by eight)
Total made tea	-	39,034 kg MT
Total fire wood	-	51,097 kg FW

M T Ziyad Mohamed and G L C Galahitiyawa

4. Project B/ENGY- Reduction of cost of energy

4.1 Modifications to the trough with a view to reduce the cost of electrical energy during withering

Experiments carried out on existing troughs indicated that:

1. About 20% of electrical energy could be saved by controlling the wet and dry bulb temperatures at the recommended range.
2. About 17% of electrical energy could be saved by varying the air flow through the leaf bed according to the actual energy requirement for the withering process.

A proto-type withering trough has been fabricated to carry out further trials. Variable speed controllers and/or split wound motors will be used in order to establish optimum air velocities and to achieve maximum energy efficiency. Based on the results, experiments will be carried out on commercial size troughs before any recommendation is made to the industry.

M T Ziyad Mohamed and G L C Galahitiyawa

4.2 Development of a method to completely inhibit polyphenoloxidase (PPO) and peroxidase activity

This is a collaborative project with the Biochemistry Division. The first part of this study was published in the 1997 report.

The two enzymes, PPO and peroxidase, play a major role during black tea manufacture. However, prolonged activity of these two enzymes is undesirable. Results of the previous study indicated that these enzymes do not get irreversibly denatured when conventional driers are used for drying tea. Thus, it was decided to look into the possibility of using microwave driers for drying tea. Results indicate that microwaves could inhibit PPO activity fully, but the quality of made tea was not comparable to that of conventionally dried teas, although the appearance was superior. Experiments will be carried out to improve the quality of the microwave-dried teas.

A.C. Liyanage*, P. A. N Punyasiri* and M T Ziyad Mohamed
* - Biochemistry Division

5. Project D/TECH - Divisional activities

5.1 Testing a new moisture meter

A new type of moisture meter – A & D Digital Infra Red (IR) Moisture meter - was tested in the Division. The temperature was set to 103 °C and made tea samples (dhool and graded tea) having various moisture levels were tested to see the feasibility of the meter for determining the moisture content.

TABLE 2: *Moisture content of samples determined by standard oven method vis- a- vis A & D Digital Infra Red Moisture meter.*

Tea Sample 6g each	*Moisture content by std oven method (%)*	*Time taken by the meter to read the actual moisture level (minutes)*		
		1st time	*2nd time*	*3rd time*
Dhool	1.8	5.0	5.5	6.0
	2.0	5.5	5.5	-
	2.2	3.5	3.5	-
	3.0	4.5	4.5	-
	4.1	6.0	7.5	-
	6.8	8.5	9.5	-
BOP	4.1	6.0	6.5	-
	4.4	5.5	7.0	-
	5.3	7.5	8.0	-
	5.7	7.0	8.0	9.5
	11.8	9.0	12.0	-
BOPF	3.7	4.0	6.0	-
	3.9	4.5	4.5	-
	4.0	6.5	7.0	-
	4.3	7.0	8.0	-
	5.1	7.0	7.0	-
Dust	3.5	4.0	5.5	-
	4.3	5.5	5.5	-
	5.0	7.0	7.5	-

The above data indicate that the time taken by the meter to read the moisture content of tea samples having the same moisture content varied. Therefore, the meter was not considered for recommendation.

M T Ziyad Mohamed, K Raveendran, S H Priyanthi and L Jayasinghe

5.2 Rapid determination of moisture content in green leaf, withered leaf and made tea, using a microwave oven

A microwave oven – Model MS – 283 MC Gold Star, having the following specifications, was tested for moisture determination in green leaf, withered leaf and made tea.

100% power	–	900w
80% power	–	650w
60% power	–	400w
40% power	–	200w
20% power	–	100w

The results were compared with those obtained from the standard oven method.

TABLE 3: *Green Leaf*

Power (%) used in Microwave oven	Moisture content (%) Std method	Moisture content (%) Microwave oven method	Period of exposure in Microwave oven (minutes) Initial	Period of exposure in Microwave oven (minutes) Additional
80	74.88	73.64	5.0	7.0
80	74.88	73.96	5.0	7.0
80	76.04	77.80	5.0	5.0
80	76.04	77.76	5.0	3.0
80	83.73	83.12	5.0	7.0
80	83.73	82.48	5.0	8.0
80	76.56	76.64	5.5	4.0
80	76.56	76.88	5.5	3.0

Note :- Initially, the samples were exposed for 5 – 5.5 minutes continuously in the microwave oven. Thereafter, the time was extended by an interval of a minute each time and the final weight of the sample was measured until a constant weight was obtained.

TABLE 4: *Withered Leaf*

Power (%) used in Microwave oven	Moisture content (%) Std method	Moisture content (%) Microwave oven method	Period of exposure in Microwave oven (minutes) Initial	Period of exposure in Microwave oven (minutes) Additional
80	66.16	66.16	5.0	6.0
80	62.32	64.60	4.0	1.0
80	62.32	62.24	5.0	6.0
80	62.32	61.48	5.0	6.0
80	66.48	61.48	5.0	6.0

TABLE 5: *Made Tea*

Power (%) used in Microwave oven	Moisture content (%) Std method	Moisture content (%) Microwave oven method	Period of exposure in Microwave oven (minutes) Initial	Period of exposure in Microwave oven (minutes) Additional
Dhool				
100	4.8	4.4	1.0	8.0
100	4.8	4.8	5.5	2.0
100	4.8	3.4	3.5	9.0
100	4.8	4.6	4.0	7.0
100	4.8	4.8	4.5	3.0
100	4.8	4.9	5.0	2.0
100	4.8	4.2	5.5	8.0
100	7.9	7.8	5.5	0.0
100	7.9	7.9	5.0	4.0
100	7.9	7.8	1.0	10.0
100	5.1	5.0	5.5	5.0
100	5.1	5.0	5.0	5.0
100	5.1	5.1	4.0	7.0
100	5.1	5.1	4.0	7.0
100	5.1	4.8	3.0	6.0
100	5.1	4.7	2.0	9.0
100	5.1	5.0	1.0	5.0
BOP				
100	4.6	4.6	5.5	1.0
100	4.6	4.4	5.0	8.0
100	4.8	3.4	4.0	3.0
100	4.8	4.2	5.0	3.0
100	8.6	8.7	5.0	1.0
100	8.6	8.4	4.5	6.0
100	8.6	8.0	1.0	10.0
100	5.1	4.5	5.0	8.0
100	5.1	4.1	2.0	4.0
100	5.1	4.6	3.0	5.0
100	5.1	5.1	4.0	1.0
100	5.1	5.0	4.5	4.0
100	5.1	5.1	5.0	2.0
100	5.1	4.5	5.5	4.0
BOPF				
100	3.4	3.4	5.0	4.0
100	3.7	3.7	5.5	3.0
100	3.7	3.7	5.0	1.0
100	3.7	3.1	4.5	8.0
100	3.7	3.1	4.0	3.7
100	3.7	2.7	4.5	9.0
100	3.7	2.4	1.0	11.0

Dust				
100	5.4	5.1	5.5	0.0
100	4.8	4.2	5.5	8.0
100	4.9	4.8	3.5	2.0
100	4.9	4.8	5.5	0.0
100	4.9	4.9	5.0	6.0
100	4.9	4.9	4.5	7.0
100	4.9	4.5	4.0	5.0
100	4.9	4.3	1.0	11.0
Pekoe				
100	5.7	5.7	5.0	5.0
100	5.8	5.3	1.0	10.0
100	5.8	5.8	3.5	7.0
100	5.8	5.7	4.0	9.0
100	5.8	5.8	4.5	4.0
100	5.8	5.7	5.0	6.0
100	5.8	5.8	5.5	2.0

M T Ziyad Mohamed, W S Botheju, S H Priyanthi and L Jayasinghe

5.3 Net outturn of made tea to green leaf

Factory owners and green leaf suppliers are concerned about the net outturn of made tea to green leaf achievable as the price paid for the green leaf depends on this outturn. Based on commercial scale experiments carried out over a period of 14 months in the low-country, the following conclusions were made.

1. Net outturn depends only on moisture content in green leaf and not on leaf standard, under low-country conditions. The correlation between the net outturn and moisture content in green leaf could be explained by

   $$(N.O.) = 91.8 - 0.908\ (M.C.) \quad \text{——— (1)}$$

   If the moisture content is known using equation (1), the net outturn could be predicted. For example,

   if MC = 76.64% N.O. = 22.22%
   MC = 77.40% N.O. = 21.50%

2. It must be noted that when the above equation is applied to predict the net outturn, there should be no deduction for surface moisture, since that too had been taken into consideration in these trials.

3. Based on the above results, an average of 21.5% (MT/GL) net outturn could be recommended in the low-country. However, it must be reiterated that it is far more advisable to predict the actual outturn on a daily basis, using the microwave oven method and the equation established.

4. Once the correlation between net outturn and moisture content in green leaf was established, it was decided to monitor the net outturn achievable over a period of one year, merely by drawing random green leaf samples and determining the moisture content of the samples. The microwave oven method described in the proceeding section could be used to determine the moisture content of green leaf within a short time.

TABLE 6:

Month	*Estate Leaf*		*Bought Leaf*	
	MC %	*NO %*	*MC %*	*NO %*
January	75.60	23.16	78.80	20.25
February	74.10	23.97	79.00	20.07
March	74.70	23.97	78.10	20.88
April	76.70	22.15	78.50	20.50
May	78.30	20.68	79.10	19.99
June	78.10	20.88	80.20	18.95
July	78.08	20.90	79.74	19.39
August	78.23	20.76	79.87	19.27
September	78.90	20.15	79.58	19.54
October	78.59	20.44	79.77	19.36
November	77.15	21.74	79.87	19.27
December	79.13	19.94	80.05	19.11

The results indicate that during the dry months of February, March etc. although a net outturn of almost 24% could be achieved from estate leaf, it was difficult to achieve even 21.5% from bought leaf, probably due to the addition of water.

The Technology staff visited factories in the low-country to monitor the net outturn achievable in those factories, using the correlation established between net outturn and moisture content. Microwave oven was used to test moisture content of green leaf samples collected from each factory. The data is presented below:

TABLE 7:

Moisture content (%) in green leaf samples	*Net outturnt (%) predicted*
77.00	21.88
76.60	22.24
76.52	22.32
79.00	20.06
78.80	20.25
81.64	17.67
81.30	17.98
77.28	21.63
76.00	22.79

79.24	19.85
79.32	19.77
77.36	21.55
77.80	21.15
79.28	19.81
79.98	19.17
76.52	22.32
77.10	21.79
80.26	18.92
81.40	17.88
80.80	18.43
80.12	19.50
79.98	19.18
76.94	21.93
81.70	17.61
78.36	20.65
80.04	19.12
79.64	19.48
81.48	17.81
82.64	16.76
81.40	17.88
79.24	19.85
80.44	18.76

Another experiment was started at Kurugama Estate tea factory from August in order to determine the effect of leaf standard and moisture content in green leaf on nett outturn of made tea to green leaf in the mid-country region. Six replicates were carried out in 1998 and a few more are planned during the year 1999. Some of the data are presented below.

TABLE 8:

Date	25-08-98	08-10-98	29-10-98	11-11-98
Results				
WT Green leaf (kg)	1163	1168	1114.5	1394.8
MC Green leaf (%)	78.90	81.57	77.99	78.88
Good leaf (%)	82.5	70.91	78.61	71.78
WT Withered leaf (kg)	767.80	687.72	751.35	1032.65
MC Withered leaf (kg)	66.90	71.82	70.29	74.21
Wither %	33.10	28.18	29.71	25.79
WT 1st dhool (kg)	26.5	40.8	40.15	38.0
WT 2nd dhool (kg)	55.4	51.7	54.05	49.3
WT 3rd dhool (kg)	47.7	23.6	22.8	21.2

WT 4th dhool (kg)	30.8	20.0	19.9	13.4
WT Big bulk (kg)	19.9	35.5	41.2	35.8
MC 1st dhool (%)	2.4	4.1	2.9	4.2
MC 2nd dhool (%)	2.2	4.7	2.1	4.0
MC 3rd dhool (%)	2.3	3.2	2.3	3.7
MC 4th dhool (%)	3.0	4.2	2.5	4.2
MC Big bulk (%)	3.2	3.9	2.2	4.3
WT Made tea	180.3	171.6	178.1	157.7
WT Made tea (3% MC)	181.09	169.04	179.08	155.21
Gross outturn	23.65	18.10	21.95	20.90
WT Graded tea	150.66	165.8	185.7	131.3
MC Graded tea (%)	varies for different grades of samples			
WT Graded tea(kg)/5% MC	152.55	163.69	183.17	131.83
WT Refuse tea (kg)	8.1	10.0	9.9	7.48
MC Refuse tea (%)	6.5	8.7	11.6	7.3
WT Refuse tea(kg)/ 5% MC	7.97	9.59	9.37	5.94
WT Refuse tea (%)	4.96	5.53	4.87	4.31
Net outturn	19.92	17.52	22.45	17.75

This is in progress.

M T Ziyad Mohamed, G L C Galahitiyawa, W S Botheju, K Raveendran and L Jayasinghe

5.4 Designing a Tea Bulking Machine

Tea bulking is done manually in most of the factories and only a small number of factories have installed tea-bulking machines to bulk teas after grading. Though the manual method is considered as the best way to bulk the teas, it does not comply with the hygienic requirements laid down by the Sri Lankan Standards Institution (SLS 143). The bulking machines currently in use do not bulk the teas properly. Since mechanical mixing equipment with moving components can effect the quality of teas, a machine without any moving components (static) was required to bulk the teas. A Prototype Tea Bulker had been designed and fabricated based on this principle and a few trials were carried out to test the effectiveness of the bulking action.

Two lots of BOP grade tea (each containing 40kg) having variable moisture levels were fed simultaneously to the bulker. Samples were collected from each lot and from the mixed lot separately for moisture determination.

TABLE 9:

Trial No	*1*			*2*			*3*		
Sample	*Moisture (%) of tea samples*								
No	*Lot 1*	*Lot 2*	*Mixed*	*Lot 1*	*Lot 2*	*Mixed*	*Lot 1*	*Lot 2*	*Mixed*
1	4.3	5.8	5.4	4.9	3.5	4.4	4.2	5.9	5.3
2	4.5	5.8	5.4	4.8	3.5	4.3	3.9	5.7	5.3
3	4.2	5.9	5.1	4.8	3.5	4.4	3.7	5.9	5.2
4	4.2	5.9	5.1	4.8	3.5	4.3	4.3	5.8	5.2
5	4.1	6.0	5.0	4.6	3.3	4.1	4.1	5.7	5.1
6	4.2	6.1	5.2	4.6	3.4	4.0	4.4	5.7	5.1
7	4.2	6.0	5.2	4.6	3.5	4.0	3.9	5.4	5.3
8	4.5	5.9	5.3	4.5	3.4	4.1	4.2	5.5	5.1
9	4.5	6.0	5.2	4.7	3.4	3.9	3.8	5.5	5.5
10	4.6	6.0	5.2	4.8	3.5	4.0	4.0	5.3	5.5
11	4.6	6.0	5.3	4.8	3.4	4.3	3.9	5.4	5.5
12	4.4	6.2	5.2	4.8	3.4	4.2	4.1	5.5	5.4
13	4.6	3.3	4.2	4.8	5.8	5.3			
14	4.7	3.4	4.1	4.7	5.8	5.3			
15	4.7	3.3	4.1	4.7	5.8	5.2			
16	4.7	3.4	4.2	4.0	5.8	5.3			

Trial No	*4*			*5*		
Sample No	*Moisture (%) of tea samples*					
	Lot1	*Lot2*	*Mixed*	*Lot1*	*Lot2*	*Mixed*
1	4.4	5.0	4.8	5.4	4.6	5.2
2	4.2	5.0	4.8	5.4	4.2	5.2
3	4.4	5.1	4.6	5.4	4.2	5.2
4	4.0	5.1	4.7	5.8	4.8	5.2
5	4.1	5.1	4.6	5.5	4.2	5.0
6	4.2	5.0	4.6	5.2	4.2	4.9
7	3.9	5.0	4.5	5.4	4.4	5.0
8	4.1	5.2	4.6	5.4	4.2	5.0
9	4.5	4.6	4.9			
10	4.4	5.1	4.8			
11	4.5	4.8	4.8			
12	4.4	4.8	4.8			
13	4.4	5.0	4.6			
14	4.2	5.0	4.6			
15	4.2	5.0	4.6			
16	4.1	4.9	4.5			

The moisture content of the mixed teas was satisfactory in that it indicated an acceptable mixing of teas. A commercial scale unit based on the same principle will be fabricated and tested for use at St. Coombs Factory.

M T Ziyad Mohamed, K Raveendran, S H Priyanthi and L Jayasinghe

5.5 Designing a Fermentation Table

Fermenting dhools are spread on fermenting tables during tea processing. A small amount of dhool falls on the floor during spreading and while removing it for firing. In order to avoid this, a smaller fermentation table with side plates to support the dhool from falling to the floor was designed and it is under fabrication. In addition to the side plates, it will have four wheels so that it can be moved to the drying room whenever appropriate. This will also help easy cleaning of the unit and the fermentation section.

M T Ziyad Mohamed, K Raveendran and Mechanics of Workshop

5.6 Fabrication of withered leaf trolley

Workers carry withered leaf from the troughs to the roller charging point at St.Coombs Factory. They use baskets that hold only 20 - 25kg of withered leaf at a time and, during this operation, leaves fall on the floor and get trampled by them. To avoid this, a trolley was designed and fabricated to carry 50kg of withered leaf at a time with provisions for easy unloading. The unit is being tested and further modifications will be carried out, if necessary.

M T Ziyad Mohamed, K Raveendran and Mechanics of Workshop

5.7 Development of Sand Separator

In many factories, there is a chance that sand/ grit at almost every stage of manufacture could contaminate the teas. A prototype sand separator was designed and fabricated in collaboration with the Department of Agricultural Engineering, University of Peradeniya. The unit was tested and satisfactory results were obtained. An industrial scale unit was fabricated. The principle of operation of the unit was demonstrated at the 197th E & E Forum.

M T Ziyad Mohamed and Officials from the Department of Agricultural Engineering, University of Peradeniya

5.8 Monitoring the standard of leaf at St. Coombs Factory

The standard of leaf 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 leaves on the troughs, samples of approximately 100g of leaves were collected at every 10 feet length along the throughs randomly. The respective samples were bulked and about 250g from each bulked sample was taken to monitor the leaf standard. The leaves were divided as Standard leaf and Sub-standard leaf.

TABLE 10:

Standard leaf	**Sub-standard leaf**
Bud itself	Bud + three or more leaves
Bud + one leaf	and leaves with hard stem
Bud + two leaves	Coarse banji
Bud + three leaves (if third is tender)	Coarse single leaves
Tender single leaf	Any damaged leaves
Tender banji	

TABLE 11: *Average standard of leaf brought to St.Coombs Factory*

Month	*St.Coombs*		*Lamilliere*	
	Count (%)	*Weight (%)*	*Count (%)*	*Weight (%)*
January	63	51	64	52
February	54	41	50	41
March	46	33	56	42
April	63	54	62	51
May	62	51	57	42
June	41	36	49	39
July	46	34	50	67
August	59	56	58	43
September	54	41	61	53
October	70	50	58	39
November	66	57	63	49
December	59	48	59	44

The acceptable standard of leaf should be about 65% good leaf (minimum) for good manufacture. The standard of leaf received from St. Coombs was poor during March, June and July. The standard of leaf received from Lamilliere Division was poor in June.

S H Priyanthi and L Jayasinghe

5.9 ISO 9000

The consultant attached to M/s Technoconsultant (Pvt.) Ltd, Colombo 5, continued to work towards ISO 9002 certification for St.Coombs Tea Factory.

The consultant completed the training on awareness of ISO 9000 to the staff and workers. The first draft of the Quality Manual was completed. The draft Quality Policy has been translated and circulated among the workers.

The consultant audited the Executives and Staff who are involved in the quality system. General worker instructions were drafted and a Quality Plan for tea processing was written. Quality assurance procedure for most of the relevant clauses in the quality manual has also been drafted. Calibration of measuring and test equipment has been completed. Action was taken to train the staff and workers on fire fighting and to check fire fighting equipment. The teas manufactured at the factory were tested for microbial growth and determination in collaboration with the Pathology Division, TRI, in order to confirm that they were safe till they reached the customer and to establish a standard for the final product. The consultant has started drafting "work instructions" for relevant activities that are included in the quality system.

M T Ziyad Mohamed and K Raveendran

5.10 Packing trials with new type of Paper Sacks

The cost of packing in tea chest is the largest component in tea processing. As a result, new packaging materials are tested from time to time for their suitability for packing tea.

Newly designed paper sacks from two different companies (A and M) were tested for keeping quality of teas. In this study, two types of tea bags (sacks), one with the inner ply having two joints of Aluminum/LDPE/Kraft paper and the other with metallized polyester/LDPE/Kraft paper were tested. The normal paper sack with the same dimension but with inner ply having one joint was used as the control.

The following information was recorded for each type of sack.

1. Sack dimensions
2. Grammage/ thickness
3. Tensile strength measured by the "drop test"

53kg of BOP grade tea was packed in each sack (6 numbers from each type) and stored in the Division. The humidity in the room and the initial moisture content of the tea were recorded. At the end of each month, duplicate samples of teas were drawn from each bag and analyzed for moisture content and chemical parameters such as Theaflavins (TF), Thearubigins (TR), total colour etc. The teas were tested for moisture content at the commencement of the trial and again at end of one and three months.

Initial sample	
TF (%)	1.4186
TR (%)	20.4652
Moisture (%)	4.2

TABLE 12:

After packing samples

Type of sack	*TF (%) after*		*TR (%) after*		*Moisture (%) after*	
	1 month	3 months	1 month	3 months	1month	3 months
A_v	1.1722	1.2645	14.8581	14.6281	4.8	4.8
A_v	1.3117	1.2701	14.7745	13.7885	4.8	5.0
A_0	1.4568	1.3837	14.9359	15.0298	4.6	4.6
A_0	1.1328	1.4833	15.0966	14.5795	4.5	4.5
M_o	1.1374	1.8562	15.1366	13.4760	4.8	4.8
M_o	1.1711	1.3229	14.9103	13.8848	4.5	4.8
M_o	1.2308	1.2813	14.8139	15.1622	4.5	4.6
M_o	1.1317	1.3890	14.0390	13.8875	4.3	4.4
C_v	1.2015	1.2105	15.4424	14.8680	4.5	4.8
C_v	1.3443	1.0707	14.4167	13.6775	4.5	5.0

C_V – Control, valve type
A_V – A, valve type
A_O – A, open type
M_O – M, open type

The samples were evaluated by tasting (sensory evaluation) and also sent to three professional tasters for their evaluation. The preliminary results indicate that the moisture barrier properties of the test sacks are comparable to those of control sack.

These trials are in progress.

M T Ziyad Mohamed, K Raveendran, S H Priyanthi and L Jyasinghe

5.11 Computer Aided tea Manufacture

A collaborative project with a private firm was initiated to study the feasibility of using computers to assist tea processing at St. Coombs Factory. The first unit operation in tea processing is withering. Preliminary trials were carried out in monitoring and controlling hygrometric differences of the air used for withering using electronic sensors. The electronic sensors developed for this purpose gave encouraging results. These units have to be tested over a period of time. In the meantime, some load cells are being developed to stop the withering process based on the weight of withered leaf. In the unit operation of withering, it is critical that this operation is stopped when the correct amount of moisture in the withered leaf is achieved. If the initial moisture content in the green leaf and the weight of green leaf are known, the amount of moisture to be removed could be easily calculated, using the weight loss as a guide. A simple rapid method to determine the moisture content in green leaf using a microwave oven developed by the Division will be used in this study.

This is in progress.

6. Seminars / Lectures

January 26th - Experiment and Extension Forum held at TRI**

February 2nd - ISO Seminar held at Chamber of Commerce, Colombo
23rd - Seminar organized by Namunukula Plantations Ltd., held at Gonekelle Estate
28th - ADB Workshop at Colombo

March 8th - Lectures/ Tutorials for students following M Sc in Industrial Chemistry
10th - Training of Trainers at TRI **
24th - NIPM Lectures on Skill Development of Factory Officers
26th - NIPM Lectures on Skill Development of Factory Officers
27th - Experiment and Extension Forum for Smallholders

April 17th - Advisory Officers' Forum held at Loolecondra Estate

June 18th - RSC (Uva) Seminar held at Bandarawela
27th & 28th - Corporate Plan Workshop held at Kandalama Hotel

July 27th - Seminar on Tea Manufacture for executives attached to Udapusselawa Plantations Limited held at Colombo

August 1st - NIPM Lectures - Professional Examination in Tea Manufacture & Factory Practices
3rd - Seminar for Private Tea Factory Owners Association held at SLTB, Colombo
6th - NIPM Lectures - Professional Examination in Tea Manufacture & Factory Practices

October 3rd - Industrial Linkage Seminar held at PGIA
30th - Energy Seminar held at National Science Foundation

November 27th - RSC Seminar held at Kandy

December 3rd & 4th - Workshop on "Fuel wood Energy & Gender Issues" organized by MPTS Network held at PGIA
13th - National Diploma in Plantations Management lectures at NIPM
** - Technology staff also attended

7. Meetings

January 5th - NIPM Academic Committee Meeting held at Colombo.
19th - Subsidy Committee Meeting held at SLTB.

February 2nd - Technical Committee on Tea Meeting at SLSI

March 2nd - Consultative Committee on Estates and Advisory Services Meeting at Colombo
09th - Subsidy Meeting held at SLTB Colombo Tea Sector Review Meeting held at Colombo

April 5th - Discussion with ADB Officials at TRI
6th - Subsidy Meeting held at SLTB, Colombo

	20th - Subsidy Meeting held at SLTB, Colombo
May	22nd - Technical Committee Meeting at SLSI
	27th - Consultative Committee on Research Meeting held at TRI
	29th - Subsidy Meeting held at SLTB, Colombo
June	8th - Consultative Committee on Estates and Advisory Services Meeting -Tea Sector Review Meeting held at Colombo
	10th - Panel Meeting - Professional Examination in Tea Manufacture (NIPM)
	19th - Subsidy Meeting held at SLTB, Colombo
	29th - Panel Meeting - Professional Examination (NIPM)
July	13th - Technical Committee Meeting held at SLSI
	17th - Tea Sector Review Meeting
	- Subsidy Meeting held at SLTB, Colombo
	27th - Subsidy Meeting held at SLTB, Colombo
August	4th - Consultative Committee on Research Meeting at TRI
September	7th - Subsidy Meeting held at SLTB, Colombo
	21st - Consultative Committee on Estates and Advisory Services Meeting
	30th - Tea Sector Review Meeting
October	9th - Consultative Committee on Research Meeting
	13th - Discussion with SIDA Officials held at Hotel Renuka, Colombo
	20th - Subsidy Meeting held at Colombo
November	10th - Tea Sector Review Meeting
	16th - Technical Committee Meeting held at SLSI
	- Subsidy Meeting held at SLTB, Colombo
December	15th - Consultative Committee on Estates and Advisory Services Meeting

8. Training Programs/Paper presentations

Dr M T Ziyad Mohamed made three presentations on the following topics, at the 197th Experiments & Extension Forum, held at TRI, Talawakelle on 31st July:

1. Rapid determination of moisture content in green leaf, withered leaf and made tea, using a microwave oven
2. Nett out-turn of made tea to green leaf in Low-country
3. Reduction of cost of electrical energy in withering.

March	30 - Training Programme - Skill Development of Tea Factory Officers
May	19 - Training Programme - Skill Development of Tea Factory Officers
November	14 & 15 - Training Programme for Superintendents organized by Maskeliya Plantations Ltd. held at St. Clair Estate
December	19 & 20 - Training Programme for Factory Officers attached to Maskeliya Plantations Ltd. held at St. Clair Estate

9. Visitors

The number of visitors to the Division during the period under review was 23.

10. Advisory Reports

During the period under review, the staff of the Division made 41 advisory visits to the factories. Details of the factories visited are given in Table 13. These include factories in Mid-Country, Uva and Low-Country, in addition to those in the Up-Country.

TABLE 13:

Estate	*Date of Visit*	*Purpose of Visit*
1. Helbodde	19/01	Drier test
2. Kirkoswald	22/01	Drier test
3. Great Western	26/01	Drier test
4. Laxapana	28/01	Demonstration on withering
5. Craighead	10/02	Drier test
6. Mathurata Group	20/02	Air flow test on troughs
7. Logie	26/02	Drier test
8. Montecristo	03/03	Manufacture test
9 Imboolpitiya	06/03	Drier test
10. Yuilllifield	11/03	Drier test
11. Strathspey	16/03	Calibration of thermometers
12. Bearwell	17/03	Drier test
13. Nivithigala	—	Drier test
14. Mooloya	06/04	Drier test
15. Craighead	27/04	Drier test
16. Gonapitiya	02/05	Air flow test
17. Gangaboda	05/05	Winnower test
18. Kurugama	09/05	Manufacture test
19. El Teb	11/05	Drier test
20. Mahaduwa	16/05	Drier test
21. Uruwala	27/05	Drier test
22. Nivithigala	—	Manufacture test
23. Mousakelle	11/06	Drier test
24. Ingestre	05/08	Drier test
25. Hayes	10/08	Air flow test
26. Anninkanda	10/08	Air flow test
27. Diddenipotha	11/08	Air flow test
28. Holyrood	14/08	Drier test
29. Mannapperuma	17/08	Manufacture test
30. Mocha	01/09	Drier test
31. Kallumalay	01/09	Demonstration of withering
32. Lankem	10/09	Manufacture test
33. Troup	11/09	Drier test
34. Glenugie	15/09	Drier test
35. Stockholm	18/09	Drier test

36. Nuwara Eliya	21/09	Drier test
37. Mayfield	01/10	Drier test
38. Hindagala	12/10	Drier test
39. Greenwood	7/11	Drier test
40. Dayagama East	08/12	Manufacture test
41. Dunsinane	12/12	Direr test

The number of samples received from estates for determining the moisture content percentage was 564. These were reported with advice for correction of defects, wherever necessary.

AGRICULTURAL ECONOMICS UNIT

Officer-in -Charge - J.A.A.M.Jayakody

1. Research Prioritization

1.1 The application of the Composite Approach to Decision Making in Agricultural Research (CADMAR) for the TRI was completed by the AEU with the technical assistance of the GTZ-CARP research management project. In this approach, 25 applied research thrusts with 82 projects covering most aspects of the problems/ constraints of the tea sector were identified for prioritization.

1.2 Considering the main objectives of the industry and the nation, the research thrusts were prioritized based on the costs and the additional benefits of the innovations resulting from the thrusts, such as contribution to Economic Growth (Income, Employment, Foreign Exchange Earnings), Equity (Income Distribution and Nutrition) and Conservation (Proper Use of Non-Renewable Resources, Sustainable Use of Renewable Resources, Maintain Flora and Fauna, Reduced Pollution). Accordingly, all the research thrusts were categorised into two groups, namely, priority group I and II. Forty-eight basic research projects were also identified and costed.

1.3 A report entitled "CADMAR, The Composite Approach to Decision Making in Agricultural Research, Application in Tea Research", incorporating details of the research lists (applied and basic), costs of research thrusts, estimation of additional benefits and the priority lists, was published in November 1998.

1.4 The prioritized research programme along with the on going research activities of the Institute was incorporated the first Corporate Plan of the TRI, prepared for the five years commencing from 1999.

J.A.A.M. Jayakody and H.W. Shyamalie

2. Economic Studies

2.1 *Estimation of tea production costs at different elevations*

2.1.1 Estimation of annual costs of tea cultivation in different locations was initiated with the objective of developing financial guidelines for decision making in tea cultivation.

2.1.2 Cost estimation of establishing and maintaining a tea nursery, replanting and maintenance of young and mature VP fields, maintenance of high and low yielding seedling fields in the up country will be completed soon. A similar exercise will be undertaken for the other three elevation categories early next year.

J.A.A.M. Jayakody and H.W. Shyamalie

2.2 *Development of linkages between incentives and plucker productivity in estate sector.* (Collaborative research between the TRI and Delta Estate, Pussellawa Plantations Ltd, Pupuresse)

2.2.1 The main objective of this study is to examine the possibility of improving plucker productivity and thereby improving the overall productivity of the estate.

2.2.2 This is a joint research programme with the Agronomy Division. Two tea fields (VP and Seedling) in Delta Estate were identified for data collection. Both fields were in the second year of the pruning cycle. The TRI recommendation on plucking and the different incentive systems are to be compared with the estate practices.

J.A.A.M.Jayakody and H.W. Shyamalie

2.3 *Assessment on the rate of plant losses in the low-country smallholder tea fields*

2.3.1 Advisory and Extension staff of the TRI and the TSHDA have observed that there is a problem of declining plant density in the low-country smallholder tea fields. In order to assess the severity of the problem and also to estimate the rate of infilling and/or replanting that will be required in the future in the smallholder fields, a pilot study was initiated in collaboration with the TSHDA Regional Office, Matara.

2.3.2 Six Tea Inspector Ranges were selected for the study, namely, Pasgoda, Beralapanatara, Akuressa, Katanwila, Morawake and Deniyaya. Two smallholder properties one each from < 0.4 ha category and 0.4-0.8 ha category were selected from the above ranges. Two blocks (10 x 10 m) from each property were taken as the sample. A format has been prepared and pre-tested for the purpose of data collection. Data collection is being jointly done by the TRI and TSHDA staff in three locations and it will be continued in order to complete the selected locations.

J.A.A.M.Jayakody, H.W.Shyamalie and J.A.S.K.V.Jayasinghe[1]

3. Socio-economic Studies

3.1 *Identification of appropriate labour use pattern to improve profitability in plantations*

3.1.1 A survey was initiated to study the labour scarcity problem prevailing in the low country tea estates due to labour migration away from the tea sector.

3.1.2 The first questionnaire of a set of three was prepared and pre-tested in the Deniyaya area to collect information from the management's perspective. Development of the other two questionnaires to collect data from the workers' point of view is yet to be done.

[1] Officer-in-Charge, TRI, Deniyaya

No progress could be made in this study due to staff limitation as both Mr.Ganewatte and Mr.Rajasinghe were away on study leave.

G.Ganewatte , J.C.K. Rajasinghe, J.A.A.M.Jayakody and J.A.S.K.V.Jayasinghe

4. Geographic Information System (GIS) studies in Tea Sector

4.1. *Development of a Tea Information System*

4.1.1 The Tea Research Institute and the Environment and Forest Conservation Division of the Mahaweli Development Authority successfully completed a collaborative project to study the potential use of GIS for Land Use Planning in tea estates. The Institute purchased some hardware and basic software PC Arc/Info and Arc View 3 in order to gradually build up in-house GIS capabilities. Necessary action has been taken to obtain input/output data of the collaborative project in the digital form, from the Mahaweli Authority.

4.1.2 Micro-level tea data collection was started through a mailed questionnaire. Fifteen Plantation Management Companies have agreed to provide estate data to develop a micro level central information system. Database structure has been developed in *Microsoft Access* in order to link the information to GIS in future.

J.A.A.M. Jayakody and H.W.Shyamalie

4.2 *Land Use Planning for Development of Marginal Tea Lands*

4.2.1 A contract research project of the CARP No 12/302/235 " Land use planning for development of marginal tea lands with multiple objectives in the mid-country" was completed. While reviewing the project, it was decided to include the soil information as well in the digital form. Therefore, a soil survey was initiated in November 1996 and completed in five estates by August 1998. The soil survey was carried out by the Soil & Plant Nutrition Division of the TRI in collaboration with the ENDEV project of the Mahaweli Authority, Polgolla.

4.2.2 Land Use Planning Maps were prepared for the five estates using the soil information.

J.A.A.M. Jayakody , R.M.S.S. Rajapakse[2] and M. Jayawardena[3]

4.3 *GIS application for smallholder sector*

A GIS application on tea smallholder sector is being undertaken to study the desirability of using this technology in this sector. The report embodying the findings will be written jointly by the TRI, TSHDA and the EFCD of the Mahaweli Authority.

J.A.A.M. Jayakody

[2] Experimental Officer, Agronomy Division
[3] Trainee cartographer

4.4 *Development of a Tea Area Overview Map*

4.4.1 TRI has proposed to undertake the above project as a collaborative study with the CARP - GTZ Research Management Project and other Institutions such as the Survey Department, Ministry of Plantation Industries, Sri Lanka Tea Board and the TSHDA. The objective of the project is to integrate the tea sector information and to develop a "Tea Area Overview Map" in Arc/View.

4.4.2 Initial discussions were held with the CARP - GTZ Research Management Project to formulate the research proposal.

J.A.A.M. Jayakody

5. Others

A leaflet on the historical and socio-economic information of the tea industry in Sri Lanka was prepared by Mr.G.Ganewatte and Mr.J.C.K.Rajasinghe for distribution at Sri Lanka's 50th Anniversary of Independence Exhibition.

6. Staff

A Graduate trainee, Ms. M.H.Attanayake, completed an 8-month training programme in February 1998.

Mr.G.Ganewatte proceeded to the University of La Trobe in Australia in May for a Postgraduate training programme leading to Ph D.

Ms. H.W.Shyamalie, who has been working as a casual Research Assistant, joined the AEU as a Graduate Experimental Officer in November.

7. Seminars and Meetings

Mrs. J.A.A.M. Jayakody and Mr. G. Ganewatte attended the group meetings of Socio-economists and Policy Analysts in the National Agricultural System, organised by the CARP.

The meeting was held once in two months.

Mrs.J.A.A.M. Jayakody participated at a 5-day workshop organized by the Department of Agriculture on Database Management from 16th to 20th March.

8. Overseas Visits

Mrs. J.A.A.M. Jayakody visited the UPASI Tea Research Institute, Advisory and Extension Service at Coonoor and a few South Indian Tea estates as a member of the first group of TRI Scientists and Advisory Officers on an exchange programme of Scientists and Advisory Officers during 24th October to 12th November.

Mrs. J.A.A.M. Jayakody participated in a training programme held by the GIS Application Centre of the Asian Institute of Technology, Thailand, on "Application of GIS in Flood Disaster Mitigation" from 30th November to 11th December. This was sponsored by the National Space Development Agency of Japan.

ST. COOMBS / LAMILIERE ESTATE

Superintendent - H.L.Dunuwile

1. General

Visiting Agent

Mr.D.H.Wickramasooriya, Visiting Agent, visited the Estate on 10th March.

Tea Brokers

Messers. Forbes & Walker and Messrs. Asia Siyaka Commodities (Pvt.) Limited continued as brokers for St.Coombs.

Junior Staff

The following staff changes were effected during the year:

Factory Mr.P.Wickramasekara, Head Factory Officer, retired in June.

Mr.P.H.G.K.Jayaratne, Junior. Asst. Factory Officer, was transferred to St.Joachim in December.

Field Mr.D.M.Muthuraj, Field Officer, St.Coombs Division, resigned in September .

Mr.S.P.Warnasooriya, Field Officer, Lamiliere Division, took over the duties of the post vacated by Mr.D.M.Muthuraj on St.Coombs.

Messrs. I.W.M.D.Alahakoon and N.Illangeswaran, daily paid Field Supervisors, were promoted as Junior Assistant Field Officers with effect from 1st May. Mr.U.V.Dayananda was recruited as Junior Assistant Field Officer with effect from 1st May.

Office Messrs. P.Periyannen, Chief Clerk, A.R.William, Senior Assistant Clerk, and N.G.L.Dayathilake, Junior Assistant Clerk, were interdicted in May.

2. Weather and Rainfall

2,290 mm rainfall was recorded over 170 days during the year as against 2,395 mm over 199 days in 1997.

3. Hectarage Statement as at 31st December 1998

	ha.
Seedling tea	30.8
V.P.tea	113.8
V.P. Immature	4.8
Uprooted area under rehabilitation	4.2
Nurseries	1.3
Labour Housing	1.0
Ravines & Grass Land	32.0
Buildings, Roads, Jungle and Patna	49.8
Total	237.7

4. Crop and Yield

	1998		1997	
	Crop (kg)	Yield (kg / ha)	Crop (kg)	Yield (kg / ha)
St.Coombs	137,186	1,413	188,515	1,923
Lamiliere	81,078	1,707	91,203	1,898
Total	218,264	3,120	279,718	3,821
Bought Leaf	35,063		104,319	
Grand Total	253,327		384,037	

5. Tea Prices

Apart from obtaining top Western Market prices on several occasions during the year under review, St.Coombs also fetched an all-time record price for BOP, of Rs.350/- per kg in November and for Dust 1 of Rs.250/- per kg in June.

6. Working Results

A profit of Rs.5,874,653/- was recorded for the year under review. (Table 1)

7. Nursery

37,600 plants of TRI 3000 and 4000 series were raised for planting and infilling.

8. Labour

During the months of May, June and July 1998, the entire workforce of the estate adopted a go-slow attitude, demanding Profit Share Bonus. Since settling this issue, the labour unrest has eased.

9. Yield Data / St. Coombs

The monthly yield of St.Coombs Estate for 1998 in comparison with that obtained from 1994 to 1997 is given in Table 2. The monthly yield of each field is given in Table 3.

TABLE 1: *Working Results of St.Coombs / Lamiliere for the year 1998 compared to the previous five years*

Year	Total Crop (kg)	Bought Leaf (kg)	Yield kg/ha	N.S.A. (Rs/kg)	Revenue C.O.P. (Rs./kg)		Profit / (Loss) Rs.
					Estimated	Actual	
1994	267,687	91,434	1,845	89.60	84.36	85.01	1,828,191
1995	292,530	107,765	2,001	93.52	83.03	82.56	2,965,830
1996	262,162	113,432	1,783	106.52	83.09	82.69	5,194,465
1997	279,718	104,319	1,915	120.30	85.79	99.49	7,922,124
1998	218,264	35,063	1,509	145.38	97.43	119.10	5,874,653

TABLE 2: *Monthly yield (kg/ha), rainfall and average 'N' applied from 1994 to 1998*

Month	1994	1995	1996	1997	1998
January	172	206	148	161	176
February	153	168	102	86	118
March	140	136	74	58	66
April	199	184	93	69	48
May	199	276	424	413	95
June	146	172	105	140	156
July	112	119	150	203	60
August	105	190	140	115	135
September	163	132	93	109	112
October	173	205	164	190	83
November	164	184	198	196	168
December	170	178	186	193	196
Total Yield	1896	2150	1877	1923	1413
Rainfall (mm)	2356	2292	2199	2397	2292
Wet days	220	188	210	199	170
Average N/ha.	220	234	258	226	220

TABLE 3: *Monthly yield (kg/ha) of fields with fertiliser mixture used and amount of 'N' applied - St.Coombs (1998)*

Field No.	Ext. ha.	Mix.	Total 'N'	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	7.7	U709	260	185	111	58	43	60	399	91	140	156	43	297	223	1846
2	2.6	U709	300	230	83	84	36	84	156	35	180	155	132	160	226	1561
3A	7.0	U360	120	198	115	64	36	68	PR.9	3	9	3	2	33	87	637
3B	6.7	U360	120	250	161	89	47	131	PR	-	-	-	-	25	120	823
4	9.1	U235	130	242	130	66	33	110	315	47	215	169	103	227	199	1556
5	7.4	U709	300	251	178	67	63	144	293	102	375	184	196	301	311	2465
6A	3.0	U709	260	171	144	70	80	176	228	192	164	138	84	196	229	1873
6B	2.9	U709	260	70	33	63	71	30	92	59	118	75	95	189	88	1013
7	4.7	U235	230	159	163	77	61	50	247	92	145	181	126	163	291	1755
8	5.2	U709	260	128	91	40	18	104	206	73	162	108	68	193	314	1535
9A	3.0	U709	260	305	148	99	91	126	180	117	246	125	149	160	241	2027
9B	4.8	U709	260	110	133	50	41	50	106	41	122	140	124	136	201	1254
10	2.0	U709	260	342	81	141	65	160	183	213	112	180	121	118	244	1960
11A	2.0	U360	120	171	136	139	77	111	PR.21	7	54	31	8	73	103	926
11B	4.0	U360	120	168	122	55	32	97	PR.	-	-	-	-	3	28	505
12A	1.2	U709	300	200	150	183	91	165	134	173	142	355	180	159	227	2299
12B	6.1	U709	220	56	50	48	33	39	14	20	47	80	39	135	132	683
13	10.4	U709	260	72	89	26	34	199	121	81	165	163	149	186	200	1062
14	7.3	U709	260	170	115	80	47	186	125	66	137	123	102	213	217	1581
Total	97.1			176	118	66	48	95	156	60	135	112	83	168	196	1413

10. Cultural Operations

Field No.	Ext.(ha.) OST	VP	Clones	Last Pruned	Year of Planting	Yield / ha 1997	Shade 1998	
1		7.1	T.R.I.777 2016 2023 2923 2025 DN	Aug - 1994	1953 - 1959	2059	1806	Dadaps,Grevillea
2		2.6	T.R.I.2143 2142 2025 DT 1 & 96	Aug - 1998	1964	2276	1561	-do-
					1967-1968			Calliandra
3	0.4	13.3	T.R.I.2027 2043 2025 WT 26	Jun - 1998	1965 -1966			
					1967-1968	2705	723	Dadaps,Grevillea
4		9.1	T.R.I.62/9 2025 3016 DN N2 CY9	Oct - 1995		2387	1856	-do-
5		7.4	T.R.I. 2142 2023 2025 TC9 DT 95 N2	May - 1996	1970	2662	2465	-do-
6		5.9	T.R.I. 2025 DN & N2	Jun - 1997	1985-1986	542	1450	Grevillea
7		4.7	T.R.I.2024 2025 62/9 DT 1 & DT 95	Apr - 1996	1962-1964	2061	1755	Dadaps,Grevillea
8		5.2	T.R.I.2024 2025 & DT 1	Jun - 1994	1962-1964	2000	1535	Grevillea
9	4.8	3.0	T.R.I. 3000 2025	Dec - 1995	OST 1935			
					VP 1986	2500	1552	Dadaps,Grevillea
10	0.5	2.0	SALT Area	Jul - 1992	OST 1935			
					VP 1993	2320	1960	Grevillea,Calliandra
11	4	2.0	T.R.I.2025 62/9 N2	Jun - 1998	OST 1935	1857	645	Dadaps,Grevillea
					VP - 1988			
12	7.1	1.2	T.R.I. 2025 KI45	Jun - 1994	OST 1935	1375	949	Grevillea,Calliandra
					VP 1985			
13	9.1	1.3	T.R.I. 2025 7/27 & DN	Jul - 1997	OST 1935	452	1062	-do-
					VP 1986			
14	1.0	6.3	T.R.I. 777 2024 & N2	Jun - 1994	1961	1843	1581	-do-

11. Report on Lamiliere

The monthly yield for 1998 in comparison with that obtained from 1994 to 1997 is given in Table 4 while the monthly yield of each field is given in Table 5.

TABLE 4: *Monthly yield (kg/ha) & average N applied from 1994*

Month	1994	1995	1996	1997	1998
January	167	184	120	149	197
February	129	161	98	76	170
March	149	114	63	58	65
April	143	171	153	76	75
May	172	196	287	311	185
June	134	146	113	186	189
July	107	60	118	196	122
August	112	134	123	111	117
September	192	93	82	142	114
October	115	161	133	191	95
November	156	141	176	209	153
December	161	144	158	193	225
Total Yield	1737	1705	1624	1898	1707
Avg. N kg/ha	220	217	215	213	219

TABLE 5: *Monthly yield (kg/ha) of fields with fertiliser mixture used and amount of 'N' applied - Lamiliere (1998)*

Field No.	Ext. ha.	Mix.	Total N.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
4A	5.1	U709	300	222	153	100	78	253	221	152	128	126	93	176	263	1985
4B	1.9	U360	120	203	180	61	48	185	110	102	PR.14	-	-	-	53	956
5	1.0	U360	180	158	21	13	10	60	60	36	36	52	38	22	30	534
6A	2.0	U360	180	53	43	14	7	25	32	23	46	83	53	44	101	518
6B	3.0	U235	160	8	31	29	31	50	51	54	59	71	69	76	87	606
7	4.5	U360	120	168	172	80	86	126	196	PR.28	-	-	-	14	57	927
8A	5.0	U709	260	190	276	79	143	319	193	194	130	120	157	184	257	2242
8B	4.0	U235	160	190	128	50	70	232	180	154	119	122	95	189	256	1785
9A	4.0	U709	300	268	236	72	73	269	276	124	207	146	130	252	296	2349
9B	4.0	U235	150	170	167	77	168	227	174	150	178	196	111	254	215	2087
10	6.6	U709	260	266	163	52	51	133	226	120	152	174	124	196	320	1977
11	6.4	U709	260	248	218	69	43	149	236	151	146	113	117	154	299	1983
Total	47.5			197	170	65	75	185	189	125	117	114	95	153	225	1707

12. Cultural Operations

Field No.	Ext.(ha.) OST	VP	Clones	Last Pruned	Year of Planting	Yield / ha 1997	Shade 1998	
4A		5.1	T.R.I.2025	Jun - 1996	1984	2058	1985	Grevillea / Dadaps
4B		1.9	T.R.I.2025	Aug - 1998	1986	2379	956	-do-
5	1.5			Jun - 1993	1935	797	534	-do-
6A	2.0			Jun - 1993	1935	830	518	-do-
6B		3.0	DT 1 WT 26 & T.R.I. Clones	Aug - 1997	1990 - 1991	582	606	-
7		4.5	T.R.I.2025	Jul - 1998	1983	2390	927	Grevillea / Dadaps
8A		5.0	T.R.I.2025	May - 1995	1983 - 1987	2620	2202	-do-
8B		4.0	T.R.I.2025 DN N2 WT 26 & CY 9	Jun - 1996	1989 -1990	1709	1785	-do-
9A		4.0	T.R.I.2025	Aug - 1996	1979	1788	2349	-do-
9B		4.0	T.R.I.2025 DN & CY 9	May -1997	1980	1195	2087	-do-
10		6.6	DN & T.R.I. 2025	May - 1994	1967 - 1969	2177	1977	Dadaps
11		6.4	DN & T.R.I. 2025	Jul - 1995	1970 - 1971	2269	1943	-do-

ST. JOACHIM ESTATE

Assistant Superintendent - S. G. Ekanayake

1. General

Mr. S. G. Ekanayake functioned as Assistant Superintendent of St.Joachim Estate. The overlooking Superintendent, Mr. L. H. Dunuwile, made his usual visits during the year under review. Mr. D H Wickramasooriya functioned as Visiting Agent. He visited the estate on 30th May. Meetings of the Estate Affairs Committee were conducted regularly with the Chairman/TRB, Director/TRI and other officials. Messrs Bartleet and Co. Ltd. and Messrs. De Silva, Abeywardena and Peiris continued as the brokers during 1998.

This year as well, the factory functioned without the Head Factory Officer and the case before the Labour Tribunal, Ratnapura, is still pending. Mr. D. J. W. Ranawaka was unable to work on the estate as he was mobilised for Army Voluntary service.

2. Hectarage as at 31st December 1998

	ha	
Mature V.P. tea	54.07	
Immature V. P.	2.02	
Land under rehabilitation	24.92	
Estate Nursery	1.58	
Timber Clearing	3.34	
Abandoned tea	-	
Land under Coconut	3.89	
Land under Rubber	12.30	
Land under Paddy	8.74	
Intercropping -Tea/Rubber	7.28	118.14
Other Lands		
Acquisition by Government, buildings, roads, ravines and jungle		23.84
Total extent		141.98

3. Crop (made tea kg)

The production on St. Joachim Estate in 1998 compared to the previous year was as follows:

Year	Estate crop (kg)	Bought crop (kg)
1997	66,847	996,106
1998	73,473	890,131

The production on the estate showed an increase of 6,626 kg or 9.91% in comparison to the previous year.

3.1 Bought Leaf

The bought leaf manufactured at St. Joachim Factory showed a decrease of 105,975 kg or 10.64 %, in comparison to last year. This decrease is mainly attributed to the unusual weather conditions that prevailed during the year.

4. Prices

All teas produced at St. Joachim Factory were sold at the Colombo Auctions in the Main Low Grown catalogue. Messrs Bartleet & Co. Ltd. and Messrs De Silva, Abeywardena & Peiris sold the teas in equal proportion.

The tea produced during the year was sold at a Nett Sale Average price of Rs.130/63 /kg – Rs 11.25/kg below Low Grown Average of Rs.141/88 /kg. The average price paid for bought leaf during the year under review was Rs.20/54.9 per kg as against an average of Rs.19/30.4 paid in the previous year. The working of St. Joachim Estate during the year resulted in a profit of Rs.14,409,500.00 (Table 1)

TABLE 1- *Working results of St. Joachim Estate for the year 1998, in comparison with previous years*

Year	Total crop sold (Made tea kg)	Yield (Made tea kg/ha)	Nett sale Average (Rs/kg)	Estimated COP (Rs/kg)	Actual COP Rs/kg)	+Profit -Loss Rs.
1992	*338,205 31,463	693	70/00	64/10.00	72/60.08	-2,999,959/-
1993	*690,355 55,775	1,014	74/70	71/65.59	72/37.69	+1,734,553-
1994	*865,691 57,487	1,045	69/49	66/13.84	69/53.08	-35,914/-
1995	*887,732 55,643	1,097	78/89	68/80.25	75/88.38	+2,827,076/-
1996	*1,094,941 63,330	1,248	113/81	87/06.38	102/30.88	+17,978,620/-
1997	*996,106 66,847	1,236	120/61	98/24.30	111/60	+19,325,357/-
1998	*890,131 73,473	1,359	130/63	94/25.00	87/43	+14,409,500/-

* Bought crop
Tea unsold as at 31/12/98: 5,499 kg

5. Nursery

The supply of planting materials to smallholders in the district continued this year as well. The sale of planting material as compared to the previous year was as follows:

Year	Shoots supplied	Income (Rs.)	Plants supplied	Income (Rs.)
1997	-	-	182,948	548,844
1998	-	-	32,145	270,918

6. Cultural Operations

Field No.1

V.P.Tea	... 5.85 ha
Clones	... T.R.I. 2023,2025,2026,2027 & S106
Last pruned	... July 1996
Yield in 1997	... 497 kg/ha
Yield in 1998	... 971 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Machine plucking, irrigation system and herbicide

Regular upkeep of the tea was done during the year.

Field No.1A

V. P tea	... 1.20 ha
Clones	... T.R.I. 2025,2027,S/106 & KEN
Last pruned	... July 1998
Yield in 1997	... 2,555 kg/ha
Yield in 1998	... 1,779 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... nil

Regular upkeep of the tea was done. Upkeep of mana grass was also undertaken during the year.

Field No.2

V.P tea	... 4.12 ha
Clones	... T.R.I. 2025,2026,2027 & S106
Yield in 1997	... 790 kg/ha
Yield in 1998	... 771 kg/ha
Shade	... Albizia and Gliricidia

This field is under the supervision of the T.R.I. and used for clonal proving trials.

Field No.2A

V.P tea	... 0.93 ha
Clones	... T.R.I.2025, S106
Yield in 1997	... 3,649 kg/ha
Yield in 1998	.... 1,861 kg/ha
Last pruned	.... June 1998
Shade	.... *Albizia and Gliricidia*

Inter-cropped area is planted with coconut in tea. Regular upkeep of tea and coconut was done during the year.

Field No.2F

V.P tea	... 6.78 ha
Clones	... T.R.I. 2025, 2026, 2027 & S106
Last pruned	... May 1996
Yield in 1997	... 1641 kg/ha
Yield in 1998	... 1732 kg/ha
Shade	... *Albizia and Gliricidia*

Regular upkeep of the tea was done during the year.

Field No.3

V.P. tea	... 8.40 ha
Clones	... T.R.I. 2023,2025
Last pruned	... July 1997
Yield in 1997	... 788 kg/ha
Yield in 1998	... 1220 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Nil

Regular upkeep of tea was undertaken during the year.

Field No. 4

V.P tea	... 5.85 ha
Clones	... T.R.I. 2023,2025,2026,2027,H50/1,S106
Last pruned	... May 1998
Yield in 1997	... 1,180 kg/ha
Yield in 1998	... 823 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Plucking

Regular upkeep was done during the year.

Field No.5

V.P tea	... 8.20 ha
Clones	... T.R.I. 2023, 2025, 2027, H50/1
Last pruned	... May 1998
Yield in 1997	... 1996 kg/ha
Yield in 1998	... 675 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Herbicide and cover crop

Regular upkeep was done during the year.

Field No.6

V.P tea	... 1.50 ha
Clones	... T.R.I.2025, 2026 & 2027
Last pruned	... June 1995

Yield in 1997	... 3,121 kg/ha
Yield in 1998	... 3,492 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Nil

Routine maintenance was undertaken during the year in tea area as well as in the area under mana grass.

Field No. 8A

V.P tea	... 6.00 ha
Clones	... T.R.I.2025, 2026, 2027, KEN 16/3, S106 & TRI 3063
Last pruned	... July 1997
Yield in 1997	... 1,782 kg/ha
Yield in 1998	... 2,821 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Nil

Regular upkeep was done during the year.

Field No. 8C

V.P tea	... 1.90 ha
Clones	... T.R.I.2025, 2027, KEN 16/3, S106 & 3063
Last pruned	... July 1997
Yield in 1997	... 1,538 kg/ha
Yield in 1998	... 2,561 kg/ha
Shade	... *Albizia and Gliricidia*
Experiments	... Nil

Regular upkeep of tea was undertaken during the year.

Field No. 3 Rubber Area

Regular maintenance was carried out during the year. Rubber in this area was tapped and the latex sold to Messers Rubber Manufacturing and Exporting Corporation of Sri Lanka Ltd., Kuruwita.

Field No. 10 Rubber Area

Tapping was undertaken during the year and the latex sold to Messers Rubber Manufacturing and Exporting Corporation of Sri Lanka Ltd., Kuruwita. Regular maintenance was carried out during the year.

Field No.10 – Rubber Area (Part)

Regular maintenance was undertaken. Tapping was done and the latex sold to Messers Rubber Manufacturing and Exporting of Sri Lanka Ltd., Kuruwita.

New clearing work done during the year could be summarised as follows:

Field No. 6C 4.08ha – Intercropping Tea and Rubber – (Planting 1998)

Tea

Replanting was undertaken in this field using clones TRI 2027, S/106, H 1/58, TRI 3000 and 4000 series. The total number of plants used were 28020. Regular upkeep after planting were done during the year. Gliricidia was planted as shade trees in the tea areas.

Rubber

Replanting was undertaken in this field with clone RRIC/102 and 1300 plants were used. Normal upkeep was undertaken during the year.

Field No. 6A 1.20ha 2nd year of upkeep (1996 planting)

Regular upkeep such as weeding, manuring etc was undertaken during the year.

Field No. 6B 2.00ha Intercropping Tea/Rubber – 1st year upkeep (1997 planting)

Regular upkeep was undertaken during the year.

Field No. 1 4.25 ha – Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year.

Field No.8D - 2.83 ha - Area under Rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year.

Field No.1 - 3.80 ha - Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year.

Field No.5 – 5.60 ha - Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year.

Field No.4 - 4.14 ha - Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year.

Field No.8C - 4.30 ha - Area under rehabilitation

Upkeep of mana, lopping, weeding and manuring were undertaken during the year

Field No.8B - 2.02 ha 1st year of upkeep

Weeding, manuring and routine upkeep were undertaken.

7. Factory

Regular upkeep of factory building and machinery was done during the year. A new Tempest drier was installed. Factory uniforms were given to workers. Toilets for men and women workers in the factory were renovated.

8. Buildings

All buildings on the estate were well maintained during the year. A twin cottage was converted to a staff quarter.

9. Labour

The health condition of the population was satisfactory. There were no strikes or major disputes. Re-roofing was undertaken in line No.3.

10. Yield Data

The monthly yield of St. Joachim Estate for 1998 in comparison with that obtained from 1993 to 1997 is given in Table 2. The monthly yield of each field is given in Table 3.

TABLE 2- *Monthly yield (kg ha^{-1}), rainfall and average of N Applied from 1993 to 1998 - St. Joachim Estate*

Month	1993	1994	1995	1996	1997	1998
January	71	102	94	82	112	146
February	34	94	68	86	42	99
March	52	99	77	83	61	81
April	90	109	96	90	118	131
May	82	66	97	96	111	104
June	96	88	99	75	147	123
July	108	66	102	119	113	103
August	79	79	101	112	95	98
September	88	75	101	108	99	120
October	98	87	89	125	90	127
November	106	89	104	126	122	107
December	110	91	69	146	126	120
	1014	1045	1097	1248	1236	1359
Rainfall (mm)	4589.3	3679.0	4216.2	3655.0	4552.3	4579.9
No. of wet days	226	217	208	188	199	220
Average N (kg^{-1} $ha^{-1}yr^{-1}$)	154	133	165	119	143	158

TABLE - 3 *Monthly yield(Kg ha^{-1}) of fields with fertilizer mixture used and amount of N applied of St. Joachim Estate*

Fld No	Extent ha	Tot. N	Fertiliser mixture	J	F	M	A	M	J	J	A	S	O	N	D	Total
1	5.85	180	U/235	75	27	25	79	70	144	129	88	97	78	63	96	971
1A	1.20	160	U/235,U/300	246	192	175	188	117	190	224	–	16	112	151	168	1779
2	4.12	TRI	EXP.BLOCK.	105	61	32	68	66	72	65	47	51	76	59	69	771
2A	0.93	180	U/235,U/300	397	261	102	123	77	-	-	17	190	214	174	306	1861
2F	6.78	180	U/235	184	119	92	186	138	189	168	154	133	134	118	117	1732
3	8.40	160	U/235	101	68	63	142	99	112	94	114	123	105	85	114	1220
4	5.85	140	U/235,U/300	144	84	58	80	18	-	-	13	75	121	123	107	823
5	6.80	140	U/235,U/300	118	51	35	74	56	13	01	11	77	91	70	78	675
5J	1.40	140	U/235,U/300	94	36	69	100	109	-	-	-	60	59	85	64	686
6	1.50	300	U/235	333	277	138	267	304	392	186	282	336	378	265	334	3492
8A	6.00	300	U/235	221	194	223	248	216	309	254	260	269	245	185	197	2821
8C	1.90	300	U/235	166	207	137	177	245	209	205	227	231	275	254	228	2561
3A	3.34	160	U/235	102	72	44	67	37	44	31	-	-	-	-	9	406
	54.07			146	99	81	131	104	123	103	98	120	127	107	120	1359

ADVISORY & EXTENSION SERVICES

Acting Head: S.Wimaladharma

General

Mr. J.C.K. Rajasinghe, Advisory Officer, commenced his M.Sc. programme at PGIA, Peradeniya, on Agricultural Extension.

Mr. C.C. Rajasingham, Senior Advisory Officer, resigned on 27th July after completion of 32 years of service.

Mr. J.A.S.K.V. Jayasinghe was promoted as Advisory Officer with effect from 1st October.

Mr. M.B.A. Perera, Advisory Officer-in-Charge, made a visit to UPASI Tea Research Institute and Tea Advisory Service of South India from 25th October to 7th November.

Mr.B.A.D. Samansiri, Advisory Officer, returned to the island on 12th November, after completion of his M.Sc programme on Development Communication.

Mr. V. S. Sidhakaran was promoted as Advisory Officer with effect from 1st October. He proceeded to follow a 9-month course in Plantation Management in India with effect from 3rd November on a scholarship awarded by Colombo Plan.

Messers K.G.J.P. Mahindapala, R.M.A.C. Rajakaruna and K.U.D. Udapola were recruited as Extension Officers with effect from 4th November.

The activities of the Advisory and Extension service centres at Ratnapura, Passara, Talawakelle, Hantana, Kottawa and Deniyaya during the year are summarised below.

Low-Country Station, Ratnapura

Senior Advisory Officer / Acting Head – S. Wimaladharma

1. Advisory Correspondence

410 advisory correspondences were sent on regular advisory matters, preparation of development plans and updating statistical information.

Approximately 285 on call requests pertaining to the advisory matters were received over the phone and necessary advice given.

2. Advisory & Extension Visits by Staff

a. Advisory Visits

91 advisory visits to the company estates and 63 visits to the smallholdings/ private estates are made.

b. Extension Visits

Extension visits were made to the estate and smallholding sector to evaluate and monitor the TRI 3000 and 4000 series clonal blocks, carry out a preliminary survey on bag plants *vis-a-vis* bed plants, inspect and monitor the fertilizer trials, establish tea and rubber intercropping and SALT trials etc.

c. Visitors to the Low-Country Station

395 persons, comprising 102 estate management personnel, 131 smallholders 60 private estate holders and 102 others, visited the Station seeking advice on problems such as nursery failure, canker and wood rot, drought casualties, termite and shot-hole borer damage, labour shortage, productivity decline, etc. 1060 students came to the station for educational purposes.

3. Advisory & Extension programmes

The following Advisory and Extension programmes were conducted.

a. Regional Scientific Committee Meeting

A new RSC Committee for the Ratnapura region was appointed. This committee organized two Scientific and Technical sessions for the tea planting community in Ratnapura, as follows:

1. First RSC Seminar for 1998 was held at the Tea Research Institute, Low-country Station Sports Club, Ratnapura on 22nd May. At the technical sessions, 2 presentations, viz. Integrated Nutrient Management Towards Enhacement of Tea Productivity and Management of Rush Crops, were made.
2. Second RSC Seminar was held at the Silver-Ray Hotel, Lellopitiya, on 22nd October. At the technical sessions 3 presentations, viz. Organic Carbon Management in Tea Lands, Management of Dry Weather Tea Pests and Pruning Practices in the Low-country, were made.

b. Community Participatory Demonstration

Six demonstrations were conducted, using TRI-TSHDA adaptive fertilizer trials situated at Deraniyagala, Kalawana, Balangoda, Pelawatte, Horana and Ingiriya, to disseminate the practical know-how on the correct mixing and application of straight fertilizers, maintenance of plucking table, shade management, blister blight and canker control and precautionery measures to mitigate drought effects.

c. Seminar and Field days

1. Five field days and seminars were conducted for the executive and field staff of the Talgaswella, Galaboda, Madampe and Yatederiya Estates on nursery management, bush management, soil conservation, mitigation of drought effects and plucking.

2. Eight field days were conducted for the smallholdings in Pundaluoya, Baduraliya, Pelmadulla, Ratnapura, Opanayake, Karapincha and Madampe for the mitigation of drought effects, shear harvesting, fertilizer application, pruning and shade management . There were 2 field days in Pundaluoya.

d. Informal discussion with individuals or groups

Ninety three informal discussions with individuals or groups were held at TRI, Low-country Station, or at their properties on development programmes, pruning programmes, manuring, nursery failures, plucking, control of canker, wood rot termite and shot-hole borer, water logging, drought mitigation, etc.

e. NIPM Programmes

Nine skill development training programmes on nursery management and plucking for the field staff of the estate sector were conducted.

f. Educational Programmes

1. Two educational programmes were conducted for students.
2. Three training programmes and one performance assessment were conducted for Diploma holders from the School of Agriculture.

5. Soil pH Analysis

358 soil samples were tested for soil pH and suitability for use in nursery.

6. Advisory publications distributed

1. Advisory leaflets (free issue)	1435
2. Priced publications	133

7. Special Events

a. Video Programmes

1. The documentary video programme on "Current Research and Advisory Activities of the Tea Research Institute" was produced and arrangements have been made to display it on the News and Current Affaris prgramme of the Sri Lanka Rupavahini Corporation.
2. The documentary video programme titled "Tea Industry in Sabaragamuwa Province" was produced and arrangement made to show it at the Provincial stall at the 50th Anniversary Independence Exhibition held at the BMICH in February.
3. Plantation Reform Project-funded a audio visual material preparation programme on land preparation, nursery management and plucking was

commenced by the Open University Video group in collaboration with TRI Advisory Staff. This is nearing completion.

8. Research and Development

i. Research Papers

The following research papers, based on the preliminery data analysis of the agro-ecological survey conducted at all tea growing regions, were presented by Mr. S.L.D. Amarathunga at the Annual Sessions of the SLAAS at the University of Sri Jayawardanapura on 18th December.

a. Minimum rainfall requirement to obtain potential yield of tea in Sri Lanka

b. Effect of precipitation defecit on tea production in Sri Lanka

ii. Case Studies

The following case studies were conducted for the identification of causes and remedial measures of the problems related to the plantations in low-country.

1. Impact of the drought on the low country tea planting districts.
2. Increase in the incidence of the stem and branch canker in low-country.
3. Causes of retarded growth and death of young as well as mature tea plants in low lying lands
4. Leaflet on "Guidelines for Tea & Rubber intercropping" for the benefit of smallholders and other growers (Sinhala medium).
5. Adoption of bending and pegging method for the low grown areas as an alternative strategy for the maintenance of ground cover
6. Identification of new canker disease in Torelana plantations in Galaboda Estate

iii. Research Article

A detailed research article on some factors associated with the death of tea plants in flat land was published.

Uva Advisory and Extension Centre, Passara

Officer-in-Charge – M.B.A.Perera

1. Advisory and Extension Activities

281 Advisory letters were sent.
58 Advisory visits were made to estates in Uva.
19 Seminars/field days/training programmes were held for estate/small holders.
2 Regional seminars were held in colloboration with Uva RSC.
318 Visitors including planters / smallholders visited the centre.
369 Soil samples were tested for pH.
396 Soil samples were tested for their organic carbon content.

2. Field trials

2.1 Clonal observation trials, UVP 7 and UVP 8, are in progress at the centre. These are carried out and monitored by the Plant Breeding and Propogation Division.

2.2 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 different locations in the region in selected smallholder properties. These are carried out by the Soils and Plant Nutrient Division in collaboration with TSHDA and monitored by the centre.

2.3 Phase II clonal observation trial /UVP -37 was commenced at the centre by the Plant Breeding and Propogation Division. Planting of this trial was completed in December.

3. Special Problems of Uva

3.1 Poor recovery from pruning was reported from many plantations. In addition to the inadequate starch reserves at the time of prune, the high ambient temperatures that prevailed due to *El-Nino* conditions during recovery from prune also contributed to the poor recovery.

3.2 Widespread incidence of shot hole borer infestation causing heavy damage to bush frame and tea crop was reported from many plantations. Special investigations were carried out by the Entomology Division on this problem. A field trial was initiated at Diyaluma Patana Estate, Mirahawatte, Bandarawela, to study methods of successful control of this pest problem.

3.3 Even though the centre sold about 200,000 VP cuttings during the year – more than double the estimated amount for the year – it could not meet the heavy demand for VP cuttings in the area. There is a marked increase in demand for quality planting material due to more smallholders planting their lands with tea in Uva.

Advisory and Extension Division, Mid-Country Station, Kandy

Advisory Officer - S.T. Yatawatte

1. Advisory and Extension Activities

1086 Soil samples received from estate and smallholders were tested for pH value.

280 Advisory letters were sent out to estates and smallholders.

106 Advisory visits were made to estates.

425 Smallholders and 176 planters visited the Centre.

2 Seminars were organized for Superintendents and Assistant Superintendents.

2 Seminars were organized for the factory Officers in Mid country tea plantations.

10 Field days and demonstrations on nursery techniques and general tea cultivation practices were organized for smallholders.

A stall was set up at the exhibition held at Gannoruwa to commemorate Sri Lanka's 50th Anniversary of Independence from 2nd – 14th August.

The smallholder E&E forum was organised at PGRC, at Gannoruwa, on 27th March.

2. Field trials

Officers of the Advisory and Extension Division assisted in carrying out the adaptive experiments in mid-country on the use of fertilizer in smallholder properties and the control of scavenging termites in tea that were conducted on two estates by the Entomology Division.

3. Publications

"Earth worm cast – A Natural Fertilizer" – TRI Update, Vol.3, No.1 October.

"Problem of scavenging termites associated with wood rot in mid-country tea plantations" – Tea Bulletin (in press)

4. Translation

The booklet, "Chemical control of tea pests" was translated into Sinhala.

Advisory & Extension Division, Talawakelle

1. Advisory and Extension Activities

98 Advisory visits were made to estates and smallholdings.

402 Advisory correspondence were sent out to estates and smallholdings.

3 Seminars were organized for Managers and Assistant Managers of plantation companies.

16 Training programmes were conducted.

1525 Students and 590 other visitors visited the Division.

12 Field days and group discussions were held for smallholders and planters.

836 Publications / leaflets were distributed among the planters, smallholders and students.

4 Exhibitions were held.

Southern Province Advisory and Extension Centre, Kottawa
Officer-in-Charge – K.D.Dahanayake

1. Advisory and Extension Activities

95 On call advisory visits were made for problem solving

34 Seminars were held for estate executives and field staff on nursery plucking, weed management, fertilizer, shear plucking, shade and pest and disease, management.

70 Training programmes were held for smallholders and planters.

348 Soil samples were tested for pH and recommendations given.

545 Visitors visited the station.

The Advisory Officer participated in the presidential mobile service held at Niyagama, Galle on 24th and 25th January.

3071 V.P.Plants were issued

203,150 V.P. cuttings were sold

1 RSC seminar was conducted for estate and TSHDA staff.

2. Field trials

Observation blocks on shear plucking, hedge planting, 4000 series, Calliandra, Cinnamon, Grevellia and young tea were maintained. A survey was conducted in Galle district to evaluate the drought damage caused for tea.

Deniyaya Advisory and Extension Centre, Diyadawa

Officer-in-Charge – J.A.S.K.V. Jayasinghe

1. Advisory and Extension Activities

37 Advisory visits were made to estates and smallholdings and 33 inspection visits made for experimental plots and adaptive trials.

65 Advisory correspondence were sent out on regular advisory matters and problems.

The following seminars were organized for smallholders:

3 on all agricultural pracices
1 on pruning
2 on pest and diseases
3 on nursery management
1 on yield decline
1 on rehabilitation
1 on pruning, plucking and drought management

4 Training programmes were conducted for school students and 1 for smallholders on nursery management.

339 Visitors including estate management personnel from smallholdings and private estates, Diploma holders and other students, visited the station.

13 Field days were held for smallholders as well as trainee planters on nursery management, pruning, agrcultural practices and agro-meterology.

62 Publications were sold.
142 Soil samples were tested for pH and recommendations given.
1 Demonstration was held for planters on mechanical harvesting.

The following informal discussions were held:

1 for planters on all agricultural practices.
2 for Tea Inspectors on assessment of plant losesses.
1 for smallholders on nursery management.
1 with Lankadeepa reporter on *El Nino.*
1 RSC Seminar was organized.

2. Audio visual programmes

26 Video films were shown.
The OIC participated in a radio programme.

3. Field trials

Experimental projects namely LVP 74 phase II, Project MeBR-MeBR 18 and project MeBR-MeBR 19, are in progress. Further, the staff attached to the station helped the research divisions on several projects carried out in the region.

Low-Country Station, Ratnapura

Officer-in-Charge - Sushila I. Vitarana

1.0 General

Mrs. S. I. Vitarana continued to serve in the dual capacity of Officer-in-Charge of the station and Acting Head of Entomology Division.

Mrs. S.I. Vitarana continued to function as the Convenor/Secretary of the Consultative Committee on Estates and Advisory Services and as a member of the Pesticide Technical & Advisory Committee. She was also appointed as a member of the Steering Committee on National Plant Quarantine and the first Specialist Committee on Plant Protection set up by CARP. She served on the Editorial Committee of the "Tea Bulletin" and also edited several papers for the "TRI Update".

A project proposal, complete with budget amounting to US $ 2.6524 mn (Rs.161,791,500/-), for the expansion of the station was submitted to the Asian Development Bank for funding. Funding was expected through the proposed ADB loan to Sri Lanka government for improvement of the tea smallholder sector. The proposal has been accepted in principle.

1.1 Appointments, Transfers, Retirements

Mr.U.W.K.Munasinghe was appointed as Assistant Plumber Mechanic of the station with effect from 4th May.

Mr.K.T.C.Perera, Experimental Officer, retired from the service of the Institute with effect from 25th May, after a continuous service of 42 years at the station.

Mr.M.Rengasamy, Guest House Keeper, was transferred to the Head Office with effect from 1st August.

Mr.N.P.S.N.Bandara, Research Assistant, Agronomy Division, was transferred from the Head Office to the station with effect from 16th October.

Mr.A.J.Gamage, Graduate Experimental Officer, Agronomy Division, was transferred from the Head Office to the station with effect from 9th November.

Mr.P.D.Ruwan de Silva was appointed as a driver with effect from 10th November and subsequently transferred to the Head Office with effect from 23rd November.

Mr.N.I.Giddawage, Administrative Officer, tendered notice of his resignation from the service of the Institute in December.

Mr.S.Koneswaramoorthy, Mechanical Engineer, was transferred to the Head Office with effect from 14th December.

1.2 Promotion

Dr.K.G.Prematilaka was promoted to Grade I of the Institute's service in December.

2.0 Advisory and Extension Services

2.1 Work carried out by Advisory and Extension Division

Staff combination of one Advisory Officer and one Extension Officer in the Advisory and Extension Division continued this year as well with research staff assisting them whenever specialist services were needed. The Advisory and Extension work carried out is summarized as follows:

1. Advisory Correspondence	410
2. Soil samples tested for pH	358
3. Visitors to the Station	395
(a) Estate Management Personnel	102
(b) Private/Smallholders	191
(c) Students	1060
(d) Others	102
4. Advisory visits made by the staff of LCS	
(a) Estates Advisory Visits	100
(b) Smallholders Advisory Visits	63

5.Field days/Demonstrations/Informal/Group discussions Seminars/Educational Programs conducted

	Smallholder Sector	Estate Sector	Diploma/ student
RSC		02	
Informal Discussions (individual/Group)	62	28	
Field days/Seminars	08	05	
Educational Programmes			05
Demonstration	06	06	
Video Programme shown	02	06	08
NIPM Programme		09	

6. Meetings attended by Advisory staff on advisory and extension matters 109

7. Video Programme produced: Two programme were completed and another 3 were being produced in collaboration with the Open University.

8. Exhibition: All Divisions of the station participated at Sri Lanka's (Golden Jubilee Independence Exhibition at B.M.I.C.H.)

   40 clonal tea bushes were displayed at the TRI exhibition stall.

9. Research and Development

Research papers submitted	2
Case studies conducted on problems relating to the low grown tea	6
Leaflet produced	2

10. Publication distributed

(a) Free issues Advisory Leaflets & Advisory Circulars	1,927
(b) Priced publications	133

2.2 Participation at Regional Scientific Committee Activities

The Regional Scientific Committee of Ratnapura region (RSC VI) was revived after a long period of quiescence. Mr.S.L.D. Amarathunga, Extension Officer, functioned as the TRI representative on RSC VI Committee.

3.0 Research Activities

Research activities of the following projects were on-going in the low-country and serviced by the staff resident at the station, except in the case of pathology studies:

Agronomy Division - projects B/INCR, D/AGRY, B/PLUK and B/PRUN
Entomology Division - projects B/TERM, D/ENTO and MeBr
Plant Breeding Division - project B/CLON
Technology Division - projects D/TECH and Solar Project
Pathology Division - Project D/PLPA

Progress of work under the above research projects has been recorded elsewhere in this report.

3.1 Extension Activities of Research Divisions

3.1.1 Agronomy Division

1) A draft advisory circular on pruning was prepared.
2) Draft guidelines on plucking were prepared.
3) Guidelines on rubber + tea intercropping were issued.

3.1.2 Entomology Division

Five Advisory Circulars of the "I" series and "N" series were revised and submitted for editing. One new circular was prepared on the subject of "Scavenging Termites and their Management in tea lands".

3.1.3 Plant Breeding Division

The Germplasm Bank was extended to cover 100 clones.
A polyclonal seed garden was established at Sorana Estate.
Forty clonal tea bushes were planted at the TRI exhibition stall.

The following visits were made to estates for various purposes:

For clonal identification:	Endane,Poronuwa, Galaboda, Hapugastenne,Madampe and Panawatta Estate
For nursery inspection:	Poronuwa Estate
For shot-hole borer sampling:	Watapotha Estate

Mother bush area at the station was extended with new clones. Clonal cuttings were issued to small holders and estates as follows:

Clones	No.of shoots
TRI 3000 & 4000 Series	18,000 (90,000 cuttings)
TRI 2000 series	5,000 (25,000 cuttings)

3.1.4. Technology Division

The staff of Technology Division resident at the station made several advisory visits to low-country estates to resolve manufacturing problems.

4.0 Human Resources Development - Local and Overseas

4.1 Local Training

Mr. S.L.D. Amarathunga continued his practical project as part fulfillment of the requirements for MSc, based on "An agro-ecological survey to study the impact of variation of the weather parameters on crop environment and productivity of tea lands in Sri Lanka".

Mr.S.Koneswaramoorthy, Research Assistant, continued his practical project on "solar energy for tea drying" as part fulfillment of the requirements for Licentate degree.

Ms. S.M.Samarasinghe, Experimental Officer, continued with her research work on allomones (Keiromones and allelomones) of tea and other plants with reference to low-country live wood termites of tea, as part fulfillment of the requirements for M Phil degree.

4.2 External Trainees

Six apprentices of the National Apprentice and Industrial Training Authority (NAITA) underwent training at the station. Two of them were trained in the Administration Division for English Stenography, one in the Advisory Division and three in the Agronomy Division for the NDT(Agriculture).

Dr. M.A. Wijeratne and Mrs. S.I. Vitarana supervised the undergraduate projects conducted at the station by two graduates, one each from the Faculties of Agriculture at Ruhuna and Peradeniya Universities.

5.0 Meteorological Station

The duties of the Meteorological Station were taken over by Mr.A.K.Premathunga with effect from 16th July. Daily recording of meteorological data and dispatch of monthly data to the meteorological Department continued. Meteorological data is given in the annexure.

A.K.M.Jayasena and A.K.Premathunga

6.0 Station Administration

6.1 Maintenance, electrical and water supply of the station

Action was initiated to replace the defective telephone system of the station with the exchange received from the Head Office.

The buildings, electrical installations and water supply to the staff quarters etc. within the campus continued to be well maintained.

Repair work of internal roads was in progress. Erection of barbed wire fencing was also in progress. However, due to shortage of labour, maintenance work fell behind schedule. There were 39 workers in the lay-out gang during the year 1997 but it dropped to 12 during the current year. Therefore, arrangements had to be made to entrust road repairs, ornamental tree planting, weeding, etc. to contractors temporarily, while making attempts to increase the labour force to the required number.

6.2 Lightening damage

Heavy damage due to lightening strikes occurred on 3rd December and repairs amounting to Rs.60,000/- were carried out. Arrangements were made to install more effective lightening arrestors.

6.3 Station Expansion

Final drawings of the plans for construction of laboratory/library extension and an auditorium were completed. Preliminary drawings for the hostel complex were begun by the Sri Lanka State Engineering Corporation.

The Tender Document for the construction of the laboratory extension was prepared by the Sri Lanka State Engineering Corporation (SEC) and evaluated by a Technical Evaluation Committee which comprised the Director, Deputy Director (Administration), Senior Accountant, the Officer-in-Charge of the station and Mrs Sriyanie de Silva, Deputy Director (Construction) of the Institute of Construction Training and Development. The revised document was being prepared by SEC for tendering purposes.

Dr M.A.Wijeratne was appointed as a visiting lecturer at the Faculty of Agriculture, University of Ruhuna.

Dr.M.A.Wijaratne, Mr.S.Wimaladharma and Mrs. S.I. Vitarana conducted lectures and practical classes for the Diploma Course of the National Institute of Plantation Management.

Dr.M.A.Wijeratne conducted field demonstrations on mechanical harvesting, mechanical pruning and soil rehabilitation for the benefit of Superintendents and smallholders in Balangoda, Kandy, Ratnapura and Nuwara Eliya

Mrs. S.I. Vitarana spoke on "Effect of Exotic Predatory Mites on Tea Red Spider Mite" at the RSC I seminar on 30th March.

Drs. M.A.Wijeratne and K.G.Prematilaka addressed the planters on the topics "Soil Rehabilitation, Soil conservation and shade establishment" and "Cultural practices and Aftercare" respectively, at the RSC IV (Mid Country) seminar in April.

A seminar of the RSC VI was held at the TRI Low-Country Station on 5th May, at which Mrs.Wimaladharma and Dr. M.A. Wjieratne spoke on the subjects "Future RSC activities and Forward extension programme for the estate sector" and Harvesting Techniques for the Rush-crop-period-Manual and shear harvesting after which Dr.Wijeratne demonstrated the use of the shears.

Mrs. S.I. Vitarana and Mrs.Wimaladharma delivered lectures on the topics "Management of Dry -weather Pests in the Low Country" and "Pruning Practices in the Low Country" respectively at the RSC VI seminar held on 22nd October.

Mrs. S.I. Vitarana delivered a lecture on "Integrated Pest Management in Tea" at the RSC IV seminar on 27th November.

Overseas Training

Mrs S.I.Vitarana participated at the Training Workshop on Monitoring and Management of Heavy Metals, Pesticides, Pcbs, Dyes & Pigments, from 17-21 May in Islamabad, Pakistan. She presented the country paper for Sri Lanka at the workshop which was conducted by the Commonwealth Science Council, UK.

Dr.M.A.Wijeratne went on a familiarization visit to UPASI and South Indian tea plantations in October / November.

Mid-Country Research, Advisory and Extension Centre, Kandy

Officer-in-Charge – P.B.Ekanayake

1. General

Ms.R.M.D.Pallemulla, Research Assistant, was transferred from Talawakele to the Entomology Division in June.

2. Advisory & Extension Service

305 Letters were written to estates and small holders.
107 Advisory visits were made during the year.
176 Local and foreign visitors and 425 smallholders came to the Station.
996 Soil samples were tested for pH.
2 RSC Seminars were held for Superintendents & Assistant Superintendents in the region.
9 Field days were held for Estate Field staff at the Station and in several estates in the Mid-Country.
7 Seminars/demonstrations were held for small holders in the region.

3. Hectarage as at 31st December 1998

Type of land use	ha
Seedling tea	3.60
VP tea (mature)	5.80
VP (young)	2.00
Mother bush	3.00
Nursery (tea)	0.20
Fruit trees	0.40
Coconut	0.81
Forestry	1.21
Marshy land	0.62
Buildings, gardens, paths & roads	5.77
Total	23.00

4. Crop

Green leaf statement: 1998

Month	Crop harvested(kg)	Crop sold (kg)	Rate received (Rs./kg)	Total receipts (Rs.)
January	3,438	3,417	18.51	63,241.67
February	2,919	2,903	18.47	53,618.41
March	1,554	1,549	19.77	30,623.73
April	2,263	2,226	17.23	38,353.98
May	2,880	2,589	18.01	46,627.89
June	3,805	4,171	15.42	64,316.82
July	3,028	3,016	14.96	45,119.36
August	3,202	3,189	17.47	55,711.83
September	3,844	3,837	15.22	58,399.14
October	3,377	3,359	12.76	42,860.84
November	3,172	3,149	14.63	46,069.87
December	3,660	3,659	14.63	53,531.17
Total	37,142	37,064		598,974.71

5. Income

No of cuttings sold	1,313,425
Sale of cuttings	Rs.313,825.00
No of VP plants sold	94,828
Sale of plants	Rs.393,533.50
Total crop harvested (kg)	37.064
Sale of green leaf	Rs.598,475.00
Guest House occupation charges	Rs.12,275.00
Electricity charges	Rs. 3,281.40
Soil testing (pH) charges	Rs.29,880.00
Miscellaneous	Rs. 46,056.78
Total income	Rs.1,397,326.68

6. Special Visitors

1. Dr.Tetsuji Saba, Makurazaki, Kagoshima, Japan, in February
2. Dr.T.Hadaka, JICA, RRDI, Batalagoda, in February
3. Mr.Dennis Ellison, ADB, in March
4. Dr.F Bolton, ADB, in March
5. Mr.H.R.G.B.Erabadupitiya, Dept.of Agriculture, in April
6. Dr.Lionel Martin, Curin University, Perth, Australia, in May
7. Dr.G.Wadasinghe, University of Peradeniya, in May

8. Ms.Ute Kholwes, Gamisevana, Galaha, in May
9. Dr.S.Kodomari, Shizuoka, Japan, in August
10. Dr.N.D.R.Weerawardena, Forest Research Station, Boyagane, in June
11. Mr.Sarath Wimalaratna, Visiting Agent, SPC/JEDB, in June
12. Mr.Rory Gallegos, California, USA, in August
13. Mr.Rolf Williges, Gamisevana, in September
14. Dr.Ray Fordham, Wye College, UK, in September
15. Ms.Sheila Foxth, UNDP, Canada, in October
16. Dr.(Mrs) Rohini Ekanayake, Entomologist, HORDI, Gannoruwa, in October
17. Dr.J.Ratnasiri, Ministry of Forestry & Environment, in October
18. Dr.Mervyn Sikurajapathy, Kituldeniya Estate, Handessa, in November
19. Dr.K.P.Premaratna, University of Peradeniya, in December

Deniyaya Advisory and Extension Centre - Diyadawa

Officer-in-Charge – J.A.S.K.V. Jayasinghe

1. General

Mr. J.A.S.K.V. Jayasinghe was promoted as Advisory Officer of the Advisory and Extension Division w.e.f.1st October. Mr. Lalantha Kodikara, Guest House Keeper, was transferred from the TRI Talawakelle to this Station w.e.f. 18th August. Mr. A. Sinnathambi, Guest House Keeper, resigned from the service of the Institute w.e.f. 1st September.

2 . Hectarage as at 31st December 1998

	ha
Area under tea	6.41
Area under coconut	0.13
Area under pepper	0.03
Buildings	1.44
Nursery	0.70
Encroachment	1.12
Gautemala	1.45
Jungle (Rocky area)	1.92
Total	13.22

3. Buildings and utility services

a) Construction of three bathrooms and one bedroom for the Guest House was completed.
b) Repairs to 'C' type building under the supplementary budget were undertaken.
c) The twin 'D' type building was colourwashed.

4. Crop

Green leaf statement (kgs) -1998

Month	Crop Harvested (kg)	Rate received (Rs./kg)	Total income (Rs.)
January	2455	20.641	50,673.66
February	1032 348	21.845 23.95	30,878.64
March	1385	21.778	30,162.53
April	2392	21.261	50856 .31
May	1953	22.847	44,620.19
June	2783	20.097	55,929.95
July	2154	22.224	47,870.59
August	2319	22.653	52,532.31
September	2496	20.311	50,696.26
October	2034	19.983	40,645.42
November	1721	18.222	31,360.06
December	2180	15.238	33,218.84
Total		25252	519,444.76

5. Income

No. of cuttings sold	213,700
Sales of cuttings	Rs.42,740.00
No .of plants sold	10,575
Sale of plants	Rs.51,825.00
Crop harvested (kg)	25,252
Sale of crop	Rs.519,444.76
Average price (kg/green leaf)	Rs.20.57
Miscellaneous	Rs.29,158.73
Total Income	Rs.643,168.49

6. Advisory & Extension Service

65 advisory correspondence were sent out on regular advisory matters and problems.

37 advisory visits to estates and the small holding sector were made by the advisory staff.

33 inspection visits were made in connection with experimental plots and adaptive fertiliser trials.

339 visitors including estate management personnel, smallholders, private planters, Diploma holders and students came to the Station.

Advisory Officers' Forum

The Officer-in-Charge attended the meetings of the Advisory Officers' Forum held at Bandarawela, Loolkandura Estate, Hewaheta and Kandy.

RSC Seminar

Regional Scientific Committee No IV (Galle-Matara region) organised a seminar in collaboration with TRI Deniyaya station for estate executives and officers of TSHDA and Tea Commissioner's Division. The Acting Head Advisory & Extension services and the Secretary General of the Planters' Association attended it. The subjects discussed covered the future programme of advisory services, antioxidant activity of black tea and strategies for organic matter management in low country tea estates. The Officer-in-Charge attended two RSC seminars organised by RSC Kandy and Ratnapuara.

Field Days

Three field days were held for smallholders each on nursery management, plucking, pruning and agricultural practices, and one for trainee planters on pruning, besides one worker programme on recording agro meteorology observation.

Training programmes

Four training programmes were conducted for school children on Agromet station and one for smallholders on nursery management .

Seminars

The following seminars were held for smallholders:

- 3 on all agricultural practices
- 1 on pruning
- 3 on pests and diseases in tea
- 2 on nursery management
- 1 on plucking and drought management
- 1 on yield decline
- 1 on soil rehabilitation

Informal discussions

The following discussions, of an informal nature, were held during the year :

- 1 for planters on all agricultural practices
- 2 for Tea Inspectors (Matara Region) on assessment of plant losses
- 1 for a smallholder on nursery management
- 1 with Lankadeepa reporter on impact of *El-Nino*
- 1 with Dr.Dantanarayana on Shot-hole borer

Others

Video programmes - 26 video films were shown

Workshops -The Officer-in-Charge participated in a workshop on characterization of clones.

Identification of land - One visit was made with RRI staff.

Demonstrations- One demonstration was held for planters on mechanical harvesting.

Radio Programmes- The OIC participated in a radio programme.

Exhibitions - The OIC participated in an exhibition held at BMICH.

142 samples were tested for pH.

62 priced publications were sold during the year.

7. Field Trials

A. The following experiments are being conducted at the station:

LVP 74 phase II
This trial was commenced in August 1997.

Project MeBR - MeBR 18
This experiment was commenced in December 1997 to determine the efficacy of soil solarisation as a means of eradicating nematodes in nursery soil. It is in progress.

Project MeBr -MeBr 19
This experiment on sedimentation process for nematode infected water, which was commenced at the station in December 1997, is in progress.

B. The staff attached to the station also helped the research divisions in the following projects being carried out in the region

1. Effect of potassium and/ or magnesium from Sul-Po-Mag and Kieserite at 2 levels of N on soil / plant nutrient status and yield of tea (Kiruwanaganga Estate)
2. Me Br 06 to test alternatives for eradication of nematode in tea fields (Handford Estate)
3. Effective time and types of pruning (Kiruwanaganga Estate)
4. Adaptive fertilizer trials at Pasgoda and Deniyaya, (in collaboration with TSHDA, Matara Region)
5. Insecticidal trial on root eating ants in Deniyaya area
6. Effect of different methods and time of pruning on the productivity of tea bushes (Deniyaya Estate)
7. Assessment of rate of plant losses in the tea fields in low-country (Agricultural Economics Unit of TRI in collaboration with TSHDA, Matara region)

Uva Advisory and Extension Centre, Passara

Officer-in-Charge : M.B.A.Perera

1. General

1.1 Staff

Mr.W.A.D.P.M.U. Attanayake, who served as a casual driver for the Centre, was made permanent and transferred to TRI Head Office at Talawakelle with effect from 16th November. Mr. K.R.M.Ranjith, who was transferred from the Head Office, assumed duty as the driver of the Centre on 16th November.

1.2 Infrastructure Developments

The Guest House of the Centre was refurbished by providing an additional bathroom and effecting other improvements.

An abandoned junk yard was refurbished with necessary alterations and is now used by night watchers as a rest room.

A culvert with cattle trap was built at the entrance to the Centre to prevent cattle menace which has been a perennial problem.

Contracts were awarded for uprooting and land preparation of an area of about 0.5 ha which is the balance old seedling area purchased from Gonakelle Estate. This work is in progress.

External and internal colour washing of all the buildings other than the Office/ Laboratory buildings was done during the year.

1.3 Special Assignments

Mr B.A.Perera, Advisory Officer-in-Charge, undertook the following responsibilities in addition to his normal duties:

a) Convener / Secretary of Smallholder Sector E&E Forum
b) Convener / Secretary of Advisory Officers' Forum
c) Member of the Editorial Board for TRI technical publications and coordinator for the publication 'TRI Update'
d) Coordinator for the activities connected with the revision of TRI Advisory Circulars
e) Collaborator in the research programme on "Biological and management studies of Anredera basselloides for its successful suppression in tea plantations", a special collaborative research project of TRI and University of Peradeniya, funded by the CARP
f) Resource person for the 9th National Diploma Programme in Plantation Management conducted by the NIPM
g) Assisted the Head, Advisory, in coordinating the work connected with Sri Lanka's Independence Golden Jubilee Exhibition held at BMICH, Colombo
h) Assisted the Head, Advisory, in coordinating the production of video

programmes for worker/ farmer education under Plantation Reform Project of the Ministry of Plantation Industries. The video films are prepared by the Media House of the Open University.

1.4 Foreign Visits

Mr.M.B.A.Perera, Advisory Officer-in-Charge visited the UPASI Tea Research Institute and Tea Advisory Service in South India from 25th October to 7th November.

2. Advisory and Extension Activities

281 Advisory letters were issued
58 Advisory visits were made to estates in Uva
19 Seminars/field days/training programmes were held for estates/small holders
2 Regional seminars were held in collaboration with Uva RSC
318 Visitors including planters / small holders visited the Centre
369 Soil samples were tested for pH
396 Soil samples were tested for their organic carbon content

3. Hectarage of the Centre as at 31st December 1998

Mature tea in plucking	.. 4.85 ha.
Mother bushes	.. 1.15 ha.
Young tea (Experimental block)	.. 0.33 ha.
Land under rehabilitation	.. 0.12 ha.
Uprooted for rehabilitation	.. 0.50 ha.
Buildings / Roads	.. 0.50 ha.
Forest / Scrub / Grass land	.. 6.85 ha.
Total extent	.. 14.30 ha.

4. Crop

Green leaf statement (kg.) – 1998

Month	Harvested	Sold	Rate Received (Rs./kg.)	Income (Rs)
January	3,153	3,154	19.14	60,367.56
February	3,237	3,237	19.32	62,538.84
Arch	3,344	3,342	20.89	69,814.38
April	4,982	4,979	18.55	92,360.45
May	3,799	3,800	17.84	67,792.00
June	3,541	3,550	13.85	49,167.50
July	1,324	1,324	15.24	20,177.76
August	4,973	4,973	16.00	79,568.00
September	4,235	4,254	14.69	62,491.26
October	3,110	3,110	12.87	40,025.70
November	3,420	3,426	14.09	48,272.34
December	3,373	3,373	12.31	41,521.63
Total	42,491	42,522		694,097.42

The income referred to above is exclusive of the leaf transport charges paid to Gonakelle Estate. The amount paid as transport charges was Rs.14, 882.70 and the net income realised from the sale of green leaf for the year was Rs. 679,274.72. The yield obtained for the year was 1930 kg. /MT/ha. which was 6.2% above the estimated yield and 12% above that obtained in 1997. The average price realised for green leaf during the year was Rs. 16/23 per kg.

5. Income

No. of VP cuttings sold	-	199,470
Sale of VP cuttings	-	Rs. 49,867.50
No. of VP plants sold	-	Nil
Green leaf sold (kg.)	-	42,522
Sale of green leaf	-	Rs. 679,274.72
Soil analytical charges	-	Rs. 54,630.00
Miscellaneous	-	Rs. 16,934.00
Total Income		Rs. 800,706.22

6. Checkroll workers (as at 31st December 1998)

No. of checkroll workers	-	26
Outturn (Women)	-	53%
Outturn (Men)	-	44%

Most of the workers from nearby villages kept away from work during the paddy cultivation seasons and during festive seasons. The low outturn hindered the scheduled field operations.

7. Field Trials

7.1 Clonal observation trials, UVP 7 and UVP 8, are in progress at the Centre. These are carried out and monitored by the Plant Breeding and Propagation Division.

7.2 Demonstration trials on the use of tea fertilizer mixtures, T-1130 and U-709, for mature tea under smallholder conditions were continued in three different locations in the region in selected smallholder properties. These were carried out by the Soils and Plant Nutrition Division in collaboration with TSHDA and monitored by the Centre.

7.3 The second phase clonal observation trial 2/UVP-37 commenced at the Centre by the Plant Breeding and Propagation Division. Planting of this trial was completed in December.

8. Special Uva Problems

8.1 Poor recovery from prune was reported by many plantations. In addition to the inadequate starch reserves at the time of prune, it was observed that the high ambient

temperatures that prevailed due to *El Nino* conditions during recovery from prune also contributed to the poor recovery.

8.2 Widespread incidents of shot-hole borer infestation causing heavy damage to bush frame and tea crop was reported from many plantations. Special investigations were carried out by the Entomology Division on this problem. A field trial was initiated at Diyaluma Patana Estate, Mirahawatta, Bandarawela, to study the methods to successfully control this pest problem.

8.3 Although the Centre sold about 200,000 VP cuttings during the year, it could not meet the heavy demand for VP cuttings in the area. There is a marked increase in demand for quality planting material due to more smallholders planting their lands with tea in Uva.

Southern Province Advisory and Extension Centre
Kottawa, Talgampola

Officer- in-Charge: K.D. Dahanayake

1. Improvements to the Centre

The old timber and tiles in the Office building and OIC's bungalow were replaced.

Construction of a new well was completed for water supply to the bungalows and workers' quarters.

The new approach road to the Centre was tarred.

New iron gates were fabricated and fixed to the two main gate entrances to the centre.

The nursery shed roof was renovated.

2. Workforce

Number in the checkroll	60
Outturn	50 percent

3. Crop

Green leaf statement -1998

Month	Crop Harvested (kg)	Crop Sold (kg)	Rate received (Rs./kg)	Receipts (Rs)
January	9,094	9,094	23/07	209,798.58
February	4,322	4,322	23/01	99,449.22
March	2,617	2,617	22/40	58,620.80

April	5,611	5,611	22/08.7	123,930.16
May	4,807	4,807	23/15.7	111,315.70
June	5,732	5,732	24/55.6	140,754.99
July	6,286	6,286	24/26.4	152,523.50
August	7,198	7,198	24/16.2	173,918.08
September	6,699	6,699	22/14.5	148,349.36
October	6,986	6,986	21/25.7	148,501.40
November	6,044	6,044	21/19.6	128,108.62
December	8,191	8,191	19/46.4	159,429.62
Total	73,587	73,587		1,654,700.03

Total rainfall 2775.2 mm
No. of wet days 161

4. Income

Sale of green leaf	Rs.1,667,281.41
No. of VP plants issued	30,071
Sale of VP plants	Rs.138,051.50
No. of VP cuttings sold	20,3150
Sale VP shoots	Rs.40,630.00
Miscellaneous	Rs.25,217.00
Total Income	Rs.1,871,179.91

5. Advisory and Extension Service

183 letters were issued.

640 visitors, of whom 545 were smallholders, sought advice at the Centre and purchased VP shoots and plants.

Advisory Visits

95 on-call advisory visits were made during the year to resolve problems relating to land selection, soil acidity, pruning, plucking, pest and diseases, nursery etc.

Seminars

34 seminars were held for estate executive staff and field staff on nursery, plucking, weed management, fertilizer, shear plucking, shade, pests and diseases.

Training in Smallholding Sector

70 groups and small batches of smallholders were trained at the Kottawa Centre and also in Galle, Matara, Buddegama, Elpitiya, Hiniduma, Udugama, Imaduwa.The

topics covered all aspects of agricultural practices in tea, especially soil acidity and dolomite application.

348 soil samples were tested for pH of which 164 were found to be low and recommendations were given to correct them. Smallholders evinced keen interest to improve their pH value and took steps to do so.

RSC

One RSC seminar was conducted for the Estate and TSHDA staff at which the following topics were discussed:

Rehabilitaion	-	Mr.P.B.Ekanayake
Health Benefit on Tea	-	Dr.Tissa Amarakoon
Pruning	-	Mr.S.Wimaladharma

6. Presidential Mobile Service

Mr.K.D.Dahanayake, OIC, participated at the Presidential Mobile Service held at Niyagama, Galle, on 24th and 25th January 1998. The advisory inputs provided to the estate and smallholding sectors on tea growing were highly appreciated.

7. BMICH Exhibition

Mr.K.D.Dahanayake, OIC, participated at the 50th Independence Exhibition held at BMICH, Colombo.

8. E and E Forum in Sinhala

The E and E Forum (Sinhala) meeting was held at Walahanduwa Laboratory. The following officers participated at the meeting.

Mr.P.B.Ekanayake, Mr.G.Galahitiyawa, Mr.S.Wimaladharma, Dr.L.S.K. Hettiarchchi, Mrs.S.I.Vitharana, Dr.A.Balasooriya, Dr.I.S.B.Abeysinghe, Dr.Kapila Zoyza, Mr.J.A.S.K.V. Jayasinghe, Mr.Jayantha Silva, Mr. K.D.Dahanayake and Mr. M.B.A. Perera.

Mr.Rohana Illangaratne, Chairman, and Mr.Asoka Somaratne, Deputy Director (Extension), participated on behalf of the TSHDA.The discussions were very useful and the linkage established has helped to disseminate research findings to the smallholder sector.

9. Drought Damage Survey - 1998

A survey was conducted by the OIC in the Galle District to evaluate the drought damage caused to tea. A number of estates and smallholdings were selected from Yakalamulla, Imaduwa, Wanduraba, and Buddegama areas for this purpose.

10. Drought caused to Mature Tea

The drought damage resulted in a loss of crop in estates and smallholdings in the Imaduwa and Yakkalamualla areas for the first 4 months of 1998. The yield in Buddegama was, however, higher in 1998 when compared with that of 1997.

11. Wilting and Defoliation

The poorly-managed fields with debilitated tea bushes suffered more than the healthy bushes. Completely defoliated blocks were seen in the Galle district. This may be due to the following reasons:

- Gravelly soil or poor soil depth
- Exposed rocks and boulders or hard pan.

12. Experiments and Observations

These related to the following:

- Shear plucking observation block-Reported by Ratnapura-1998
- Hedge planting observation block
- 4000 Series clones observation block
- Caliandra plants block
- 200 plants Cinnamon in boundaries (intercropping)
- Growth performance of Gravilia
- Reported by Ratnapura and Talawakelle - 1996 and 1998
- Growth performance of young tea
- Reported by Ratnapura-1998

LIBRARY

The collection and dissemination of information on tea and allied areas were carried out throughout the year.

Acquisitions

The library acquired 56 new books and subscribed to 46 journals. About 16 journals were also received on a gift/exchange basis.

Services

The library continued its normal work such as classification, cataloguing, indexing, lending materials and maintained a news clipping collection.

Inter-library loan activities continued satisfactorily. On request, 49 articles were sent to various agricultural libraries while 43 articles were received for our use.

Twenty literature surveys were done using CD-ROM databases and Internet facilities available at the IIMI, CARP and NSF.

The library continued to maintain close relationship with AGRINET (Agricultural Information Network) and received 172 journals content pages according to our user requirements and we forwarded 343 journal content pages to AGRINET libraries on SDCP services. We received 29 articles from other libraries and sent 26 articles to them through AGRINET.

A "Literature Survey on Tea" was carried out bi-monthly using CCOD Agri. Bio. & Env. Science. This was distributed among the staff.

Library Automation

The following databases were made and updated using CDS/ISIS package:

- Lending record of library books
- Periodical records

Meetings

The Librarian attended the AGRINET Librarians and Advisory Committee meeting held at the CARP Office, Colombo, on 2nd October.

METEOROLOGICAL OBSERVATIONS: 1998
TRI - ST. COOMBS, TALAWAKELLE
(LAT 6° 55' N, LONG 80° 40° E, 1382m amsl)

Month	Mean Temperature (°C) Min Dry	Mean Temperature (°C) Max Dry	Soil at 20 cm under grass 08.30 hrs	Soil at 20 cm under grass 15.30 hrs	Relative Humidity % 08.30 hrs.	Relative Humidity % 15.30 hrs	Wind travelled (miles)	Mean Sunshine (h'day-1)	Total Rainfall (mm)	Wet days	Total Evaporation (mm)
January	12.6	24.4	21.9	22.8	93.6	96.8	2770.20	6.6	34.1	3	94.70
February	11.9	27.5	23.1	24.1	94.5	98.1	1984.20	8.3	14.0	3	99.90
March	11.2	29.0	24.2	25.6	89.2	92.4	2473.08	9.5	22.4	6	123.00
April	13.1	28.8	23.8	24.7	91.3	93.9	2727.40	8.0	105.8	7	100.60
May	15.8	25.9	23.1	23.6	96.9	98.4	1993.80	4.8	262.4	16	64.70
June	16.2	23.0	22.2	22.5	98.6	98.8	6200.20	2.1	407.2	26	46.10
July	15.2	22.8	21.3	21.7	98.0	98.2	7601.20	2.7	217.2	24	48.00
August	15.1	23.4	21.4	21.8	96.5	96.5	1950.00	3.7	318.5	25	56.00
September	14.5	22.5	21.5	21.8	97.1	94.8	4018.00	2.8	340.4	24	32.40
October	14.1	23.6	21.3	21.4	96.2	96.7	1932.60	3.6	170.4	20	62.30
November	13.2	23.8	21.5	21.8	94.0	92.7	1786.70	5.9	135.6	15	73.30
December	12.1	23.7	21.6	22.1	92.8	92.5	8179.00	3.7	155.6	15	55.50

MID-COUNTRY RESEARCH, ADVISORY AND EXTENSION STATION, KANDY: 1998

(Elevation 762 m amsl)

Month	Mean Temperature (°C)		Relative Humidity (%)		Mean Sunshine (hrs/day)	Cum.Rainfall (mm)	No: of Wet days	Cum.Evaporation (mm)
	Min.	Max.	08.30 h	15.30 h				
January	19.30	27.60	86.40	76.00	6.90	57.9	6	NA
February	19.70	30.20	88.30	62.70	7.70	14.4	4	66.50
March	20.20	30.20	87.80	51.30	8.20	63.2	3	122.96
April	21.50	32.60	87.60	64.40	8.40	61.6	3	119.66
May	22.20	31.10	91.20	95.20	6.80	135.4	13	81.69
June	21.20	27.80	94.00	91.50	4.10	156.30	20	58.09
July	20.30	27.80	90.60	82.90	5.20	257.60	16	64.68
August	20.20	27.90	93.10	88.00	4.60	218.70	18	69.09
September	20.20	26.70	88.60	83.72	4.80	235.20	19	57.00
October	20.00	26.40	87.60	82.30	4.00	172.50	19	53.00
November	19.50	27.00	92.50	81.30	5.60	177.70	13	69.48
December	19.10	27.10	89.70	78.40	5.40	201.00	15	54.05

LOW-COUNTRY STATION RESEARCH, ADVISORY & EXTENSION CENTRE, RATNAPURA: 1998

(LAT 6^0 41 N, LONG 80^0 E - 40^0 E, 29m amsl)

Month	Temperature (^{0}C) Min Dry	Max Dry	Relative Humidity 9.00 hrs. a.m	16.00 hrs p.m.	Mean Sun Shine h'day	Rainfall Total	Difference from 30 years	Wet days	Difference from 30 years	Pan Evaporation m.m
January	23.5	33.9	86	66	5.9	196.7	+85.6	7	-2	3.10
February	23.9	35.2	85	61	6.8	149.4	+12.4	5	-4	4.17
March	24.0	36.0	84	63	6.3	189.4	-22.8	14	0	4.73
April	24.5	35.6	84	72	5.7	218.1	-120.8	16	-4	4.03
May	24.7	33.7	87	76	4.5	551.7	+75.8	19	-1	2.85
June	24.1	31.9	86	77	3.2	499.5	+87.3	26	+5	2.73
July	24.0	31.3	86	77	5.1	526.2	+233.4	19	-1	3.08
August	23.0	31.1	88	76	3.4	444.0	+139.9	24	+4	2.89
September	23.9	31.3	86	77	2.7	425,5	+4.1	26	+6	2.54
October	23.5	31.7	85	71	2.8	603.9	+167.1	21	0	2.43
November	23.2	32.2	87	70	3.8	266.0	-5.4	13	-5	4.21
December	22.5	32.2	89	74	3.1	426.1	+190.8	18	+4	2.40
Total	-	-	-	-	-	4596.5	-	-	-	-
Mean	23.73	33.0	86	72	4.4	-	-	-	-	3.26

DENIYAYA ADVISORY AND EXTENSION CENTRE: 1998

(Elevation 250 m amsl)

Month	Mean Temperature(C)		Relative Humidity(%)		Total wind (Km)	Total Rainfall (mm)	Wet Days
	Max.Dry	Min .Dry	08.30 h	15.30 h			
January	25.9	20.4	81.6	69.4	849	89.7	7
February	33.1	20.7	80.7	65.2	830	72.8	8
March	33.9	24.1	78.3	59.9	881	160.9	11
April	36.3	26.3	.80.0	75.5	849	205.8	12
May	33.1	24.2	80.5	66.4	1336	308.5	17
June	30.7	25.1	85.7	78.8	2962	379.0	21
July	29.4	24.3	82.6	77.9	1751	376.2	18
August	30.2	25.0	82.0	77.0	*	176.1	17
September	29.3	22.9	75.7	76.0	*	393.3	19
October	30.2	22.5	80.2	78.2	*	261.6	17
November	31	20.8	82.0	80.5	*	347.3	15
December	32.1	21.5	81.5	79.0	*	495.7	20
Total						3266.9	182
Mean	32.1	23.1	80.9	73.6			

*Animometer was not functioning.

ADVISORY AND EXTENSION CENTRE, PASSARA:1998

(Elevation 1120 m amsl)

Month	Mean Temperature ^{0}C		Mean Relative Humidity		Mean Sun Shine	Total wind (Km)	Total Rainfall (mm)	Total Evaporation
	Min Dry	Max Dry	08.30 h	15.30 h	h day^{-1}			
January	15.4	24.5	85	87	4.7	1123	218.1	50.87
February	17.3	26.0	84	81	6.0	823	46.3	68.46
March	17.3	28.2	80	73	6.2	610	107.0	131.46
April	19.5	27.6	83	77	6.5	329	108.6	88.98
May	20.1	26.3	80	82	6.1	460	79.1	93.5
June	20.0	28.1	79	77	3.8	1433	34.1	92.18
July	18.6	27.5	77	75	4.1	1006	159.4	94.78
August	18.1	26.5	84	88	4.6	442	206.4	63.06
September	17.8	26.7	82	79	3.3	495	44.2	65.43
October	18.6	25.7	83	82	4.0	510	133.9	58.09
November	23.7	25.5	80	88	4.0	379	201.5	42.39
December	17.8	24.0	90	92	3.8	1184	459.2	45.32
Total						8794	1797.8	894.52
Mean	18.7	26.4	82	81	4.8	732.8	149.8	74.54

SOUTHERN PROVINCE ADVISORY AND EXTENSION CENTRE
KOTTAWA, TALGAMPOLA: 1998
(Elevation-30m amsl)

Month	Mean Temperature (°C) Max	Min	Relative Humidity (%) 08.30h	Mean Sunshine (h day^{-1})	Total Rainfall (mm)	Differnce from 20 years	Wet days
January	32.4	22.2	90	7.1	32.4	-80.0	06
February	33.2	22.4	89	8.4	66.3	-23.9	04
March	34.6	23.0	87	8.3	24.8	-103.7	04
April	34.0	24.2	85	7.9	181.5	-88.1	08
May	32.2	25.1	87	5.0	140.3	-221.8	17
June	30.4	24.1	92	3.7	189.7	-108.2	19
July	29.6	23.9	91	4.3	450.0	+254.0	16
August	30.2	23.7	91	5.9	219.9	+10.2	16
September	30.0	23.1	92	5.3	280.5	08.0	23
October	29.9	22.9	90	5.4	386.5	37.6	16
November	30.0	22.9	83	5.5	437.1	+115.8	14
December	29.7	21.9	92	4.3	366.2	+200.9	18
Total						2775.2	161
Mean		31.4	23.3	89	5.9		

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கணக்காய்வாளர் தலைமை அதிபதி திணைக்களம்
AUDITOR - GENERAL'S DEPARTMENT

මගේ අංකය
எனது இல.
My No. PI/H/TRB/98/179

ඔබේ අංකය
உமது இல.
Your No.

දිනය
திகதி
Date 24th November 1999

The Chairman
Tea Research Board

Report of the Auditor General in terms of Section 13 (7) (a) of Finance Act No. 38 of 1971 on the Accounts of Tea Research Board for the Year ended 31 December 1998.

The above mentioned report is sent herwith.

In this connection your attention is drawn to Section 13 (8) of the Finance Act reproduced in the note below.

(J.D.P. Jayalath),
Assistant Auditor General,
for Auditor General.

Copies : 1. Secretary, Ministry of Public Administration, Home Affairs and Plantation Industries.

2. Secretary, Ministry of Finance and Planning.

Note :

Section 13 (8) of the Finance Act

"The reports referred to in paragraphs (a) and (b) of sub-section (7) shall be considered by the governing body of a Public Corporation and after such consideration that body shall inform the Auditor General of the steps that they propose to take with regard to the matters pointed out in the audit reports within three months of the submission of the reports to the corporation."

නිදහස් චතුරශ්‍රය
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E-Mil oaggov@sltnet.lk

PI/H/TRB/98/179 24 November, 1999

The Chairman,
Tea Research Board.

Report of the Auditor General in terms of Section 13 (7) (a) of the Finance Act No. 38 of 1971 on the accounts of the Tea Research Board for the year ended 31 December 1998

The audit of accounts of the Tea Research Board for the year ended 31 December 1998 was carried out under my direction in pursuance of provisions in Article 154 (1) of the Constitution of the Democratic Socialist Republic of Sri Lank read in conjunction with Section 13 (1) of the Finance Act No. 38 of 1971. My report in terms of Section 13 (7) (a) of the Finance Act appears below.

1.2. Scope of the Audit

Audit opinion, comments and findings in this report are based on a review of the financial statements presented to audit and substantive tests of samples of transactions. The scope and the extent of such review and tests were such as to enable as wide an audit coverage as possible within the limitations of staff, other resources and time available to me. The audit was planned and carried out in accordance with generally accepted auditing standards, methods and practices to obtain reasonable assurance as to whether the financial statements are free of material misstatements. The audit included examination of evidence supporting the amounts and disclosures in financial statements and assessment of accounting principles and significant estimates and judgements made in the preparation of financial statements, evaluation of their overall presentation and determining whether accounting policies adopted were appropriate, consistently applied and adequately disclosed. Sub-sections (3) and (4) of Section 13 of the Finance Act No. 38 of 1971 give discretionary powers to the Auditor General to determine scope and extent of the Audit.

2. Accounts

2.1 Financial Results

According to the accounts presented, the working of the Tea Research Board for the year ended 31 December 1998 had resulted in a surplus of Rs. 34,482,014 compared with the surplus of Rs. 35,309,603 in the previous year. The following statement gives a summary of the financial results for the year under review and the preceding year.

	As at 31 December			
	1998		1997	
	Rs.	Rs.	Rs.	Rs.
Income				
Cess and grants	119,749,513		94,433,902	
Income from plantation and other commercial activities	25,307,003		33,910,940	
Miscellaneous income	3,000,611		4,279,304	
Interest on investments	4,631,058	152,688,185	3,226,181	135,850,327
Less : **Expenditure**				
Personnel emoluments	38,111,803		31,120,839	
Travelling expenses	3,996,974		4,285,504	
Supplies and requisites	7,780,785		9,476,067	
Repairs and maintenance of capital assets	10,382,565		13,012,056	
Depreciation	9,294,024		8,300,297	
Transportation, communication, utility and other services	19,965,237		15,746,117	
Losses and write-offs	5,004,378		29,238	
Media, advertising, publicity symposia and gifts	2,233,251		474,130	
Contributions, grants and subsidies	1,683,436		1,431,020	
Pensions and retirement benefits	4,421,041		3,312,759	
Provision for Gratuity	1,569,272		4,827,854	
Cultivation and experiments	4,901,934		4,328,305	
Expenditure Walahanduwa	1,438,628		–	
Miscellaneous	7,342,843	118,206,171	4,196,538	100,540,724
Surplus for the year		34,482,014		35,309,603
Prior period items		(64,975)		(112,493)
Transferred to Tea Research Fund		34,417,039		35,197,110

2.2. Financial Structure

The financial structure of the Board as at 31 December 1998 compared with that as at 31 December 1997 is given below.

	As at 31 December	
	1998	1997
	Rs.	Rs.
Resources		
Government grant	1,175,000	1,175,000
Capital Reserve	40,495,458	40,196,431
Long Term Liabilities		
- Land Reform Commission	754,670	754,670
- Provision for Gratuity	14,156,538	17,117,790
Tea Research Fund	247,858,748	213,441,710
	304,440,414	272,685,601
Utilization		
Fixed Assets at written down value	125,348,635	113,507,235
Capital work-in-progress	7,450,413	6,747,175
Development Projects	4,590,056	8,795,003
Net Current Assets	167,051,310	143,636,188
	304,440,414	272,685,601

2.3. Cash Flow

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

	Year ended 31 December			
	1998		1997	
	Rs.	Rs.	Rs.	Rs.
Cash flows from operating activities				
Surplus for the year excluding interest on investments		29,890,957		32,083,422
Adjustments for items not involving movement of cash				
Depreciation	11,437,450		11,354,050	
Provision for gratuity	1,569,272		5,790,149	
	13,006,722		17,144,199	
Less : Income from sale of fixed assets	223,900	12,782,822	1,102,334	16,041,865
		42,673,779		48,125,287
Prior period items	(64,975)		112,493	

Adjustments for items not involving movment of cash				
Depreciation	758,512	693,537	–	112,493
Operating surplus before changes in items of working capital		43,367,316		48,012,794
Changes in items of working capital				
Stocks (Increase)/Decrease	412,468		(1,881,220)	
Debtors and other balances - (Increase).Decrease	9,208,142		(26,344,681)	
Deposits, prepayments and purchase advances - (Increase)	(885,032)		(1,332,526)	
Loans and Advances to employees - (Increase)	(4,931,074		(2,330,741)	
Other current assets - (Increase)	–		(5,000)	
Suspense - (Increase) / Decrease	348,077		(10,677)	
Excesses and shortages - (Increase)/Decrease	(44,336)		4,394	
Identified Losses (Increase)	–		(156,507)	
Creditors and Provisions - Increase	2,386,892	6,495,137	4,206,928	(27,830,030)
		49,862,453		20,162,764
Less				
Gratuity paid		4,530,524		–
Cash generated from operating activities		45,331,929		20,162,764
Cash flows from investing activities				
Interest on Investments	4,021,213		3,479,863	
Purchase of fixed assets	(24,043,625)		(19,488,631)	
Proceeds from sale of fixed assets	230,164		1,106,507	
(Increase) / Decrease in capital work-in-progress	3,501,709		(5,724,389)	
Cash used in investing activities		(16,290,539)		(20,626,650)
Cash flows from financing activities				
Grant received from NORAD	298,732		1,310,000	
ARP	–		561,491	
TRAD Project	293		–	
Cash generated from financing activities		299,025		1,871,491
Net increase in cash and cash equivalent		29,340,415		1,407,605
Cash and cash equivalents at beginning of the year		45,841,734		44,434,130
Cash and cash equivalents at end of the year (Note)		75,182,149		45,841,734

Note : Head Office

Short Term Investments - 7 day call deposits	81,000,000	34,000,000
Bank of Ceylon Corporate Branch	1,157,611	850,519
Bank of Ceylon - Talawakele	(7,465,515)	9,056,487
Bank of Ceylon - Deniyaya	(53)	1,947
Petty Cash Imprest	332,858	310,089
Stamp Imprest	10,668	18,503
St. Joachim Estate		
Cash in hand	4,269	33,857
Cash at Bank	128,098	10,824
Stamps	73	28
St. Coombs Estate		
Cash in hand	7,409	3,502
Cash at Bank	6,590	1,555,957
Stamps	141	21
	75,182,149	45,841,734

Format - 1

Methods and formulae used in Estimating Physical Quantities of Materials

Description of Materials	*Whether receipts/ issues of inventory*	*Description of formulae or method*	*Whether the basis is realistic*	*Whether there was a change in the basis*
Green leaf	Receipts	Factory weight of green leaf is ascertained after deducting 3% of the field weight for moisture	Realistic	No.

Format - 2

Items in accounts based on Estimates and Provisional Valuation

Description of items in the accounts	*Value Rs.*	*Basis of estimating on provisional valuation*
(a) Provision for payments	123,832	Actual payment made in subsequent year
(b) Provision for Audit fees	321,000	- do -
(c) Provision for bad debts	100,521	- do -
(d) Provision for Goods in transit	1,815,194	- do -
(e) Provision for Uniforms & protective clothings	250,000	- do -
(f) Provision for Holiday pay & Incentive Bonus	278,588	*Total earnings for the year* x *Entitled days* / Total days worked for the year (per employee)
(g) Provision for Gratuity	14,156,538	Half month salary x Number of years of service.

Format - 3

Basis of Costing Receipts and Issues of Materials

Type of materal	*Whether receipts/issues*	*Basis adopted*
(i) Stocks	Receipts/Issues	First in First out
(ii) Green (Tea) Leaf	- do -	- do -
(iii) Tea Chests	- do -	- do -
(iv) Fire Wood	- do -	- do -

Format - 6

Fixed Assets - Depreciation Rates

Type of Assets		*Method of depreciation*	*Rate per annum*	
			1998	*1997*
(i)	Buildings	Straight line method	2%	2%
(ii)	Motor vehicles	- do -	20%	20%
(iii)	Laboratory equipment	- do -	20%	20%
(iv)	Library books	- do -	10%	10%
(v)	Water supply	- do	10%	10%
(vi)	Furnitures	- do -	10%	10%
(vii)	Office equipment	- do -	10%	10%
(viii)	Computer	- do -	10%	25%
(ix)	Electrical installation	- do -	10%	10%
(x)	Workshop equipment	- do -	10%	10%
(xi)	Telephones	- do -	10%	10%
(xii)	Capital replanting	- do -	3%	3%

Note : Depreciation is provided for the year of purchase and no depreciation is provided in the year of disposal.

Format - 9

Accounting Deficiencies

Description of item in the accounts affected	*Type of deficiency*	*Description of deficiency*
(a) Fixed Assets	Errors in Capital and revenue recognition	Following fixed assets purchased by the Board had been written off without considering their capital nature.

	Description of the asset	*Name of the account charged*	*Value*
			Rs.
(a)	Supply of 03 Nos Yamato Counter Scale 8kg. 50 g.	"Supplies & Requisites account"	26,229
(b)	Supply of 01 Nos. W Lamp (Tungstem) for Hitachi spectrophoto meter	- do -	11,850

(b) Depreciation — Understatement — Following understatement of depreciation of fixed assets had been revealed in the accounts due to errors in calculation.

Nature of assets	*Understatement*
	Rs
Lab equipment	61,628
Office equipment (computer)	118,125

(c) Prior year adjustment — - do

(i) According to the schedule of depreciation the actual prior year adjustments were amounting to Rs. 2,478,746. However, the prior year adjustment shown in the balance sheet was Rs. 758,512 which accounts a difference of Rs. 1,720,234.

Omission

(ii) The prior year adjustments amounting to Rs. 11,186 and Rs. 43,858 in connection with St. Coombs and St. Joachim estates respectively had not been adjusted to the respective working accounts of the estates.

(d) Fixed Assets — Classfication error

(i) A sum of Rs. 433,738 incurred on renovation of buildings at Hantana had been debited to the account of "Land and building at Kottawa" instead of being debited to the account of "Land & building at Hantana".

(ii) A sum of Rs. 332,492 incurred on curtains of the guest house had been shown under "Land and building" instead of being capitalized under "Furniture & fittings".

(e) Work-in-progress account — Inappropriate disclosure

(i) An advance payment amounting to Rs. 200,000 paid for "Colloboration Project" during the year 1998, had been shown under "Work-in-progress account" instead of being shown as an advance.

(ii) Following advances had also been shown under work-in-progress account.

Vr. No.	Date	Amount Rs.
1026	9.4.98	25,000
1629	24.6.98	25,000
1707	8.7.98	25,000

(f) Prior Year Adjustment Account — - do -

(i) An overpayment amounting to Rs. 605,668 made in 1997 for insurance of vehicles had been shown as prior year adjustments instead of being taken into revenue for 1998.

(ii) Following estimation errors had also been shown as prior year adjustments.

Description	Amount Dr. Rs.	Cr. Rs.
Analytical charges 1997	300	–
Analytical service 1996	60	–
Analytical charges 1997	150	–
- do - 1996	60	–
Min. of Plantation Industries credited in 1997	–	3,167
- do - 1996	–	2,943
- do - 1997	–	929
- do - 1997	1,635	–
Sale of cuttings taken to income in 1997	3,000	–
Over paid labour in 1997	–	4,371
Cost of Binding Book charges	–	6,750
Analytical charges	270	–
	5,475	18,160

(g)	Miscellaneous expenses	Classification error	The renewal fees for patent right for 1998 valued at Rs. 25,560 had been accounted as "Supplies and requisitions" instead of being shown under "miscellaneous expenditure".
(h)	Consumable stocks at St. Joachim estate	Inappropriate disclosure	A fibre tank valued at Rs. 5,000 had been shown under consumable item instead of being capitalized.
(i)	Cash advance and stock purchase suspense at St. Coombs estate	Classification error	Following cash advances and advance for stock purchase had been debited sundry creditors account instead of being debited to respective advance accounts.

Voucher No.	*Amount Rs.*	*Description*
1640	10,000	Cash advance
313	5,000	- do -
1444	20,000	- do -
291	35,000	Advance (cheque)

(j)	Revenue account	Omission	An insurance claim received amounting to Rs. 173,546 in respect of an accident of vehicle during the year under review had not been taken into revenue of the year.
(k)	Fixed assets	Classification error	A sum of Rs. 1,100,000 paid for the purchase of lorry in December 1998 had been debited to advance account instead of being capitalized.
(l)	Current account - St. Coombs estate	Unidentified debits	A sum of Rs. 3,113,115 had been debited to Current Account in December 1998 which had not been identified.
(m)	Depreciation	Classification error	Depreciation on motor vehicles amounting to Rs. 24,509 had been shown under the repairs and maintenance in the income and expenditure account.

Format - 10

Verification of Physical Assets

Class of Asset	Percentage verified during the year or at the end of year	Shortages observed	Excesses observed	Value of assets not based on physical verifications	Whether variations have been investigated	Treatment of variations in accounts
		Rs.	Rs.	Rs.		
TRB - Head Office						
General Stocks	100%	6,150	12,150	Nil	No	-
Electrical Stocks	100%	Nil	Nil	Nil	No	-
Stocks at TRI Ratnapura	100%	1,482	4,415	Nil	No	-
Drugs Stocks	100%	Nil	Nil	Nil	No	-
Motor Spares	100%	Nil	Nil	Nil	No	-
Stationery Stocks	100%	Nil	Nil	Nil	No	-
Scientific Stocks	100%	9,854	16,491	Nil	No	-
St. Coombs Estate						
Consumable Stock	100%	410	1,656	Nil	No	-
St. Joachim Estate						
Consumable stock	100%	Nil	8,625	Nil	No	-

Format - 11

Confirmation of Assets

	Type of Asset	Balance as per accounts	Total No. of accounts	No. of accounts confirmed	Value of balances confirmed	No. of accounts confirmed as a percentage (%)	Percentage of balances confirmed in value (%)
		Rs.			Rs.		
TRB - Head Office							
(i)	Sundry debtors	1,335,443	97	14	39,909	14,43	2.99
(ii)	Trade debtors	72,378,704	30	12	46,310,881	40	63.98
(iii)	Analytical charges Due A/c	687,516	200	50	206,695	25	30.06
(iv)	Insurance claims Due - vehicles	319,602	7	Nil	Nil	Nil	Nil
(v)	Pre-payments	1,323,12	10	Nil	Nil	Nil	Nil
(vi)	Advances	8,458,47	135	Nil	Nil	Nil	Nil
(vii)	Deposits	409,048	28	1	1,100	3.57	2.27
(viii)	Bank Balances	1,157,612	1	1	1,157,612	100	100
(ix)	Petty cash balances	187,858	8	7	128,679	87.5	68.50
St. Coombs							
	Cash in hand	7,409	1	1	7,209	100	97.30
	Cash at Bank	6,590	1	1	6,590	100	100
St. Joachim Estate							
Sundry debtors		42,748	24	Nil	Nil	Nil	Nil
Cash at Bank		128,098	1	1	128,098	100	100

Format - 12

Confirmation of Liabilities

Type of Liability	Balance as per accounts Rs.	Total No. of accounts	No. of accounts confirmed	Value of balances confirmed Rs.	No. of accounts confirmed as a percentage (%)	Percentage of balances confirmed in value (%)
TRB - Head Office						
(i) Sundry creditors	5,540,976	69	27	871,172	39.13	15.72
(ii) Tender deposits refundable	365,750	188	23	52,500	12.23	14.35
(iii) Security deposits refundable	184,983	4	Nil	Nil	Nil	Nil
(iv) Petrol deposits refundable	9,350	53	6	4,400	49,05	47.06
(v) Retention money payable	55,647	6	Nil	Nil	Nil	Nil
(vi) Bank of Ceylon	7,465,568	2	2	7,465,568	100	100
(vii) Other creditors	3,787,931	10	Nil	Nil	Nil	Nil
St. Coombs Estate						
Sundry creditors	1,802,104	33	Nil	Nil	Nil	Nil
St. Joachim Estate						
Sundry creditors	1,098,230	35	4	477,720	11,43	43.5

Format - 13

Unreconciled Control Accounts

Description of Control Account	*Balance as per account*	*Description of subsidiary records*	*Balance as per subsidiary records*	*Difference*
	Rs.		*Rs.*	*Rs.*
(i) Fixed assets				
- Additions during the year				
1998 - H.O.	17,581,672	Detailes schedules	17,657,182	75,510
- Depreciation during the year				
1998 - H.O.	9,318,532	- do -	9,574,532	256,000
- Estates	1,660,791	- do -	1,502,234	158,557
- Depreciation of capital				
Re-planting - St. Coombs estate	264,298	- do -	256,513	7,785
- St. Joachim estate	193,826	- do-	194,760	934
(ii) Prior year adjustment - H.O.	758,512	- do -	1,207,652	449,149
- St. Joachim	Nil	- do -	40,973	40,973
(iii) Stocks at TRI Ratnapura	318,241	- do -	321,171	2,930
(iv) Drugs Stocks	91,637	- do -	86,536	5,101
(v) Motor Spare Parts Stocks	1,083,843	- do -	1,084,523	680
(vi) Scientific Stocks	700,807	- do -	704,782	3,975
(vii) Trade debtors - SLTB	48,427,350	Confirmations	45,927,350	2,500,000
(viii) Sundry Creditors - St. Joachim estate	1,098,230	Detaile schedules	1,090,648	7,582
(ix) Checkroll debtors - St. Coombs	69,970	- do -	65,357	1,163

Format - 15

Lack of Documentary Evidence for Audit

Description of item in the accounts affected	*Value shown in the accounts* Rs.	*Documentary evidence not available*
(a) **Vehicle running expenses**	-	Information in connection with the transport fleet such as No. of Kilometres performed, No. of litres of fuel consumed, etc. of vehicles attached to St. Coombs estate.
(b) **Stocks**		
Stocks at Estates		
St. Coombs Estate		
Rice and foodstuff	124,806	Detailed schedules and verification reports
Nursery stock	215,593	- do -
St. Joachim Estates		
Nursery stock	206,467	Detailed schedules and verification reports

(c)	**Debtors**		
	St. Coombs Estate		
	Sundry debtors	1,052,958	Detailed schedules, confirmations and age analysis
	Staff Salaries	305,389	Detailed schedules
(d)	**Deposits and Pre-payments**		
	St. Coombs Estate		
	Stock purchase suspense	65,409	Detailed schedules
(e)	**Loans and Advances**		
	St. Coombs Estate		
	Special Loan	24,950	Schedules
	Festival loan - workers	225,910	- do -
	Labour Advances	55,130	- do -
(f)	**Creditors and Other Credit balances**		
	(i) Provision for payment	123,832	Schedules
	(ii) **St. Coombs Estate**		
	Accrued expenditure	28,860	Schedule
	Sundry Creditors	1,802,104	Age analysis and confirmations
(g)	Expenditure - H.O.	8,640	Bills

Format 16

Age Analysis of Debtors

Class of Debtor	Amount as at Balance Sheet Date	0-3 Months	3-6 Months	6-9 Months	9-12 Months	1-2 Years	2-3 Years	3-4 Years	4-5 Years	Over 5 Years
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
TRB - H.O.										
Sundry debtors	1,335,443	413,445	16,213	5,499	14,530	768,269	95,052	-	(52)	22,487
TRIEL Package	194,767	194,767	-	-	-	-	-	-	-	-
Trade debtors	72,378,704	72,362,085	-	-	-	1,237	10,938	4,444	-	-
Analytical Charges Due a/c	687,516	290,930	108,822	25,055	17,650	127,299	75,985	19,440	14,820	7,515
Insurance Claims Due-Vehicles	319,602	-	-	270,646	-	-	-	-	-	48,956
Bonds Outstanding	2,172,176	-	-	-	-	-	-	-	-	2,172,176
Foreign travelling advances	152,791	-	-	-	-	-	152.791	-	-	-
	77.240,999	73,261,227	125,035	301,200	32,180	896,805	334,766	23,884	14,768	2,251,134
St. Joachim Estate										
Sundry Debtors	42,748	-	-	13,566	-	-	21,217	7,965	-	-

Format - 17

Age Analysis of Creditors

Class of Creditor	Amount as at Balance Sheet Date	0-3 Months	3-6 Months	6-9 Months	9-12 Months	1-2 Years	2-3 Years	3-4 Years	4-5 Years	Over 5 Years
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
TRB - H.O.										
Sundry Creditors	5,540,976	5,540,976	-	-	-	-	-	-	-	-
St. Joachim Estate										
Sundry Creditors	1,098,230	1,085,986	-	-	-	-	4,662	-	-	-

Format 19

Identified losses

Particulars of Items		*Amount Rs.*	*Reasons for Loss*	*Treatment of loss in accounts*
(a)	Petty cash loss	76,436	Loss of petty cash at cash counter in 1992	Amounts identified had been transferred to the identified losses account and shown under the current assets.
(b)	Loss of salary packets	132,238	Loss of salary packets at the cash counter in June 1992.	Action had not been taken to recover the amount over 6 years and the amount recoverable had been transferred to identified losses account.
(c)	Unpaid travelling claim	3,778	Advances not settled over 5 years	- do -
(d)	Unpaid medical Claims	2,221	- do -	- do -
(e)	Loss of items from electrical foreman's bungalow	109,331	Assets removed by the officer who had occupied the bungalow	Action had not been taken to recover the losses over three years.
(f)	Missing items from Divisions	156,507	Loss of office and lab equipment investigated by the Internal Auditors.	Action had not been taken to recover from relevant officer.
(g)	Loss of VP Plant Sales Deniyaya Investigated by the Internal Auditors.	227,116	Reasons for loss had not been investigated.	Adjustments had not been made in accounts.
(h)	Missing inventory items of Entomology & DDR (T)'s office investigated by the Internal Auditors.	8,741	- do -	- do-

Format - 22

Cost of personnel

	No. of Employees		Total cost				Cost per Employee			
	As at end of 1998	As at end of 1997	Normal Pay		Overtime		Normal Pay		Overtime	
			1998 Rs.	1997 Rs.	1998 Rs.	1997 Rs.	1998 Rs.	1997 Rs.	1998 Rs.	1997 Rs.
Executives	57	52	8,682,480	5,956,224	-	-	152,324	114,543	-	-
Non-executives	129	119	12,134,136	8,649,626	822,490	729,048	94,063	72,686	6,376	6,126
Minor Employees	69	62	4,032,660	3,224,424	709,380	722,028	58,444	52,007	10,281	11,646

Format - 25

Other Slow-moving, Idle and Under-utilised Assets and Idle Labour

Description of item	*Period of non-use or under-utilisation*	*Reason*
Tea factory at Lamilear Division - St. Coomb's estate	Since 1987	A Tea Factory with machinery installed for the production of green tea had remained idle from the time of acquisition of Lamilear division by the Board.

Format - 26

Uneconomic Transactions

	Class of Transaction	*Details of Transaction*	*Nature of Deficiency*
(a)	Gasifier and steam boiler/radiator system for withering and drying Project at St. Joachim Estate-Ratnapura	An Advance amounting to Rs. 2,043,750 paid to M/s Colombo Commercial Company Ltd. for supply & installation of gasifier steam boiler at St. Joachim Estate-Ratnapura	Eventhough the advance had been paid, the work had not been completed yet. Action had not been taken by the Board to get the installations completed or to recover the advance.
(b)	Foreign Scholarships	Employees of the Board who went on study leave abroad had not resume duties at the Board as per their bonds agreed. the value of the bonds has to be recovered as follows.	The service of the experts had not been received by the Board eventhough it had facilitated employees to increase their skills and competence.

Name of the officer	*Bond outstanding*
	Rs.
Athula Ekanayake	317,370
U. K. K. Wickramasinghe	422,020
Sri Ramaratnam	125,325
Ashoka Basnayake	104,261
T. Thevadasen	851,000
T. S. Gunasekara	2,382,496
Nalin L. Herath	260,157
W. A. D. P. Wanigasundara	891,000
D. K. Nawaratna	598,848
	5,952,477

(c)	Advances	No action had been taken to recover the following advances given to suppliers since 1990 upto 1997.	The funds belong to the Board is used by the private parties due to mismanagemnet of funds of the Board.

	Rs.
1990	37,255
1991	725
1994	4,882
1995	29,710
1996	234,027
1997	797,433
	1,104,032

Format - 28

Major Variations against the Budget Year 1998

Class of Items		*Budget* Rs.	*Supplementary* Rs.	*Total* Rs.	*Actual* Rs.	*(A) Adverse (B) Favourable* Rs.	*Percentage* %	*Reasons given by the Mangement*
(A)	**Revenue**							
a)	Sale of Green Leaf	2,856,000		2,856,000	4,231,833	1,375,833 F	48	Increase in price of Green Leaf and Sale of Green Leaf from Walahanduwa Estate.
b)	Miscellaneous	1,124,000		1,124,000	3,040,611	1,916,611 F	171	Disposal of Assets and analytical charges of acquaired Walahanduwa Laboratory
(B)	**Expenditure**							
	Supplies and Requisites	12,440,000		12,440,000	8,261,784	4,178,216 F	34	Budgeted for foreign chemicals etc. purchased in the year 1999.
	Tramsportation, Communication, Utility and other Services	16,981,000 1,200,000		18,181,000	19,484,237	(1,303,237) A	(7)	Increase of Electricity Telephone charges and payment of GST.

	Gratuity	1,080,000		1,080,000	1,569,272	(489,272) A	(45)	Due to salary increase.
	Losses & Write Offs	25,000		25,000	5,004,378	(4,979,378) A	(19,978)	Written off of the Instant Tea Project with the approval of the Tea Research Board.
	Contribution Grants & Subsidies	1,260,000		1,260,000	1,683,436	(423,436) A	(34)	Increase of Tea Prices.
	Media, Advertising, Publicity & Gift	1,002,000		1,002,000	2,333,251	(1,231,251) A	(123)	Rs. 1,000,000 paid to Tea Museum with the approval of the Tea Research Board.
Miscellaneous		10,087,000		10,087,000	7,342,843	2,744,157 F	27	Less number of Overseas Training.
Expenditure Walahanduwa					1,438,628	(1,438,628) A		Not Estimated.
(C)	**Capital Expenditure**							
1.	Buildings	15,896,000	4,550,000	20,446,000	3,508,505	16,937,495 F	83	Ratnapura Buildings renovated in 1999.
2.	Plant Machinery & Labouratory Equipment	3,178,500	4,450,000	7,628,000	7,514,424	114,076 F	1	
3.	Office Equipment	953,500	2,194,000	3,147,000	1,582,593	1,564,907 F	50	Action has been taken to purchase foreign orders in last quarter.
4.	Furniture and Fittings	767,000	212,000	979,000	785,724	193,276 F	20	Work-in-progress
5.	Road, Water Supply, Electricity and Telephone	1,903,000	3,617,000	5,520,000	2,105,738	3,414,262 F	62	Telephone Exchange installed in 1999.
6.	Motor Vehicles and Bicycles	2,700,000		2,700,000	45,350	2,654,650 F	98	Budgeted for the year 1998. But, purchased in the year 1999.
7.	Workshop tools and Equipment	100,000		100,00	49,772	50,228 F	50	Arrangements made to purchase in 1999.
8.	Other Fixed Assets	1,180,000	222,300	1,402,300	1,989,567	(587,267) A	(42)	Price increae of journals.
St. Coombs Lamilliere & St. Joachim Estates								
1.	Machinery & Equipment	377,400		377,400	1,763,465	(1,386,065) A	(367)	Machineries budgeted for the year 1997 purchased in 1998
2.	Utility Service	75,000		75,000	111,736	(36,736) A	(49)	Completed Water Supply Line transferred from WIP.
3.	Vehicles	2,130,000		2,130,000	311,142	1,818,858 F	85	Vehicles purchased in 1999.
4.	Other Fixed Assets	25,000		25,000	337,850	(312,850) A	(1251)	Transferred completed work from Work-in-progress 1997.
5.	Replanting	3,136,400		3,136,400	2,891,715	244,685 F	8	Less Re-planting work.

Format - 33

Delays in Projects

Description of the Project	*Details of delays in completion*	*Reasons for delays*
Funds granted from foreign agencies for specific research projects	(a) **Field trial on Sul-po-mag**	
	Out of a sum of Rs. 50,000 granted in May 1991 for this Project Rs. 6,381 only had been utilised for the project.	The trial had been abandoned.
	(b) **Radopholus Projects**	
	Details are given below	Reasons for delay had not been explained.

Sums granted	*Rs.*
April 1993	50,000
Sep. 1994	112,568
	162,568
Amount spent	47,413
Amount un-utilised as at 31 December 1998	115,156

(c) **Ortho - CTC Project**	
A sum of Rs. 2,500,000 received in July 1995 remained unutilised upto 31 December 1998.	Reason had not been explained.
(d) **Collaboration Project**	
A total sum of Rs. 300,000 had been incurred for this Project as at 31 December 1998. But, no progress had been reported as yet.	Reasons had not been furnished

Format - 36

Non-compliance with Laws, Rules, Regulations and Management Decisions

Reference to Laws, Rules, and Regulations, etc.	*Non-compliance*
(a) Financial Regulations	
F.R. 685 (i)	A sum of Rs. 129,301 had been incurred for a seminar conducted at Kandalama Hotel, for the purpose of preparation of a Corporate Plan of the Board, without following tender procedure.
F.R. 756	Annual verfication of fixed assets of the Board for the year 1998 had not been carried out.
F.R. 1645	No log books or running charts had been maintained for the following vehicles of the Board. *Vehicle No.* 14 Sri 4675 14 Sri 5011
(b) (i) Department of Inland Revenue Circular dated 24 August 1989.	Turnover tax collected amounting to Rs. 22,368 in 1994 onwards required to be remitted to the Department of Inland Revenue within 7 days had not been remitted upto 31 December 1998.
(ii) Department of Inland Revenue Stamp Duty Act No. 43 in 1982	According to the Stamp Duty Act No. 43 of 1982, the stamp duty amounted to Rs. 9,280 had not been remitted to the Inland Revenue Department as details given below. *Amount Rs.* Deniyaya sub-station 8,001 from 1995 Passara sub-station 1,279 from 1996 9,280
(c) Employes' Provident fund Act no. 15 in 1958 and Employees' Trust Fund Act No. 46 in 1980	(i) The Contribution for EPF & ETF aggregating Rs. 231,091 deducted from the staff salaries of June to December 1998 of Walahanduwa laboratory had not been remitted as at 31 December 1998.

	Amount Rs.
EPF	212,197
ETF	18,894
	231,091

(ii) The contribution for the month of February 1998 for EPF amounting to Rs. 143,904 deducted from holiday pay of St. Coombs estate had been remitted to the Central Bank on November 1998.

(iii) EPF contributions for February 1997, amounting to Rs. 3,067, deducted from the staff, Passara Sub-station, had not been remitted to the Central Bank as at the date of Audit Inspection on

(d) **Establishment code**

Chapter XXIV
Section 7.5

Certificate of registration, revenue licence, confirmation of payment, etc. had not been funished within two weeks after obtaining the loan by the officers mentioned below so as to confirm the utilisation of vehicle loans.

Name of the officer	*Amount Granted Rs.*
Car loans	
J. A. A. M. Jayakody	200,000
K. D. Dahanayake	219,000
Motor cycle loans	
G. P. Udumulla	50,000
W. D. J. P. T. Bandara	50,000
J. M. Jothipala	30,000
T. A. D. Gamini	38,700
O. W. Jayawardana	50,000

(e) Ministry of Finance and Planning Circular No. MF/6/1/1/96 dated on 2 April 1996

Advance amounting to Rs. 152,791 obtained by a Deputy Director on foreign visits made to Kenya in October 1996 had not been settled upto 31 December 1998.

(f) S.L.A.S. - 10

The rate of depreciation on computers had been increased from 10% to 25% during the year under review. However, the deviation had not been disclosed in the accounts.

Format - 38

Systems and Controls

Main functional Areas	*Detailed aspect*	*General comments*	*Detailed comments*
Fixed Assets	Accepted accounting systems had not been followed.	Poor control of system	A photocopy machine purchased in 1997 at a cost of Rs. 200,850 had been capitalized in 1998.
General ledger at St. Coombs estate	General ledger had not been maintained properly	poor operation of system	Most of the ledger balances shown in the general ledger of St. Coombs estate were written in pencil. These balances were not agreed with the final accounts of the estate as shown in the Schedule Number 1.
Advances	Lack of system	Lack of control of system	Subsidiary records such as advance register had not been maintained at St. Coombs Estate Office.
Estate expenditure	The account of estate expenditure had not been properly maintained and not completed at the year end.	Poor system of control	The balance shown in the estate expenditure at the year end should have been transferred to Current Account of the Head Office. Due to poor control over of the estate expenditure account the accuracy of the current account of the Head Office cannot be ruled out.
Cheque Payments	Bank account had been overdrawn	Lack of System	Cash had been overdrawn to meet payments made on 31 December 1998 as details given below.

				Rs.
			Bank balance as at 31.12.98 (Cr.)	876,557.83
			Cheques deposited on 31.12.98	693,130.00
				1,569,687.83
			Less :	
			Cheques issued on 31.12.98	4,792,231.00
			Cash overdrawn	3,222,544.00
				It was observed that the total advances paid on 31 December 1998 amounted Rs. 3,242,500.
Losses & Writeoffs	No prior approval had been taken for losses and writeoffs	Lack of system	The following balances shown in the respective accounts had been written off without obtaining the prior approval of the board.	

	Name of the account	*Amount Rs.*
(i)	Debtors account	162,820
(ii)	Suspense account	169,285
(iii)	Instant Tea Project	4,652,782

Format - 38
Schedule 1

Description of accounts		*Balance as per Final Account Rs.*	*Balance as per Ledger Account Rs.*	*Difference Rs.*
Provision for gratuity	(Cr)	575,272	1,651,171	1,075,899
Sub-contractors	(Dr)	Nil	444,657	444,657
Suspense	(Dr)	Nil	178,793	178,793
Estate Staff Medical Aid Scheme	(Cr)	44,160	29,512	14,648
Sundry Debtors	(Dr)	1.052,958	1,008,679	44,279
Sundry Creditors	(Cr)	1,802,104	1,884,480	82,376
General Stock	(Dr)	1,795,179	1,814,214	19,035
Staff Salary	(Dr)	305,389	505,353	199,964
Checkroll A/c	(Cr)	1,469,036	1,479,812	10,776
Nursery Stock 96/97	(Cr)	Nil	144,847	144,847

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இலங்கை தேயிலை ஆராய்ச்சி நிலையம்
TEA RESEARCH INSTITUTE OF SRI LANKA

විදුලි පුවත් : රසරථී, තලවාකැලේ
தந்தி : றிசேச், தலவாக்கொல்லை
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குறிப்பு இல.
REFERENCE NO.
CA/42/97

සාන්ත කුම්බස්
சென்ற் கூம்ஸ்
ST. COOMBS

තලවාකැලේ ශ්‍රී ලංකා
தலவாக்கொல்லை, இலங்கை
TALAWAKELLE, SRI LANKA

Your Ref: PI/H/TRB/98/179

22nd February 2000

The Auditor General,
Auditor General's Department,
Independence Square,
Colombo 7.

Attention : Mr. J. D. R. Jayalath
Assistant Auditor General

Dear Sir,

Report of the Auditor General in Terms of Section 13 (7) (a) of Finance Act No. 38 of 1971 on the Accounts of the Tea Research Board of Sri Lanka for the year ended 31st December, 1998

This has reference to your report of 24th November 1999 on the above subject, and wish to forward our comments, which was discussed by the Consultative Committee on Administration & Finance at its meeting held on 22nd February 2000 and recommended by the Tea Research Board at its meeting held on 24th February 2000.

Thanking you,

Yours faithfully,

Dr. S. D. I. E. Gunawardena
Chairman
Tea Research Board

W. B. Herath
Senior Accountant
Tea Research Board

Format 9

Accounting Deficiencies

Description of item in the accounts affected	*Type of Deficiency*	*Value*	*Comments*
a) Fixed Assets	Errors in capital and revenue recognition		
	a) Supply of 03 Nos. Yamato Scale 8 Kg 50 g	Rs. 26,229	This has been transferred to Capital Account in 1999
	(b) Supply of 01 No. W. Lamp (Tungsten) for Hitachi Spectrophoto meter	Rs. 11,850	This is a Tungsten bulb used in the Sepectrophot to meter and it is a consumable item. Therefore, the accounting treatment is correct.
b) Depreciation	Understatement		
	Lab equipment	Rs. 61,628	These have been adjusted in 1999 accounts
	Office equipment (Computer)	Rs. 118,125	
c) Prior Year Adjustments	Understatement		
	(i) Difference	Rs. 1,720,234	New schedules of depreciation submitted without differences. The prior year adjustments arose due to a Policy decision by the TRB i.e. Percentage of depreciation of computer had been increased from 10% to 25%.
	(ii) Omission		
	St. Coombs	Rs. 11,186	Error is regretted.
	St. Joachim	Rs. 43,858	Appropriate action had been taken to correct the procedure.
d) Fixed Assets	Classification error		(i) This has been corrected. (ii) This has been corrected.

e)	Work-in-Progress account	Inappropriate disclosure	(i) Accounting treatment is right. this is an advance payment for turning out a Sand Separator and the work is in progress. (ii) Accounting treatment is right. This is an Advance payment for construction work, and the construction was completed in 1999.
(f)	Prior year Adjustment Account	Inappropriate disclosure	(i) Error is regretted. This is not an Overpayment. (ii) Contents noted.
g)	Miscellaneous expenses	Classification error	Contents noted. Action will be taken to show fees for Patent Right under Miscellaneous Expenditure.
h)	Consumable stocks at St. Joachim Estate	Inappropriate disclosure	This was adjusted in 1999 A/c.
i)	Cash advance and stock purchase suspense at St Coombs Estate	Classification error	*Voucher No* *Amount* *Remarks* 1640 10,000 Settled in 1998 1444 20,000 Settled in 1999 291 35,000 Settled in 1998
j)	Revenue Account	Omission	This is not an income, but an amount receivable as an insurance claim.
k)	Fixed Assets	Classification error	This was included in capital account in 1999.
l)	Current Account St. Coombs Estate	Unidentified debits	A new Ledger has been prepared.
m)	Depreciation	Classification error	Adjustment has been done.

Format 10

Verification of Physical Assets

Class of Asset	*Shortages observed Rs.*	*Excesses observed Rs.*	
TRB - Head Office			
General Stocks	6,150	12,150	This has been corrected.
Stocks at TRI Ratnapura	1,482	4,415	This has been corrected.
Scientific Stocks	9,854	16,491	This has been corrected.
St. Coombs Estate			
Consumable stock	410	1.656	This has been corrected.
St. Joachim Estate			
Consumable stock		8,625	This has been corrected.

Format 11

Confirmation of Assets

Type of asset	*Balance as per accounts Rs.*	
TRB - Head Office		
(i) Sundry debtors	1,335,443	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(ii) Trade debtors	72,378,704	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(iii) Analytical charges due A/c	687,516	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.

(iv)	Insurance claims Due vehicle	319,602	In respect of prepayments and advance payments we do not invite the confirmations. Since signed receipts from the payees are available.
(v)	Pre-payments	1,323,126	In respect of prepayments and advance payments we do not invite the confirmations. since signed receipts from the payees are available.
(vi)	Advances	8,458,426	In respect of prepayments and advance payments we do not invite the confirmations. Since signed receipts from the payees are available.
(vii)	Deposits	409,043	In respect of prepayments and advance payments we do not invite the confirmations. Since signed receipts from the payees are available.
(ix)	Petty cash balances	187,858	It has now ben confirmed.
St. Coombs			
Cash in hand		7,409	It was corrected. No action can be taken against the officer who is responsible as he has left the Institute.
St. Joachim Estate			
Sundry Debtors		42,748	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.

Format 12

Confirmation of Liabilities

	Type of libility	*Balance as per accounts Rs.*	
	TRI - Head Office		
(i)	Sundry creditors	5,540,976	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.

(ii) Tender deposits refundable	365,750	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(iii) Security deposits refundable	184,983	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(iv) Petrol deposits refundable	9,350	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(v) Retention money payable	55,647	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
(vii) Other creditors	3,787,931	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
St. Coombs Estate		
Sundry creditors	1,802,104	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.
St. Joachim Estate		
Sundry creditors	1,098,230	It is explicitly stated in our confirmation letter that in the absence of a response, it will be concluded that the balance indicated is correct.

Format 13

Unreconciled Control Account

	Description of Control Account	*Balance as per account*	*Balance as per subsidiary records*	*Difference*	
		Rs.	*Rs.*	*Rs.*	
(i)	Fixed Assets - Additions during the year 1998 - H.O.	17,581,672	17,657,182	75,510	It has now been reconciled.
	- Depreciation during the year 1998 - H.O.	9,318,532	9,574,532	256,000	It has now been reconciled.
	- Estates	1,660,791	1,502,234	158,557	It has now been reconciled.
	- Depreciation of Capital Re-planting-St. Coombs estate	264,298	256,513	7,785	It has now been reconciled.
	- St. Joachim Estate	193,826	194,760	934	It has now been reconciled.
(ii)	Prior Year Adjustment - H.O.	758,512	1,207,652	449,149	It has now been reconciled.
	St. Joachim Estate	Nil	40,973	40,973	It has now been reconciled.
(iii)	Stocks at TRI Ratnapura	318,241	321,171	2,930	Reconciled in 1999.
(iv)	Drug Stocks	91,637	86,536	5,101	Reconciled in 1999.
(v)	Motor Spare Parts Stock	1,083,843	1,084,523	680	Reconciled in 1999.
(vi)	Scientific Stocks	700,807	704,782	3,975	Reconciled in 1999.

(vii)	Trade debotrs - SLTB	48,427,350	45,927,350	2,500,000	This was recovered by the SLTB and adjusted in our accounts 1999.
(viii)	Sundry Creditors - St. Joachim Estate	1,098,230	1,090,648	7,582	This has now been reconciled.
(ix)	Check roll debtors- St. Coombs	65,970	64,357	1,613	Action is being taken to reconcile the differnece.

Format 15

Lack of Documentary evidence for Audit

	Depreciation of items in the accounts affected	*Value shown in accounts*	
(a)	Vehicle running expenses	-	It has now been prepared.
(b)	**Stocks**		
	Stocks at Estate		
	St. Coombs Estate		Detail schedules will be submitted.
	Rice and foodstuff	124,806	The 1998 balance figure had been
	Nursery stock	215,593	brought forward and in 1999 the physical balance was found to be correct.
	St. Joachim Estate		
	Nursery stock	206,467	Detail schedules will be submitted. The 1998 balance figure had been brought forward and in 1999 the physical balance was found to be correct.
(c)	**Debtors**		
	St. Coombs Estate		
	Sundry debtors	1,052,958	Schedules will be submitted
	Staff salaries	305,389	Schedules will be submitted
(d)	**Pre-payments**		
	St. Coombs Estate		
	Stock purchase suspense	65,409	Schedules will be submitted

(e) **Loans and Advances**

St. Coombs Estate

Special loan	24,950	Schedules will be submitted
Festival Loan-workers	225,910	Schedules will be submitted
Labour advances	55,130	Schedules will be submitted.

(f) **Creditors and Other Credit balances**

(i) Provision for payment	123,832	Schedules will be submitted.
(ii) **St. Coombs Estate** Accrued Expenditure	28,860	Schedules will be submitted
Sundry Creditors	1,802,104	Schedules will be submitted
Expenditure - H.O.	8,640	Documents are available

Format 19

Identified Losses

Particulars of Items		*Rs.*	
a)	Loss of Petty Cash	76,436	A case is pending against the officer
b)	Loss of Salary Packets	132,238	concerned at the High Courts, Kandy.
c)	Loss of Travelling Claims	3,778	(L.T. Case No : 9/TK 1184/94)
d)	Loss of Medical claims	2,221	
e)	Loss of items from Electrical Foreman's Bungalow	109,331	Action will be taken to adjust the accounts after the Police Investigation
f)	Missing Items from Divisions	156,507	These items had been recovered by Police. Court case is still pending.
g)	Loss of Plant Sales - Deniyaya By the Internal Auditors	227,116	This was treated as a normal loss and adjusted in the same year.
h)	Missing Inventory items of Entomology & DDR (T)'s Office Investigated by the Internal Auditors.	8,741	These items had been recovered by Police. court case is still pending.

Format 25

Tea Factory at Lamiliere Division - St. Coombs Estate	The Green Tea Project would not be reactivated due to lack of trained staff. The machinery will be used for research purposes.

Format 26

Uneconomic Transactions

Class of Transactions		
(a) Gasifier and steam boiler/ radiator system for withering and Drying Project at St. Joachim Estate, Ratnapura	Rs. 2,043,750	Written to PERC to settle this issue.

(b) Foreign Scholarships

Name of the Officer	*Value of the bonds outstanding Rs.*	
Athula Ekanayake	317.370	These Cases have been referred to the Attorney General, and the Attorney General has requested for their addresses. Since the addresses are not known to TRI. The TRI has written to the Foreign Missions in order to obtain the addresses to be given to the Attorney Generals's Department.
U. K. K. Wickremasinghe	422.020	
Sri Ramaratnam	125,325	
Asoka Basnayake	104,261	
T. Thevadasan	851,000	
T. S. Gunasekara	2,382,496	
W. A. D. P. Wanigasundara	891,000	
D. K. Nawaratne	598,848	
	5,692,32	
Nalin L. Herath	260,157	Papers have been handed over to the Attorney-at-Law in Nuwara Eliya appointed by the Attorney General's Department to file the case. Case No. will be given in due course.

Advance

No action had been taken to recover the following advances given to suppliers since 1990 up to 1997.

	Rs.	*Settled up to 31/01/2000*	
1990	37,255	-	
1991	725	-	
1994	4,882	-	Action will be taken to request for a write-off in 2000.
1995	29,710	-	
1996	234,027	114,048/80	
1997	797,433	548,919/99	
	1,104,032		

Format 33

Delays in Projects

Description of the Project	*Details of delays in completion*	*Value* *Rs.*	
Loans granted from The foreign agencies for specific research projects	(a) Field Trial on Sul-po-mag	43,619	This has been cleared in 1999 accounts
	(b) Radopholus Project	115,156	This has been cleared in 1999 accounts
	(c) Orthodox Project	2,500,000	This has been settled.
	(d) Collaboration Project	300,000	The work is in progress.

Format 36

Non-compliance with Laws, Rules, Regulations And Management Decisions

(a) Financial Regulations

F.R. 685 (i)	Tender procedure had been followed.
F. R. 756	Annual verification of Fixed Assets had been carried out for the year 1998.
F. R. 1645	These vehicles had been allocated to foreign consultants and the mileage was agreed upon.

(b) (i)	Department of Inland Revenue Circular Dated 24 August 1989	*Detail* 22,368			This has been settled.
(ii)	Department of Inland Revenue Stamp Duty Act No. 43 in 1982	Deniyaya Passara	8,001 1,279 9,280		This has been settled.
(c)	Employees Provident Fund Act No. 15 in 1958	EPF ETF	212,197 18.894 231,091	(i)	payment of salaries to the Walahanduwa Laboratory staff were made in January 1999 and the EPF, ETF too were remitted during 1999.
	And Employees Trust Fund Act No. 46 in 1980		143,904	(ii)	This is the practice of the estate. Action will be taken to remit EPF immediately after payment of Holiday Pay.
			3,067	(iii)	This has been remitted in 1999.

(d) **Establishment Code**

Chapter XXIV
Section 7.5

Car Loan

J. A. A. M. Jayakody	Rs. 200,000
K. D. Dahanayake	219,000

Motor Cycle Loan

G. P. Udumulla	50,000
W. D. J. P. T. Bandara	50,000
J. M. Jothipala	30,000
T. A. D. Gamini	38,700
O. W. Jayawardena	50,000

Officers concerned have been instructed to submit the documents immediately or settle the loan in full.

(e) Ministry of Finance and Planning Circular No. MF/6/1/1/96 dated 2 April 1996.

This officer has been dismissed from the service of the TRI. He has initiated L. T. proceeding. Action will be taken to recover this from his gratuity once the L. T. proceedings are over.
(L. T. Case No. 9/TK/1720/97)

(f) S.L.A.S. - 10

This had been disclosed in the accounting policies of the TRB.

Format 38

Systems and controls

Main Functional Areas	*Detailed aspect*	
Fixed Assets	Accepted accounting systems had not been followed	Although the monies were paid in Dec. 1997 the photocopier was received in 1998.
General Ledger as St. Coombs	General Ledger had not been maintained properly.	New Ledger has been prepared.
Estate expenditure	The account of estate expenditure had not been properly maintained and not completed at the year end	The Balance had been transferred to Head Office Accounts and found to be correct.
Cheque Payments	Bank account had been overdrawn	(a) Standing orders have been given to the Bank to transfer funds as and when it is necessary.

Format 38

Description of Accounts	*Differences Ledger/Accounts*	
St. Coombs Estate	*Rs.*	
Provision for gratuity	1,075,899	Correct schedule would be submitted.
Sub-contractors	444,657	
Suspense	178,793	
Estate Staff Medical Aid Scheme	14,648	
Sundry Debtors	44,279	
Sundry Creditors	82,376	
General Stock	19,035	
Staff Salary	199,964	
Check roll A/c	10,776	
Nursery Stock 96/97	144,847	