ISSN 1012 -3954

ANNUAL REPORT - 1996

TEA RESEARCH BOARD OF SRI LANKA

THE TEA RESEARCH INSTITUTE OF SRI LANKA

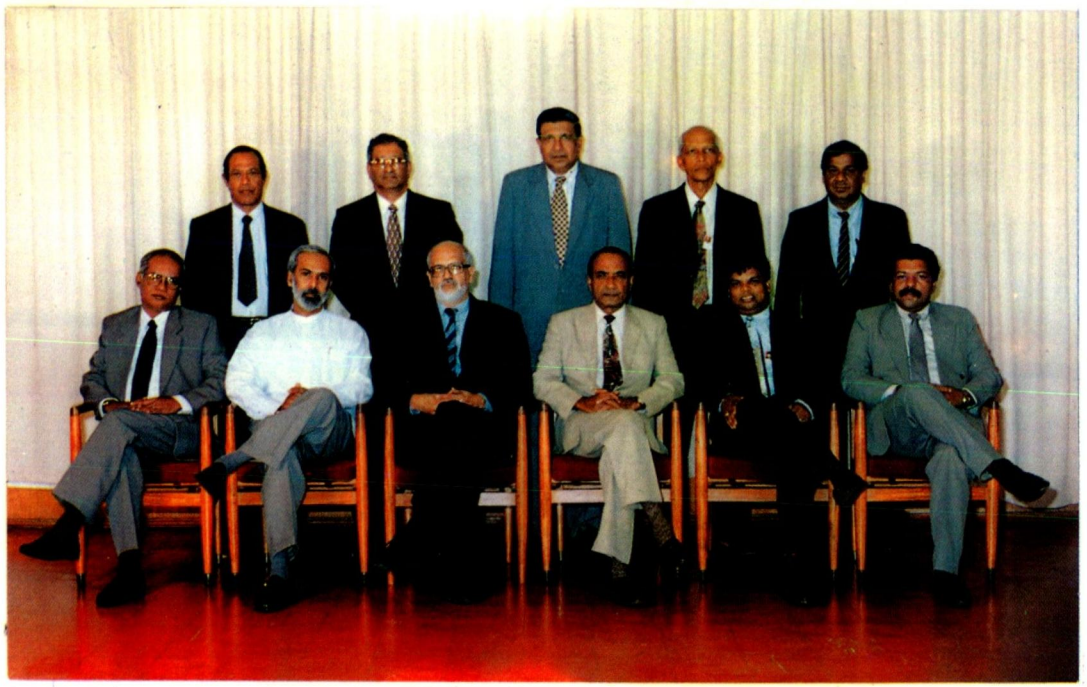
ANNUAL REPORT FOR THE YEAR 1996

ISSN 10127 - 3954

Published by
THE TEA RESEARCH INSTITUTE OF SRI LANKA
ST. COOMBS, TALAWAKELE, SRI LANKA
1996

C O N T E N T S

TEA RESEARCH BOARD - 1996



Standing : Prof. H.P.M. Gunasena, M/s. S.K. Seneviratne, I.L.A. Fernando, J.P.M.Y. Ratnayeke & S. Wirasinghe

Seated: Mr. E. Kanendran, Dr. Anura Ekanayake, Dr. W.W.D Modder/Director-TRI.

Dr. S.D.I.E. Gunawardena/Chairman-TRB, M/s. V. Puthirasigamoney & Sivam Loganathan.

Absent: M/s. Rohana Illangaratne, G.V. Tissera, Clifford Ratwatte.

REPORT OF THE CHAIRMAN TEA RESEARCH BOARD

An Action plan was drawn up on Restructuring of TRI to meet the challenges of the 21st Century.

CADMAR (Composite Approach to Decision Making in Agricultural Research) was initiated following a series of workshops on problems and constraints analysis of the tea sector, with the participation of sector-wide representatives. This process is aimed at prioritising research and development activities at TRI.

Developed an improved tea plucking shear to circumvent anticipated labour shortage in tea plantations.

Action was initiated to obtain assistance from Plantation Housing and Welfare Trust for TRI estates in order to upgrade the living conditions of workers.

Action was also initiated to get Consultants through the Commonwealth Secretariat in disciplines where the TRI lacked expertise.

Action was initiated to obtain ISO 9000 Certification in processing at the two factories of the TRI.

Manual of Procedure was prepared and approved by the Tea Research Board.

The Post of Director, TRI was filled in June.

Based on the recommendations of the committee appointed by the Ministry of Plantation Industries to review the activities of TRI, two Deputy Directors of Research were appointed one in technology and the other in production, in August.

The Tea Research Board held 08 Meetings during the year 1996. The three Consultative Committees of the Tea Research Board on Research, Estate and Advisory Services, and Administration & Finance held 01, 03 and 06 meetings, respectively.

Dr S D I E Gunawardena
Chairman
Tea Research Board

REPORT OF THE DIRECTOR - 1996

STAFF APPOINTMENTS

Directorate

Dr W W D Modder was appointed as the Director of the Institute w e f 10th June.

Dr M T Z Mohamed Head, Technology Division was appointed Deputy Director, Research (Technology) w e f 1st August.

Dr G D Wimaladasa Head, Soils and Plant Nutrition Division was appointed Deputy Director Research (Production) w e f 1st August.

Heads /OIC's of Divisions/Substations/Units

Dr L S K Hettiarachchi Research Officer, Soils and Plant Nutrition was appointed Acting Head of the Division w e f 2nd September.

Others

Mr K Ravindran, was appointed Chemical Engineer, Technology Division w e f 3rd July.

Mr N I Giddawage, assumed duties as Administrative Officer, Ratnapura w.e f 1st August.

Mr W B Herath was appointed Senior Accountant of the Institute w e f 16th December.

Mr R Kariyawasam was appointed as Internal Auditor of the Institute w e f 2nd December.

Promotions

Mr H Jayaweera, Technical Assistant, Biochemistry Division , was promoted as Experimental Officer w e f 1st June.

Resignations/Retirements

Dr N L Herath Head, Biochemistry Division resigned from the services of the Institute w e f 24th February.

Mr I D Gooneratne Consultant, Advisory and Extension Services left the TRI after completing his contract on 31st May.

Mr L A Seevaratnam Superintendent, St Joachim Estate, retired from the services of the Institute w e f 31st March.

Mr R M Chandrasekera, Experimental Officer, Hantane retired from the services of the Institute on 22nd June.

Mrs B W S Kariyawasam, Research Officer, Biochemistry Division resigned from the services of the Institute w e f 1st December.

Ms P S F Perera, Technical Assistant, Biochemistry Division resigned from the services of the Institute w e f 31st December.

Transfers

Mr W M S Wijethunge, Experimental Officer, Soils and Plant Nutrition Division was transferred to mid-country station, Hantane w e f 5th March.

Mr J C K Rajasingha, Actg OIC and Advisory Officer, Deniyaya TRI Advisory and Extension Centre, was transferred to the Head Office as Advisory Officer w e f 1st July.

Mr B W S Kariyawasam, Research Officer, Technology Division was transferred to the Biochemistry Division w e f 4th September.

Mr P A N Punyasiri, Research Assistant, Biochemistry Division was granted two years no pay leave w e f 7th July.

Mr D W Bartholomeusz Administrative Officer, Ratnapura was transferred to the Head Office w e f 1st August.

Messrs W A M Dharmasena, U B Herath and Mrs B Sureshkumar, Experimental Officers, Entomology Division were transferred from the Head Office to the Entomology Unit at Hantane in February.

Obituary

Mr W A M Dharmasena, Experimental Officer, Entotmology Division passed away on 10th October. He joined the Institute as a Technical Assistant in 1964 and served at four stations of the Institute during 32 years of service working in both Entomology and Nematology Divisions.

Overseas visits

Dr M T Z Mohamed, DDR(Technology) visited Kenya from 6th October to 16th November to study Tea Processing Technology in Kenya. He also spent two weeks at the Tea Research Foundation of Kenya working on the Environmentally Controlled Miniature Manufacturing system.

Dr G D Wimaladasa DDR(Production), attended a training programme on Plant Nutrient Management in Nairobi, Kenya and visited Tea Research Foundation of Kenya during the period 12th to 26th October.

Dr N L Herath Head, Biochemistry Division, returned after his sabbatical leave in Japan in February.

Mrs S I Vitarana, underwent a training in advanced techniques in Nematology at the Institute of Nematology of National Research Council of Italy. She also visited 'Koppert BV', Rotterdam and the University of Amsterdam to hold discussions with

their acarologists on usage of biocontrol agents of tea mites and the Bayer Crop Protection Centre, Monheim, Germany to hold discussions with the scientists on substitutes for methyl bromide as a nematicide.

STAFF TRAINING PROGRAMMES

Post-graduate degree

Mr B S Sithakaran, Extension Officer commenced his post-graduate studies for the MSc in January at the Post-graduate Institute of Agriculture.

Mr A M T Amarakoon, Research Assistant, Biochemistry Division, completed the local research component of his post-graduate programme and left for UK on 8th May to continue his PhD programme at the University of Southampton.

Mrs K Amarakoon, Research Assistant, Plant Propagation and Plant Breeding Division left for the UK to continue her studies for her PhD at the Southampton, UK.

Mr S Koneswaramoorthy Technology Division, left for Sweden in July to pursue his post-graduate studies at the Royal Institute of Technology, Stockholm.

Mr K M Mohotti, Research Assistant, Entomology Division returned to the Institute from UK in February to commence the local component of his PhD programme.

Mrs J Mohotti, Research Assistant, Plant Physiology Division returned to the Institute from UK to commence her post-project component of her PhD programme.

Mr A K N Zoysa, Research Assistant, Soils and Plant Nutrient Division, left for New Zealand in March to continue his post-graduate training for the PhD.

Mr B A D Samansiri, Advisory Officer, left for the Philippines on 1st June to pursue a course of post-graduate studies at UPLP College, Philippines.

Mrs S M Nagahaulla, Research Officer, Entomology Division returned to the island in July to commence the local component of her PhD.

Mr G Ganewatte, Research Assistant, Agricultural Economics Unit returned to the Institute on 1st September after completing his course work for his MSc programme at PGIA.

Mr D P B Herath , Research Assistant, Agricultural Economics Unit, left for Canada in October to follow a training programme for a PhD.

Mr J A S K V Jayasinghe, who assumed duties as OIC, Deniyaya on 1st July left for India on 30th October to commence a Diploma training programme.

Special Visitors

Dr K Malik, from the National Institute of Biotechnology and Genetic Engineering, Faisalabad, Pakistan visited the Division in May for two weeks under an IAEA programme.

RESEARCH PROGRAMMES

CROP PRODUCTION

Agronomy

The series of trials carried out in the low-country involves intercropping of rubber with tea indicated that tea performed better at wider spacings of rubber than otherwise.

A study commenced in 1992 evaluating different methods of harvesting reconfirmed the adverse effects on bush health by the adoption of a continuous system of machine and shear harvesting which accounted for a loss in yield of 57 and 30% respectively over the year.

A study initiated to overcome the problem of finding suitable soil media to strike tea cuttings has shown that at least a quarter of the medium could be met by sand alone which also enhanced growth.

A final laid out at Aningkande Estate , Deniyaya to evaluate the effect of innoculating earthworms with compost or mulching materials and artificial fertilizer showed that yield was not depressed with a mixture of earthworms and mana mulch alone in the first year of the trial.

Trials with sprays of a growth regulator, Dormex showed that yield increases of 8 - 10%.

Physiological Research

Investigations on resting tea without plucking prior to pruning showed that resting had a favourable effect on root starch reserves.

A physiological investigation evaluating transpirational loss of water of young tea revealed that within limits, a vigorously growing clone like TRI 2025 could survive with less water applied frequently whereas a relatively drought tolerant clone like CY 9 could survive with a greater volume of water applied less frequently.

Soils and Plant Nutrition

Soil Mg levels were not affected by the addition of Mg corrected NPK fertilizer mixtures of any formulation tested.

A major collaborative project with the Land Use Division of the Irrigation Department was commenced to characterize the soils of the tea growing areas. As a preliminary step the tea soils in the Ratnapura district are being identified. The development of a land use planning system of marginal tea lands in the mid-country with detailed soil distribution maps employing the GIS technology is in progress in collaboration with the Environment and Forest Conservation Division of the Mahaweli Authority in Kandy.

Eighteen trial sites in smallholder properties have been identified with a view to study the yield response of the fertilizer formulations of U 709 and T 1130.

CROP IMPROVEMENT

Plant Breeding Division

The evaluation of biclonal and polyclonal seedling progeny obtained from seed gardens of different locations is continuing.

Monitoring of the field performance of clones developed from biclonal and polyclonal seed established at different sites is in progress.

There was a greater demand for cuttings of the 3000 and 4000 series clones from plantations and smallholdings of all elevations and these were met from the stocks of mother bush plots established at Talawakele and at the sub-stations.

CROP PROTECTION

Entomology

A Task Force for the Integrated Pest Management of the shot hole borer was set up in July in collaboration with several other research disciplines; field investigations are planned to be carried out at Uva, Deniyaya and at Kandy. These studies involve investigations on time and methods of pruning in containing the problem of the SHB and evaluation of presently recommended shade trees as alternate hosts to the SHB.

A range of 4000 series clones are being screened against both the root-lesion nematode *(Pratylenchus loosi)* and the burrowing nematode *(Radopholus similis)*.

A study has been initiated to find suitable alternate substances to the methyl bromide fumigant for eradication of plant parasitic nematodes.

A series of botanicals screened for their nematicidal effects showed that *Tecoma stans; Cestrum nocturnum* and *Hibiscus rosa sinensis* have nematicidal properties against *Radopholus similis.*

A study is in progress in collaboration with the Plant Pathology Division to evaluate the effect of systemic fungicides on the SHB fungus, *Monacrosporium ambrosium.*

A new electronic device has proved successful in the early detection of the up-country live-wood termite. Further refinements are being made on this detector.

A range of clones are being screened for their susceptibility/resistance to the low-country. On the basis of a study involving the 4000 series clones two clones have been identified as highly susceptible, six as moderately susceptible while six others as resistant.

Several acaricides are being tested in the low-country for their efficacy against tea mites.

Plant Pathology

Several clones including those of the 3000 and 4000 series in the Phase II and III trials of the Plant Breeding Division have been ranked for their resistance/ susceptibility to blister blight. Preliminary indications are that the common table salt could prove beneficial in controlling blister blight provided Na does not get unduly accumulated in the leaf or soil causing other undersirable effects.

PROCESS TECHNOLOGY

Biochemistry

The collaborative studies with the University of Peradeniya on the control of the SHB focused attention on weather a relationship existed between polyphenols and caffeine content. The more resistant clone TRI 2023 showed a greater difference in caffeine content between the healthy and infected stems. It was observed that where the polyphenol content was double that of the caffeine content it suppressed the anti-fungal activity of caffeine. Further studies are in progress.

A collaborative project has been initiated with the Entomology Division to determine whether the volatile chemicals present in the bark of tea could be gainfully employed as attractants or repellents of the SHB.

An indepth study on the climatic profile of the Uva region is underway to elicit information on the relationship of climatic parameters and quality of Uva teas.

Further studies on the foliar application of phosphorus showed that 4% diammonium phosphate enhanced total colour 2 weeks after foliar sprays.

Manufacturing Techonology

Further work is in progress on the feasibility of harnessing solar energy for tea drying.

After several trials the design of the solar collector was finalized. The required number of collectors will be fabricated, installed with the necessary ducting and the performance would be monitored.

Studies are in progress at Talawakele to test the usefulness of nylon bags in the transport of green leaf over long distances. It was seen that leaf damage was greater when the harvested leaf standard was poor irrespective of whether nylon or the traditional coir bags are used. These studies are to be repeated in the low-country.

Studies on the standard of leaf entering the factory showed that minimum of 65% good leaf standard should be maintained for satisfactory manufacture.

Documentation of the ISO 9000 standard for St Coombs Estate has commenced and work on related manuals is also in progress.

Economics Unit

The activities of the Economics Unit were strengthened during the year through more macro-level studies, better research interaction, updated tea information and with greater emphasis on smallholder related problems. Studies on some of the socio economic aspects relevant to the tea sector were also initiated. The staff of the Unit also served as resource personnel in several seminars organized by the Institute.

Research interaction via CADMAR

Following an indepth analysis of the problems/constraints of the tea sector and a classification of the issues according to their researchability 25 thrusts and 91 accompanying projects have been drawn up along with estimates of the cost and time frame relating to each of them. Presently, the potential benefits pertaining to them are being evaluated, the ultimate objective being to prioritise them according to the needs of the end-users and make them results oriented. This is being done through the CADMAR (Composite Approach to Decision Making in Agricultural Research) approach and is coordinated by the Agricultural Economics Unit. The prioritization is expected to be completed before the end of 1997.

Analytical Service

The Entomology Division carried out nematode estimation on 472 root/soil/ nursery plant samples for advisory and research purposes and 40 reports and 40 letters have been issued.

The Soils and Plant Nutrition Division analyzed a total of 6268 soil, 1809 leaf and 1613 fertilizer samples as part of their continuing programme of analytical service to the industry.

The Plant Breeding Division supplied promising cuttings of the 3000 and 4000 series clones to estates and smallholdings in all tea growing areas with a view to establish mother bushes and for evaluation of trials.

Publications

The Institute's publications during the year included the *Sri Lanka Journal of Tea Science* and the Annual Report.

Extension Service

The Extension Service continued its role in providing advice to all estates, private plantations and to the tea smallholdings sector throughout the tea planting districts.

During the year under review, the extension staff attached to the main laboratories as well as the five regional stations conducted a total of 262 field days, seminars, demonstrations and training programmes for the benefit of plantation executives, field staff and tea smallholders. A total of 491 advisory visits were undertaken. The Senior

Scientific staff of the various research disciplines were actively engaged in the transfer of technology.

Income and Expenditure

The Institute received -/35 cts from a sum of Rs 2/- levied on teas exported. The total amount of the cess income received by the Institute for the year ending 31st December 1996, amounted to Rs 86.2 million. The total income received by the Institute inclusive of the income from its commercial activities amounted to a total sum of Rs 119.36 million. The total recurrent expenditure for the year under review amounted to Rs 82.97 million resulting in an income over expenditure of Rs 36.39 million.

The total capital expenditure incurred during the year amounted to Rs 11 million.

TRI ESTATES

St Coombs Estate

During the year under review, St Coombs produced 262,162 kg made tea while 113,432 kg (made tea) was from bought leaf. The average yield was 1793 kg per ha. The nett sale average during the year was Rs 106.52 at estate level while the average revenue cost of production was Rs 92.69. The total profit realized by the estate was Rs 5,194,465.02.

St Coombs continued to top the western market on several occasions at the weekly auctions while recording an all time high of Rs 300/- per kg for the BOP grade in March.

The average price paid for green leaf during the year was Rs 13.54 per kg. The total capital expenditure for the year was Rs 2,389,475.

St Joachim Estate

During the year under review, St Joachim produced 63,330 kg made tea while 1,094,941 kg made tea was from bought leaf purchased from the smallholders. The nett sale average realized during the year was Rs 113.81 while the cost of production was Rs 102.31.

The profit realized by the estate was Rs 18,431,737 during the year. The average price paid for green leaf during the year was Rs 17.32 per kg. The total capital expenditure for the year was Rs 560,877. St Joachim continues to assist tea smallholders by selling them fertilizer on easy terms, VP plants at a reasonable cost and by purchasing their leaf amounts to about 95% of the tea manufactured at the factory.

W.W.D. Modder

Director

TEA RESEARCH BOARD OF SRI LANKA
REPORT FOR THE YEAR - 1996

1.1 Introduction

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

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

1.2 The functions of the Tea Research Board

The specific functions of the Tea Research Board are :

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

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

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

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

1.3 Tea Research Institute Head Office at Talawakele.

The Head Office at Talawakele is responsible for the maintenance, administration, overall planning and execution of research and extension and advisory programmes of its main centre at Talawakele and 5 sub-stations located in different tea growing districts.

1.4 Members of the Tea Research Board as at 31st December, 1996.

1.	Dr S.D.I.E.Gunawardena	-	Chairman, TRB
2.	Dr W.W.D. Modder	-	Director, TRI - TRB
3.	Mr Rohana Illangaratne	-	Member
4.	Mr Clifford Ratwatte	-	Member
5.	Dr Anura Ekanayake	-	Member
6.	Mr E. Kanendran	-	Member
7.	Mr S.K. Seneviratne	-	Member
8.	Mr G.V. Tissera	-	Member
9.	Mr J.P.M.Y. Ratnayeke	-	Member
10.	Mr Sivam Loganathan	-	Member
11.	Mr V. Puthirasigamoney	-	Member
12.	Mr I.L.A. Fernando	-	Member
13.	Mr S. Wirasinghe	-	Member
4.	Prof H.P.M. Gunasena	-	Member

Secretary to the Board : Mr. C.C Mawilmada

Mr. Sepala Ilangakoon served as a Member of the Tea Research Board until he tendered his resignation on 5th August, 1996.

1:5 Senior Management Staff as at 31st December, 1996

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

1.6 Heads of Divisions, Administrative, Scientific & Research and Advisory Staff - Grades I & II as at 31st December, 1996.

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

Finance Division:

1.	Mr. W.B. Herath	-	Senior Accountant
2.	Mr. G.A.K.P. de Silva	-	Accountant I
3.	Mr. M. Bowatte	-	Accountant II

Internal Audit:

1.	Mr. R. Kariyawasam	-	Internal Auditor

Library:

1.	Mrs. R.W.M.W.K.Illanganthilake	-	Librarian

STAFF LIST AS AT 1.2.1996

Name of Officer	*Grade*	*Designation*
Dr W.W.D.Modder		Director
Dr M.T.Ziyad Mohamed		Deputy Director Research (Technology)
Dr G D Wimaladasa		Deputy Director Research (Production)
Mr C.C.Mawilmada		Deputy Director (Adminstration)
Administration Division		
Mr D.W.Bartholomeusz	II	Administrative Officer
Finance Division		
Mr W.B.Herath	I	Senior Accountant
Mr G.A.K.P.de Silva	II	Accountant I
Mr M.Bowatte	II	Accountant II
Library		
Mrs R.W.M.W.K.Illanganthilake	II	Librarian
Publication Division		
Mrs F.Y.M.Maharoof	II	Publication/Publicity Officer
Advisory Division		
Mr C.C.Rajasingham	I	Senior Advisory Officer
Mr J.C.K.Rajasinghe	II	Advisory Officer
Mr B.A.D.Samansiri	II	Advisory Officer
Mr V.Sithakaran	IV	Extension Officer
Agronomy Division		
Dr A.Kathiravetpillai	I	Head/ Agronomist
Mrs M.S.D.L.de Silva	II	Research Officer
Mrs J.Balasooriya	II	Research Assistant
Mr A.R.Amarasekara	IV	Experimental Officer
Mr U.P.Abeysekara	IV	Experimental Officer

Agriculture Economics Division

Mrs I.A.A.M.Jayakody	II	OIC/Research Officer
Mr D.P.B.Herath	II	Research Assistant
Mr G.Ganewatte	II	Research Assistant

Biochemistry Division

Dr I.S.B.Abeysinghe	I	Actg. Head/ Senior Research Officer
Dr (Mrs) A.C.Liyanage	I	Senior Research Officer
Mr A.M.T.Amarakoon	II	Research Assistant
Mrs J.Jayasundara	II	Research Officer
Mrs B.W.S.Kariyawasam	II	Research Officer
Mr H.Jayaweera	IV	Experimental Officer
Miss P.S.F.Perera	V	Technical Assistant

Entomology Division

Mrs S.I.Vitarana	I	Head Actg. Entomologist
Dr (Ms) L.D.Amarasinghe	I	Senior Research Officer
Mr K.Thirugnanasuntharan	I	Senior Research Officer
Mrs K.U.S.M.Nagahaulla	II	Research Officer
Mr M.M.Keerthi	II	Research Assistant
Mr D.D.Liyanage	III	Experimental Officer
Mr N.Navaratne	IV	Experimental Officer
Mrs P.V.A.R.Abeysekera	IV	Experimental Officer
Mr H.M.L.L.S.Abeysinghe	IV	Experimental Officer
Mr P.D.Peter De Silva	IV	Technical Assistant
Mr G.P.Udumulla	V	Technical Assistant
Mrs B.S.N.Vithana	V	Technical Assistant

Plant Physiology Division

Dr A.Ananthacoomaraswamy	I	Actg. Head/Senior Research Officer
Mrs A.J.Mohotti	II	Research Assistant
Mrs V.Sithakaran	V	Technical Assistant
Mrs D.M.S.Navaratne	V	Technical Assistant

Plant Pathology Division

Mr A.Balasooriya	II	Actg. OIC / Research Assistant
Mrs R.M.D.T.Pallemulla	II	Research Officer
Mr T.S.Gunasekara	II	Research Assistant
Mr R.M.A.Ratnayake	IV	Experimental Officer
Mrs K.M.N.K.Ratnamalala	IV	Experimental Officer

Plant Propagation &Plant Breeding Division

Mr V.Shanmugarajah	II	Actg.OIC/Research Officer
Mrs M.T.K.Gunasekara	II	Research Assistant
Mr P.D.Upali	III	Experimental Officer
Mr M.Ratnayake	IV	Experimental Officer
Mr S.W.Gunadasa	1V	Experimental Officer
Mrs. U.Sridharan	IV	Experimental Officer
Mr B.A.Ratnagoda	V	Technical Assistant

Soils & Plant Nutrition Division

Dr L.S.K.Hettiarachchi	I	Actg. Head/ Senior Research Officer
Mrs S.Ananthacoomaraswamy	II	Research Officer
Mr A.K.N.Zoysa	II	Research Assistant
Mr G.P.Gunaratne	II	Research Officer
Mr R.G.A.Wijewardhana	IV	Experimental Officer
Mr H.A.P.Warnasiri	V	Technical Assistant
Mr S.M.Dissanayake	V	Technical Assistant

Technology Division

Mr P.A.N.Punyasiri	II	Research Officer
Mr W.S.Botheju	II	Research Officer
Mr K.Raveendran	II	Chemical Engineer
Mrs S.H.P.Waduge	IV	Experimental Officer
Mr V.Wickramesinghe	IV	Experimental Officer
Mr L.Jayasinghe	V	Technical Assistant

Statistics Division

Miss T.S.N.Senaratne	1V	Data Entry Operator

TRI Sub Station, Deniyaya

Mr J.A.S.K.V.Jayasinghe	IV	Actg. OIC/ Extension Officer
Mr O.W.Jayawardhena	IV	Station Assistant

TRI Sub Station, Hantane

Mr P.B.Ekanayake	II	OIC/Agronomist
Mrs S.K.J.Liyanage	II	Research Officer
Mr S.T.Yatawatte	II	Advisory Officer
Mr T.M.Sarathchandra	III	Experimental Officer

Mr A.P.D.A.Jayasekara	IV	Experimental Officer
Mr U.B.Herath	IV	Experimental Officer
Mrs B.Sureshkumar	IV	Experimental Officer
Mr W M S Wijethunga	IV	Experimental Officer
Miss R. M.S.S. Rajapakse	IV	Experimental Officer
Mrs S.N.Wijesekara	IV	Experimental Officer
Mrs K.Sarathchandra	V	Technical Assistant

TRI Sub Station, Kottawa

Mr K.D.Dahanayake	II	OIC/Advisory Officer
Mr P.K.Jayawickrama	IV	Experimental Officer
Mr E.K.Somapala	IV	Station Assistant

TRI Sub Station, Ratnapura

Mr S.Wimaladharma	I	OIC/ Senior Advisory Officer
Dr M.A.Wijeratne	I	Senior Research Officer
Mr D.I.N.N.Giddawage	II	Administrative Officer
Mr S.Koneswaramoorthy	11	Mechanical Engineer
Mr G.L.C.Galahitiyawa	II	Research Officer
Mr K.G.Premathilaka	II	Research Assistant
Miss S.M.Samarasinghe	III	Experimental Officer
Mr H.S.N.Peiris	IV	Experimental Officer
Mr N.K.S.L.D.Amarathunge	IV	Extension Officer
Mr A.K.Premathunge	IV	Experimental Officer
Mr E.R.Perera	IV	Experimental Officer
Mr C.Gunasekara	IV	Experimental Officer
Mr D.W.Vithana	IV	Experimental Officer
Mr H.J.M.De Silva	III	Experimental Officer
Mr P.B.Chandradasa	IV	Technical Assistant
Mr A.K.M.Jayasena	IV	Technical Assistant
Mr K.T.C.Perera	IV	Technical Assistant
Mr J.H.M.Piyasundera	V	Technical Assistant
Mrs E.W.D.P.Premathunga	V	Technical Assistant

TRI Sub Station, Passara

Mr M.B.A.Perera	I	OIC/Advisory Officer
Mr R.Nandasena	V	Station Assistant

(b) TRI Advisory & Extension Centre, Deniyaya

1. Mr. M.K.S.L.D. Amaratunge - Actg. Officer-in-Charge/ Extension Officer

(c) TRI Advisory & Extension Centre, Kottawa

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

1.7 The vacant positions of Senior Accountant, Internal Auditor and Assistant Superintendent, St. Joachim Estate, Ratnapura were also filled, in 1996.

1.8 Action has been taken to fill several existing vacancies in Scientific, Technical and Administrative disciplines during the year 1996.

1.9 The new Manual of Administrative Procedures of Tea Research Institute of Sri Lanka has been implemented.

1.10 Action has been initiated to draft a Manual of Disciplinary Procedure during the year 1996.

1.11 Action has been taken to conduct a Medical Clinic daily with the assistance of a Government Medical Officer from September, 1996 at the TRI Medical Centre.

1.12 The Tea Research Board appointed a Salaries & Cadre Committee to look into the Salary anomalies and promotion schemes of the TRI staff.

1.13 Action has been initiated to improve the Medical Aid Scheme and the Insurance Policy Scheme of the TRI staff with more benefits in consultation with relevant experts.

1.14 The Director, TRI appointed an Advisory Committee to look into the matters pertaining to promotions, transfers and any other grievances of the staff.

1.15 Action has been initiated to supply electricity to the labour cottages of St. Coombs Estate.

1.16 A new electric generator (350 KVA) has been purchased for St. Joachim Estate, Ratnapura.

1.17 Maintenance Divisions - Engineering, Electrical and water supply of the TRI continued to maintain a high standard in the maintenance of the buildings, roads, electrical installations etc., and in the supply of water to the staff quarters within the TRI Campus during the year 1996.

1.18 Welfare facilities given to TRI staff - Action has been taken to improve the welfare facilities and other fringe benefits to TRI staff.

1.19 Action has been taken to improve the Security within the TRI Head Office as well as its substations.

REPORT OF THE FINANCE DIVISION - 1996

The year under review had resulted the working of the Tea Research Board in a surplus of Rs. 36,392,435/- as compared with the surplus of Rs. 26,774,835 in the previous year.

The total cess income for the year under review amounted to Rs. 86,027,473 as compared with the total cess income of Rs. 83,616,416 in the previous year.

The profits realized from the workings of St. Coombs Estate and St. Joachim Estate were Rs. 5,202,251 and Rs. 17,978,620 respectively, as compared with the profits realized Rs. 2,965,830 and Rs. 6,251,986 respectively in the previous year. Details of the actual expenditure are given below:

ACTUAL EXPENDITURE 1996

	Research	**Advisory & Extension**	**Administration & Support**
Personnel Emoluments	11,111,175	4,305,485	10,237,404
Travelling	1,075,954	854,706	971,534
Supplies & Requisites	6,167,047	1,089,839	1,667,374
Repairs & Maintenance of Capital Assets	708,934	682,441	7,414,571
Transportation, Communication Utility & Other services		5,478,661	7,680,467
Losses & Write-off			4,976
Contributions, Grants & Subsidies	167,625	17 9,479	844,409
Media Advertising, Publicity & Gifts		367,599	69,580
Cultivation & Field Trials		4,050,269	
Miscellaneous	5,068,117	60,319	122,342

TEA RESEARCH BOARD
BALANCE SHEET AS AT 31 DECEMBER - 1996

1995 Rs.			Tea Rsearch Institute 1996 Rs. cts.	St. Coombs Estate 1996 Rs. cts.	St. Joachim Estate 1996 Rs. cts.	Total 1996 Rs. cts.
	FIXED ASSETS					
227,911,518	Property, Plant, Equipment etc.		240,485,117.32	-	-	240,485,117.32
(122,976,359)	Less: Accumulated Depreciation	(Anx. I)	(135,108,290.78)	-	-	(135,108,290.78)
104,935,159			105,376,826.54			105,376,826.54
10,508,994	Capital Work in Progress	(Anx. II)	9,817,789.12			9,817,789.12
1,504,670	Purchase Consideration-Lamiliere Estate		-			- (Note 1)
116,984,823			115,194,615.66			115,194,615.66
	CURRENT ASSETS					
9,668,114	Stocks	(Anx. III)	7,154,979.31	1,534,391.89	798,450.69	9,487,821.89
41,116,215	Debtors and Other Debit Balances	(Anx. iv)	63,044,559.83	1,003,154.89	149,295.45	64,197,010.17
7,745,747	Deposits, Pre-Payments & Purchase Advances	(Anx. V)	10,801,973.68	546,007.01	544,085.87	11,892,066.56
8,635,663	Loans and Advances to Staff & employees	(Anx. VI)	6,721,370.83	1,093,160.09	717,101.38	8,531,632.30
5,300	Other Current Assets-Patents		5,300.00	-	-5,300.00	
21,000,000	Short Term Investments-7 day Call Deposits	43,000,000.00	-	-	43,000,000.00	
5,801,275	Cash and Bank Balances	(Anx. VII)	(87,596.76)	36,196.81	1,485,530.34	1,434,130.39
93,972,314			130,640,586.89	4,212,910.69	3,694,463.73	138,547,961.31
201,990	Suspense	(Anx. VIII)	158,608.02	178,791.62	-	337,399.64
234,720	Identified Losses	(Anx. IX)	344,051.28	-	-	344,051.28
19,150	Excess & Shortages	(Anx. IX)	18,712.71	-	-	18,712.71
94,428,174			131,161,958.90	4,391,702.31	3,694,463.73	139,248,124.94
	CURRENT LIABILITIES					
(19,876,551)	Creditors and Provisions	(Anx. X)	(9,323,717.83)	(5,872,828.07)	(9,419,342.89)	(24,615,888.79)
74,551,623	Net Current Assets		121,838,241.07	(1,481,125.76)	(5,724,879.16)	114,632,236.15
191,500,446	Total Assets Less Current Liabilities		237,032,856.73	(1,481,125.76)	(5,724,879.16)	229,826,851.81
	REPRESENTED BY					
36,578,507	Grants and Reserves	(Anx. XI)	39,499,940.89	39,499,940.89		
143,163,182	Tea Research Fund	(Anx. XII)	178,244,599.60	178,244,599.60		
-	A/C Current St. Coombs Estate		3,467,244.80	(3,467,244.80)	178,244,599.60	
-	A/C Current St. Coombs Estate		6,749,616.44	(6,749,616.44)	-	
754,670	Long Term Liabilities - Land Reform Commission	754,670.00		-		
11,004,087	Provision for Gratuity		8,316,785.00	1,986,119.04	1,024,737.28	11,327,641.32
191,500,446			237,032,856.73	(1,481,125.76)	(5,724,879.16)	229,826,851.81

Note: 1. Purchase consideration Lamiliere Estate transferred to Property Negative figures are show within brackets.

TEA RESEARCH BOARD
TEA RESEARCH INSTITUE
OPERATING ACCOUNT FOR THE PERIOD 01ST JANUARY TO 31ST DECEMBER 1996

1995 Rs.				1996 Rs. cts.
	INCOME			
83,616,461	3.1 Cess		(Note 1)	86,027,473.35
11,734,658	3.2 Income from Estates and other commercial Activities (Annex XIII)			27,118,482.60
571,510	3.3 Interst on Investments			3,603,802.78
1,992,340	3.4 Miscellaneous (Annex XIII)			2,612,752.55
97,914,969	TOTAL INCOME			**119,362,511.28**
		Administration Finance & Services	**Research Advisory & Extension**	
	EXPENDITURE			
29,932,922	4.1 Personnel Emoluments	9,796,892.50	15,857,177.89	25,654,070.39
2,385,110	4.2 Travelling	732,866.76	2,169,333.51	2,902,200.27
6,284,425	4.3 Supplies and Requisites	1,877,298.77	7,046,964.48	8,924,263.25
7,274,156	4.4 Repairs and Maintenance of Capital Assets	7,680,905.92	1,125,047.33	8,805,953.25
8,163,216	4.4 Depreciation of Fixed Assets	960,345.00	7,936,604.57	8,896,949.57
12,201,985	4.5 Transportation, Communication, Utility and Other Services	7,680,467.86	5,478,662.06	13,159,129.92
14,199	4.5 Losses and Write-offs (Annex XVI)	4,976.39	-	4,976.39
916,392	4.7 Contributions, Grants and Subsidies	852,771.65	338,743.79	1,191,515.44
2,508,136	4.8 Pensions and Retirement Benefits	419,222.50	2,254,606.34	2,673,828.84
834,992	4.8 Gratuity Provision	519,062.50	499,886.00	1,018,948.50
311,216	4.10 Media, Advertising, Publicity and Gifts	69,580.40	367,599.83	437,180.23
3,064,402	4.11 Cultivation and Field Trials		4,050,269.77	4,050,269.77
2,248,983	4.12 Miscellaneous	132,436.43	5,118,354.39	5,250,790.82
71,140,134	**TOTAL EXPENDITURE**	**30,726,826.68**	**52,243,249.96**	**82,970,076.64**
26,774,835	Operating Suplus			36,392,434.64
(622,990)	Prior year adjustments (Annex xv)			(1,311,016.97)
26,151,845	Excess of income over expenditure transferred to Tea Research Fund			**35,081,417.67**

Note 1 :

Tea cess for the year 1996	491,585,562.00
TRI Share 17 1/2 % on above	86,027,473.35
Less: Remitted during the year 1996 by SLTB	59,033,538.97
Receivable	**26,993,934.38**

Tea Research Board
Source and Application of Funds - 1996

Source of Funds	Rs.	Rs.
Surplus for the year	36,392,435	
Adjustments in respect of items not involving the movement of funds		
Add: Provision for Gratuity	323,554	
Depreciation	12,131,931	
	48,847,920	
Less: Prior year Adjustments	(1,311,071)	
Funds generated from operations		47,536,903
Other Sources		
Grants and Reserves		2,921,434
		50,458,337
Application of Funds		
Purchase of Fixed Assets	12,573,599	
Decrease in Capital Work-in-Progress	(691,205)	
Purchase Consideration - Lamilere Estate	(1,504,670)	10,377,724
		40,080,613
Increase in Working Capital as analysed below		

Effect on Working Capital	Increase/(Decrease)
Stocks	(180,291)
Debtors	23,080,795
Deposits Pre-Payments and Advance for Purchases	4,146,320
Loans and Advances	(104,031)
Short Term Investments (7 Day Call Deposits)	22,000,000
Cash and Bank Balances	(4,367,145)
Suspense	135,410
Identified Losses	109,331
Excess & Shortage	(438)
Creditors & Provision	(4,739,338)
	40,080,613

RESEARCH PROJECTS

The progress made in the Multi-disciplinary and Mono-disciplinary projects are reported below:

MULTI-DISCIPLINARY PROJECTS

1. Project A/INCR - *Intercropping in tea lands to maximize income and conserve soil through optimal land utilization*

Project Leader - P.B. Ekanayake

1.1 Effect of intercropping tea and rubber on productivity

1.1.1. *Kuruwita*

Tea planted after rehabilitation was pruned in June, tipped in October and brought into plucking. Assessments on pruning and tipping were taken and the results are given in Table 1. Pruning weights of tea bushes under rubber was significantly lower than that of monocropped tea. Assessments on tipping also followed a similar pattern of variation. The results highlight that the growth of tea under rubber has been poor compared to that of monocropped tea. It was also noted that the growth of tea under rubber planted at closer spacings (2.4 x 8.0 m) has been adversely affected than rubber planted at wider spacings (2.4 x 12.0 m). Table 2 shows the variation in tea yield over the year. The yield of interplanted tea was comparatively less than that of monocropped tea. It is also evident that the tea planted under rubber at closer spacings wi(2.4 x 8.0 m) has given less crop than tea under rubber at wider spacings (2.4 x 12.0 m).

TABLE 1 - *Weight of prunings and tippings and of tipping shoot number*

	Fresh weight (kg/bush)		
	Prunings	*Tipping*	*No. of tipping shoots*
Tea (monocropping)	3.03	0.400	28.2
Tea+Rubber (2.4x 8.0m)	1.33	0.132	11.7
Tea+Rubber (2.4x12.0m)	1.58	0.146	15.2
LSD (P=0.05)	0.53	0.109	4.6

TABLE 2 - *Yield of tea under different cropping systems*

	Yield (FW)	
	kg/bush/yr	*kg/bush(Jan-May)*
With rehabilitation	-	0.385
Tea (monocropping)	-	0.190
Tea+Rubber (2.4x 8.0m)	-	0.222
Tea+Rubber (2.4x12.0m)	-	

Without rehabilitation		
Tea+Rubber (2.4x 8.0m)	0.482	-
Tea+Rubber (2.4x12.0m)	0.587	-
LSD (P=0.05)	NS	NS

1.1.2. *St. Joachim Estate, Ratnapura*

Yield records of tea during the year showed that tea intercropped with rubber (2.4 x 12.0m) has yielded less than the monocropped tea. Yield was 740 g/bush for monocropped tea and 560 g/bush for tea under rubber which was about 24% loss in crop. Although a partial removal of rubber branches (about 20-21%) was done on half of each interplanted plot, there was no improvement of yield.

1.1.3. *Demonstration plot at St. Joachim Estate, Ratnapura*

Harvesting of rubber and tea continued together with other cultural practices. Shear plucking was introduced to this block for evaluating the performance of the TRI shear.

1.1.4. *Observation trial at St. Joachim Estate, Ratnapura*

Tea plants were centered at a height of 30 cm and the other cultural practices continued in this observation block.

P.B. Ekanayake, M.A. Wijeratne and C. Gunasekera

1.2 Effect of intercropping seedling tea with coffee and pepper

1.2.1. *Mid-country - Hantane Estate, Kandy*

This experiment was abandoned due to several casualties in pepper.

1.2.2. *Mid-country - Hantane substation, Observation trial*

Except for mango, other species did not establish well. This trial in progress.

A.P.D.A. Jayasekera

1.3 Sloping Agricultural Land Technology

1.3.1. *St. Coombs Estate, Observation trial*

This trial in progress.

U.P. Abeysekera

1.3.2. *Hantane substation, SALT demonstration hedgerows*

Five loppings were done during the year. *Calliandra, Cassia* and *Flemingia* gave higher biomass production than the other species (Table 3).

TABLE 3 - *Biomass production of hedgerow species*

Species	*Biomass production (kg ha^{-1})*
Flemingia congesta	3365
Desmodium rensonii	96
Calliandra calothyrsus	7860
Cassia spectabilis	3923
Teckoma stans	1370
Adathoda vasica	1080

More casualties were seen in **Desmodium** which increased with each lopping. This trial is in progress.

A.P.D.A. Jayasekera

1.3.3. *Low-country station, Ratnapura*

The SALT trial is in progress.

MONO-DISCIPLINARY RESEARCH PROJECTS AND DIVISIONAL ACTIVITIES

AGRONOMY DIVISION

Head - A. Kathiravetpillai

1. General

Mr K.T.C. Perera was transferred from the Advisory and Extension Unit to the Agronomy Unit at Ratnapura w.e.f. 1st January.

2. Project B/PLUK - *Harvesting practices*

Project Leader - M.A. Wijeratne

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

Different combinations of machine, shear and hand plucking continued. Due to lack of foliage and growing shoots, continuously machine harvested plots were given a light skiff (about 10 cm) using the same machine during February. Although this practice improved the conditions of the canopy foliage and plucking table, a marked yield reduction was still obvious (Table 1). In comparison with manual plucking, continuous use of machine and shears recorded yield reductions of about 57% and 30%, respectively. However, combined plucking systems had not given such a drastic drop in yield compared to continuous manual plucking.

TABLE 1 - *Yield of tea under different plucking systems*

	Made tea yield (kg/ha/yr)
Manual plucking	3529
Machine plucking	1519
Shear plucking	2498
Manual + Machine (Cropping season)	2867
Manual + Shear (Cropping season)	2655
Manual + Machine (Alternate rounds)	2829
Manual + Shear (Alternate rounds)	2734
LSD (P=0.05)	687

2.2 Mechanical harvesting at Rassagala Estate - (1996)

Two plots of tea about 0.5 ac each (TRI 2023) were harvested manually and by machine to test the performance of Kawasaki NV60H machine. Due to a severe shortage of labour, extended plucking rounds of about 10-12 days or more are usually adopted in the fields selected for the trial. Yield records over the last 3 months showed a slight reduction in yield i.e. about 6% under mechanical harvesting compared to manual plucking (extended rounds). Green leaf yield over the period from October-December was recorded to be 5087 kg/ha and 5404 kg/ha for

mechanical harvesting and for manual plucking respectively. Both systems recorded about 7% of coarse leaves in the harvested crop. Fuel consumption by the machine was about 3 l/day(390 minutes/day) and the machine can harvest about 0.5 ha/ day (field is an undulating land with an average slope).

M.A. Wijeratne, D.W. Vithana and K.T.C. Perera

2.3. Effect of frequency of plucking on yield of clone TRI 2027, TRI 2025, and S106, St. Joachim Estate, Ratnapura

This experiment was terminated and the plots were used to test seasonal variation in root reserves of tea with and without resting before pruning. A third of the plots were rested for 2 months while same number of plots were rested only for a month. The balance 1/3rd of plots were continuously plucked without resting until pruning. Bushes were pruned in June and tipped in October. Before imposing of resting treatments, a higher percentage of root reserves were observed under extended plucking rounds (8 day). This was followed by 6 day and 4 day rounds respectively. Further, estate clones 106 recorded a higher % of root reserves compared to the other two high yielding TRI clones. Root starch content of TRI 2025 was less than that of TRI 2027 (Table 2). Results also showed that one month resting had not contributed to enhanced root reserves. However, 2 months resting before pruning has augmented starch content of tea roots. Analysis of root reserves so far has shown that root starch content declined with the continuation of plucking (7 day rounds).

TABLE 2. *Starch content of tea roots (%)*

	Sample Number					
	1	*2*	*3*	*4*	*5*	*6*
Clone						
TRI 2027	5.08	5.64	1.38	0.78	1.40	2.73
TRI 2025	7.22	7.98	2.39	1.38	3.60	5.04
S 106	8.00	9.56	4.56	2.09	2.23	3.91
LSD (P=0.05)	NS	NS	1.58	1.02	1.53	4.32
Resting						
Control	4.02	3.86	3.06	1.89	2.39	2.24
1 month resting	6.47	6.17	1.39	1.26	2.52	2.03
2 month resting	9.81	13.14	3.89	1.10	2.32	7.41
LSD (P=0.05)	4.42	5.98	1.58	NS	NS	4.32

Set 1 - 6 are root samples taken 1). before imposing treatments, 2). 2 months after resting and 3) - 6) 1-4 months after pruning. The sample numbers at pruning and tipping are 2 and 6 respectively.

M.A. Wijeratne, and P. Prematunga

3. Project B/PRUN - *Pruning practices in tea*

Project Leader - M.A. Wijeratne

3.1. Effect of different methods and time of pruning on shot-hole borer damage (SHB Task Force), Kiriwanaganga Estate, Deniyaya.

This experiment was commenced in line with the proposals made by the Shot-hole Borer Task Force:

Clone : TRI 2025
Plot size : 50 bushes/plot
No. of replicates : 4

Treatments:

Time of pruning (3) : January, April and October
Style of pruning (3) : Clean, 25 cm (10")
Rim-lung, 45 cm (18")
Cut-across, 60 cm (24")

Treatments were randomized in a Factorial Design. Twelve plots were pruned in October '96.

M.W. Wijeratne, D.W. Vitana and K.T.C. Perera

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

A new experiment was commenced with the following treatments

Clone : TRI 2025
Plot size : 30 bushes/plot
No. of replicates : 4

Treatments

Style of pruning : Rim-lung, 50 cm, (20"), minimum cleaning
Rim-lung, 50 cm, (20"), full cleaning
Cut-across, 65 cm, (26"), no cleaning
Rim-lung, 50 cm, (20"), full cleaning and cut-across

Bringing into plucking: Plucking-in and tipping to hard green wood

Analysis of results on time taken for pruning has shown that the labour requirement (only for pruning) for rim-lung pruning with good cleaning was about double that for rim-lung pruning with minimum cleaning. Bud counts taken at two months after pruning revealed that bud break was comparatively less under rim-lung with full cleaning than rim-lung with minimum cleaning and cut-across types of pruning (Table 3).

TABLE 3 - *Bud break after pruning*

	Number of buds/bush
Rim-lung, 50 cm, (20") (Minimum cleaning)	34.4
Rim-lung, 50 cm, (20") (Full cleaning)	23.5
Cut-across, 65 cm, (26") (No cleaning)	49.8
LSD (P=0.05)	9.82

M.A. Wijeratne, D.W. Vithana and K.T.C. Perera

3.3. Effect of height of pruning, retention of lungs and method of tipping on yield, St. Coombs Estate, Talawakele - (1995)

Plucking commenced in September 1995.
The results are given in Table 4.

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

Treatments	*Yield (kg made tea. ha^{-1})*
Pruning at 45 cm + with lungs + pluck in	2553
" + " + tipping	2229
" + without lungs + pluck in	2469
" + " + tipping	2557
Cut across at 55 cm + with lungs + pluck in	2706
" + " + tipping	2713
" + without lungs + pluck in	2704
" + " + tipping	2867
Cut across at 65 cm + with lungs + pluck in	2625
" + " + tipping	2494
" + without lungs + pluck in	2711
" + " + tipping	2742
LSD (P=0.05)	NS
CV%	10

A. R. Amarasekera

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

4.1 To evaluate the effect of Dadap shade on yield of tea - Field No. 7, Stonycliff Estate, Kotagala

The first year of the trial was completed in December 1996. The yield for the period December 1995 - November 1996 is given in Table 5.

During the year assessments were carried out for the effect of blister blight in shade and no shade plots.

TABLE 5 - *Effect of shade and no shade on yield and blister blight*

Treatments	*Yield (kg made tea ha^{-1})*		
Without Dadaps	3664 a		
With Dadaps	3222 b		
CV(%)	7		
Blister Blight Assessment(%)	19-07-96	02-08-96	14-08-96
Without Dadaps	10	65	45
With Dadaps	18	78	47
CV(%)	7		

4.2. Evaluation of suitable *Calliandra* provenances

Calliandra provenances trials at St. Coombs Estate, Talawakele, Dessford Estate, Nanu Oya, Park Estate, Kandapola are in progress.

A.R. Amarasekera

4.3 Evaluation of *Grevillia robusta* provenances

Grevillia robusta seeds of 66 different known provenances obtained from Australian Tree Seed Centre of the CSIRO Division of Forestry in Australia were sown on 07 August 1996 at Talawakele. Out of the 66 provenances, 38 showed 50-100% germination. These seedlings will go into a replicated trial in seedling seed orchards in up-country (Pedro Estate, Nuwara Eliya), and low-country (St. Joachim Estate).

J. Balasuriya

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)*

This experiment is in the third year of the first cycle.

Analysis of results on yield showed no significant difference between the rehabilitation treatments tested. The yield recorded over the year 1996 is given in Table 6.

TABLE 6- *Effect of soil rehabilitation on yield*

	Yield (FW) kg/plot
Control	61.8
Sugar cane, CO 775	62.7
Sugar cane, M 292/70	68.6
Sugar cane, LF 31/52	78.4
Eragrostis spp.	69.1
Vetiver spp.	75.2
Mana grass	72.5
LSD (P=0.05)	NS

C. Gunasekera

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

The yield for the fifth year (January - June) of the current cycle is given in Table 7.

TABLE 7 - *Yield of tea*

	Yield (kg made tea ha^{-1})
Rehabilitation	908
No rehabilitation	907

The plots were pruned on 24th June and plucked in November.

A.R. Amerasekera

5.1.3. *Effect of burying prunings on yield, St Coombs Estate - (1991)*

This experiment is in the first year of the current cycle. The yield is given in Table 8.

TABLE 8 - *Effect of burying and retention of prunings on yield*

Treatments	*Yield (kg made tea ha^{-1})*
T1. Control (with normal fertilizer)	4208
T2. Burying prunings + normal fertilizer	4630
T3. Burying prunings + half of normal fertilizer	4198
T4. Burying prunings only	3588
T5. Burying brush wood + normal fertilizer	4170
T6. Burying brush wood + half of normal fertilizer	3758
T7. Retention of prunings + normal fertilizer	4158
LSD (P=0.05)	554
CV (%)	9

There is a trend to show that burying of prunings with normal fertilizer enhanced the yield. Treatments T4 and T6 depressed the yield.

A. Anandacoomaraswamy

5.1.4. *Effect of direct planting vs planting after soil reconditioning on yield, Concordia Estate - (1991)*

This experiment is in the third year of the first cycle. The yield is given in Table 9.

TABLE 9 - *Effect of planting tea with and without rehabilitation on yield*

Treatments	*Yield (kg made tea ha^{-1})*	
	Rehabilitated	*Direct planted*
TRI 2025	1580	1293
TRI 2024	1957	1342
NAY 3	2527	2184
DT 1	2317	1701
PK 2	2857	2447
LSD (P=0.05) for planting	224	
LSD (P=0.05) for clones	154	
CV%	11	

The yield of clones improved in the rehabilitated soil.

A.R. Amerasekera and U.P. Abeysekera

5.1.5 *Effect of alternate methods of rehabilitation compared with rehabilitation under grass, New Peacock Estate, Pussellawa - (1996)*

This trial commenced in June with a view to eliminate the period of soil rehabilitation by alternate methods. The treatments were replicated three times in a RCBD, with clone TRI 3013. The growth and mortality rate is given in Table 10.

TABLE 10 - *Height and casualties of plants*

	Height (cm)	*Casualties (%)*
Control (2 years rehabilitation with grass)	65.9	0
Direct planting with compost (3 kg/planting hole)	54.6	15
Direct planting with compost (1.5 kg/planting hole + 20g T200 fertilizer mixture)	58.2	2
Direct planting with coir dust (1.5 kg/planting hole at bottom + 1.5 kg compost on top)	56.2	8

Direct planting with coir dust (3.0 kg/planting hole at bottom + 20g T200 fertilizer mixture)	57.9	8
Direct planting with coir dust (3.0 kg/planting hole at bottom)	54.7	9
Interplanting *Flemingia congesta* as cover crop in tea interrows	49.7	23
Direct planting with 20g T200 fertilizer mixture + 1.5 kg compost on top	53.3	3
Direct planting only	56.2	8
LSD(P=0.05)	7.3	
CV (%)		12

A.R. Amerasekera and U.P. Abeysekera

5.2. Cover crops

Cover crop spp planted last year formed a good ground cover over the vacant patches of the experimental plots. Growth of **Arachis pintoii** was superior to the other species tested. **Wedeliya** vines tends to climb the tea bushes while **Desmodium** spp. showed a vigourous and an erect growth habit on some vacant patches.

M.A. Wijeratne and D.W. Vithana

5.3. Mulching materials

5.3.1. *Galphele Estate, Panwila - (1993)*

The yield of the second year (January - December) is presented in Table 11.

TABLE 11 - *Effect of mulching materials on yield of young tea*

Treatments	*Yield(kg made tea ha^{-1})*
Saw dust	2050 ab
Coir dust	2013 b
Paddy husk	1998 b
Tea refuse	2278 a
Mana grass	2239 ab
Control	1994 b
CV (%)	8

The plots mulched with tea refuse gave a higher yield than the control. This experiment is in progress.

A.P.D.A. Jayasekera

6. Project B/WEED - *Weed management in tea*

Project Leader - P.B. Ekanayake

6.1. Effect of different weed management practices on yield of young tea, Galphele Estate, Panwila - (1994)

The yield during the 2nd year of the first cycle showed that there was no significant difference between any of the treatments. However slash weeding resulted in higher yields (Table 12).

TABLE 12 - *Effect of different methods of weed management on yield*

Treatments	*No. of weeding rounds/year*	*Yield (kgha -1)*
T1 - Manual weeding at monthly interval	12	2949
T2 - Manual weeding at 2 monthly interval	6	2983
T3 - Manual weeding at 3 monthly interval	4	2974
T4 - Chemical weeding with Paraquat (1.1l ha^{-1})	4	2715
T5 - Chemical weeding with Glyphosate (0.3%)	3	2731
T6 - Chemical weeding with Sulphosate (0.3%)	3	2747
T7 - Chemical weeding with Paraquat (1.1l ha^{-1}) + 2,4 D (1.5kg ha^{-1})	3	2913
T8 - Chemical weeding with Paraquat (1.1l ha^{-1}) + 2,4 D (1.5kg ha^{-1}) + Diuron (1.2kg ha^{-1})	3	2874
T9 - Slash weeding	4	3176

(CV% = 12.5)

The experiment is in progress

A.P.D.A. Jayasekera

6.2. Effect of different frequencies of paraquat application on yield of tea compared to manual weeding, St Coombs Estate, Field No. 8

Treatments
T1 - Manual weeding (monthly interval)
T2 - Paraquat at 1.1 l ha^{-1}(monthly)
T3 - Paraquat at 1.1 l ha^{-1} (bimonthly)
T4 - Paraquat at 1.1 l ha^{-1} (3 months interval)

Treatments were applied continuously from 1995. No significant difference in yield were recorded. In general, the yield of the manually weeded plots were more than those weeded chemically. This may be due to adverse soil conditions in plots treated with Paraquat continuously for long periods and/or due to detrimental effects caused to the tea bush by the herbicide coming into contact with the bark of tea; the herbicide could gain access through cracks in the bark caused by wind damage.

The yield is tabulated below.

Treatment	*Yield (kg made tea ha^{-1})*
T1 - Manual weeding (monthly interval)	2259.8
T2 - Paraquat at 1.1 l ha^{-1} (monthly)	2089.2
T3 - Paraquat at 1.1 l ha^{-1} (bimonthly)	2101.5
T4 - Paraquat at 1.1 l ha^{-1} (3 months interval)	2134.0
LSD (P=0.05)	NS
CV (%)	7.68

This experiment is in progress.

6.3 Effect of different weed populations on yield of mature tea, St. Coombs Estate, Field No. 7

Different levels of weed populations (by removing weeds) such as 15%, 30%, 45% and 60% were compared with control plots (no weeding) and the yield of tea is being recorded. (Table 13).

TABLE 13 - *Effect of weed population on yield of tea.*

Treatment	*Yield (made tea ka ha^{-1})*
15% weed population	1898.2
30% weed population	1828.8
45% weed population	1851.4
60% weed population	1764.0
Control (80-90%) weed population	1710.8
LSD (P=0.05)	288.26
CV (%)	11.8

The results showed that there is a suppression of yield due to the weeds. though there is no significant yield reduction in the 1st year of the 3rd cycle. This experiment is in progress.

6.4. Control of problem weeds

6.4.1. *Andredera basseloides and Talinum paniculatum, Uva Highlands Estate, Bandarawela.*

The experiment was repeated with the following treatments:

The treatments were applied onto the cut surfaces of stems after slashing of the weed species up to ground level.

	Least square mean
T1 -2% Glyphosate	9.4
T2 - 2.5% Glyphosate	19.16
T3 - Control (without herbicide)	23.68

R-Square = 0.70

6.4.2. *Control of Andredera basseloides. St. Coombs Estate, Talawakele, Field No. 9*

The following treatments were applied onto the cut surfaces of stems of weed spp. in (one year after pruning) a field in plucking and the weight of the rhizomes were analysed.

Treatments	*Least square mean*
T1 - 2% Glyphosate + kaolin 2.5 kg ha^{-1}	1.21
T2 - 2.5% Glyphosate + kaolin 2.5 kg ha^{-1}	5.05
T3 - 4% Glyphosate + kaolin 2.5 kg ha^{-1}	7.36
T4 - Bihedonol 3l ha^{-1}	5.00
T5 - Bihedonol 5l ha^{-1}	6.86
T6 - Basta 3l ha^{-1} + Diuron 2.4 kg ha^{-1}	10.79
T7 - Paraquat 1.1l ha^{-1} + Diuron 2.4kg ha^{-1}	6.13
T8 - Control	29.30
R-Square = 0.92	

The results showed that T1 and T4 were superior than the other treatments.

Though 2% Glyphosate + 2.5 kg kaolin or Bihedonol 3l ha^{-1} gave successful control of *Andredera basseloides* it cannot be applied in tea as it gets accumulated in the bark. Therefore, the following measures are recommended to mitigate the problem of these two spp:

> Remove the weeds with yams as much as possible and do not dump them all over the field as there is a possibility of regeneration from the yams and/or propagules. Special care should be taken to compost these weeds.
>
> The above herbicide screening on *Andredera basseloides* was terminated.

M.S.D.L. de Silva

6.5. The following weed specimens were added to the herbarium at St. Coombs.

Passiflora suberosa (Passifloraceae)
Cyclea burmanii (Menispermaceae)
Fragaria indica (Rosaceae)
Thunbergia alata (Acanthaceae)
Browallia viscosa (Solanaceae)
Hydrocotyle javanica (Umbelliferae)

6.6. Residue studies of Sulphosate

N - (phosphonomethyl) glycine residue levels in processed tea

A study on residue level of sulphosate was carried out in 2 smallholdings in Manikdiwela, Kandy during August-September. Four application rates at 0, 7 and 14 day intervals were tested. The results are presented in Table 14.

TABLE 14 - *N - (phosphonomethyl) glycine residue levels in processed tea*

Rate of application	*Days after application*	*PMG residue (mg kg^{-1}) Godogamuwa*	*PMG residue (mg kg^{-1}) Gonedeniya*
0	Control	< 0.05	< 0.05
1x0.66	0	0.17	0.24
1x0.66	7	0.06	0.06
1x0.66	14	< 0.05	< 0.05
1x1.32	0	0.31	0.19
1x1.32	7	0.07	0.08
1x1.32	14	0.05	0.05
1x2.64	0	0.85	0.47
1x2.64	7	0.16	0.11
1x2.64	14	0.10	0.06
1x5.28	0	0.11	1.20
1x5.28	7	0.17	0.20
1x5.28	14	0.16	< 0.05

A.P.D.A. Jayasekera.

7. Project D/AGRY - *Divisional Activities*

7.1 Earthworm culture

7.1.1. *Effect of inoculation of earthworms on yield of tea, Galphele Estate, Panwila-(1995)*

The following treatments were applied.

Treatments:

T1 - 600 earthworms per plot (36 tea bushes) + T 750 fertilizer at the recommended rate

T2 - T 750 fertilizer at the recommended rate

Design : Paired test with 7 replicates.

Yield was recorded to compare the effect of earthworms + fertilizer and fertilizer alone. The yield data during 2nd year after treatment application is presented in Table 15.

TABLE 15 - *Effect of inoculation of earthworms on yield of* tea

Treatments Critical	*Mean yield (made tea kg ha^{-1})*	*t Calculated (two tail)*
T1 - 600 earthworms + T 750	3190	0.1982
T2 - T 750 fertilizer	2844	2.160

The results indicate that inoculation of earthworms had no significant effect on yield. This experiment is in progress.

7.1.2. *The role of earthworms in decomposition of commonly used mulching materials, Galphele Estate, Panwila- (1995)*

This experiment was carried out to investigate the influence of earthworms on the decomposition of mulching materials.

Treatments:
T1: 200g air dried Mana in nylon mesh bags with 7mm openings
T2: 200g air dried Gautemala in nylon bags with 7mm openings
T3: 200g air dried Mana in nylon mesh bags with 0.5mm openings
T4: 200g air dried Gautemala in nylon bags with 0.5 mm openings

Mass loss of mulching materials were taken to ascertain the decomposition rate and results are presented in Table 16.

TABLE 16 - *Mean dry mass (g) of grass remaining in nylon mesh bags (1 - 8 months)*

Month	*T1*	*T2*	*T3*	*T4*	*CV (%)*
Nov. 95	200.00	200.00	200.00	200.00	
Dec. 95	192.23a	192.81c	130.43c	152.43b	0.47
Jan. 96	39.15c	35.15c	92.18a	55.32b	5.21
Feb. 96	25.26c	22.92c	73.08a	44.50b	5.49
Mar. 96	24.69c	16.07d	66.13a	35.52b	2.63
Apr. 96	15.61c	11.06c	58.76a	26.90b	8.14
May 96	9.57c	1.65d	22.88a	21.87b	3.43
Jun. 96	1.00c	1.08c	18.22a	13.01b	1.36

Decomposition rate of grass loppings was higher in earthworm worked soil and the decomposition rate of Mana grass was low than the decomposition rate of Gautemala grass.

7.1.3. *Effect of earthworm casts on growth of tea plants, Hantane substation*

Treatments:

T1 - 75 g casts per plant
T2 - 150 g casts per plant
T3 - 250 g casts per plant
T4 - T200 at the recommended rate

Design : RCBD with 4 replicates

This experiment was started in 1 x 1 x 3 m cement tanks to investigate the effect of earthworm casts on growth of tea plants. The growth and dry matter assessments taken 12 months after planting are presented in Tables 17 and 18 respectively.

TABLE 17 - *Effect of earthworm casts on growth of tea*

Treatment	*Increase in plant height (cm)*	*Increase in girth (cm)*	*No. of roots*	*Length of the longest root (cm)*	*No. of leaves*
75g casts	30.92	2.56	23	27.5	33
150g casts	44.38	3.28	24	28.0	36
250g casts	54.78	3.85	29	28.5	53
T200 fert.	42.15	3.01	27	28.3	44
CV (%)	45.56	23.08	16.31	15.21	31.97

TABLE 18 - *Effect of earthworm casts on dry matter production*

	Dry weight (g)				
Treatment	*Roots*	*Leaves*	*Main stem*	*Side shoots*	*Plant*
75g casts	5.49	5.5b	4.40b	0.94b	16.35b
150g casts	5.23	6.69b	5.08ab	0.92b	18.22b
250g casts	8.32	11.08a	11.18a	2.66a	34.89a
T200 fert.	5.56	7.34b	7.34ab	0.86b	18.48b
CV (%)	40.48	34.20	34.20	51.51	25.15

The results indicate that treatment with 250g earthworm casts per plant enchanced growth than the other treatments.

This experiment is in progress.

7.1.4. *Effect of inoculation of earthworms on growth of tea plants, Hantane substation*

This experiment was started in 1 x 1 x 3 m cement tanks.

Treatments :

T1 - Inoculate 100 earthworms per tank + tea fertilizer at the recommended rate.

T2 - Tea fertilizer at the recommended rate.

Design: Paired t test with replicates.
The results of the second destructive sampling are presented in Table 19.

TABLE 19 - *Effect of inoculation of earthworms on growth of tea*

	Treatments			
	T1	*T2*	*Calculated*	*Critical (two tail)*
Increase in plant height (cm)	37.8	36.64	0.0507	2.306
Increase in girth (cm)	2.71	2.18	0.8172	2.306
No. of roots	167.2	130.8	0.1063	2.306
No. of leaves	41	32	0.7074	2.306
Length of longest root (cm)	30.2	29.7	0.1224	2.306
Dry wt.of roots (g)	4.05	3.49	0.4891	2.306
Dry wt. of side shoots (g)	1.09	1.02	0.1105	2.306
Dry wt. of main stem (g)	4.78	5.39	0.4153	2.306
Total dry wt. (g)	16.7	15.85	0.0209	2.306

There was no significant difference between treatments. This experiment is in progress.

R.M.S.S. Rajapakse

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

This experiment was carried out to investigate the influence of earthworms with and without compost on yield of tea.

Treatments:

T1 - Inoculate earthworms with mana, compost 8000 kg ha^{-1} $annum^{-1}$ and tea fertilizer at recommended rate.

T2 - Inoculate earthworms with compost 8000 kg ha^{-1} $annum^{-1}$ and tea fertilizer at recommended rate.

T3 - Inoculate earthworms with mana and compost 8000 kg ha^{-1} $annum^{-1}$.

T4 - Inoculate earthworms with mana and tea fertilizer at recommended rate.

T5 - Inoculate earthworms with mana.

T6 - Mana, compost 8000 kg ha^{-1} $annum^{-1}$ and tea fertilizer at recommended rate.

T7 - Compost 8000 kg ha^{-1} $annum^{-1}$ and tea fertilizer at recommended rate.

T8 - Mana and compost 8000 kg ha^{-1} $annum^{-1}$.

T9 - Mana and tea fertilizer at recommended rate.

T10- Tea fertilizer at recommended rate.

The yield data obtained for the 6 month period after treatment application is presented in Table 20.

TABLE 20 - *Effect of earthworms with and without compost on yield of tea*

Treatment	*Yield (made tea, kg ha^{-1})*
T1	1118
T2	1116
T3	1072
T4	1047
T5	823
T6	900
T7	954
T8	800
T9	987
T10	910
CV (%)	19.69

There was no difference between any of the treatments.

R.M.S.S. Rajapakse and J.C.K. Rajasinghe

7.1.6. *Identification of earthworms*

Earthworms were sampled in the following locations.

Sampled locations:

Hantane substation, Kandy
Anninkanda Estate, Deniyaya
Galphele Estate, Panwila
St. Coombs Estate, Talawakele
Gonakele Estate, Passara
St. Joachim Estate, Ratnapura

The specimens were identified by the Department of Zoology, University of Peradeniya as follows;

a)
Phylum	:	Annelida
Class	:	Oligochaeta
Order	:	Haplotaxda
Sub order	:	Limbricina
Sub family	:	Glossoscolecidae
Genus	:	*Pontoscolex*
Species	:	*Pontoscolex corethrurus*

This species was found in St. Joachim Estate, Anninkanda Estate, Hantane substation, St. Coombs Estate and Gonakelle Estate.

b)
Phylum	:	Annelida
Class	:	Oligochaeta
Order	:	Haplotaxda
Sub order	:	Lumbricina
Super family	:	Eudrilidae
Sub family	:	Eudrilinae
Genus	:	*Eudrilus* [Perrier]
Species	:	*Eudrilus eugeniae* [Michaelsan (1900)]

This is a dominant epigeic species.

c)
Phylum	:	Annelida
Class	:	Oligochaeta
Order	:	Haplotaxda
Sub order	:	Lumbricina
Super family	:	Megascolecidae
Family	:	Acanthodrilidae
Genus	:	*Perionyx* [Perrier (1905)]
Species	:	*Perionyx excavatus*

This species is a well developed elogeoc (litter decomposing) earthworm.

d) Phylum : Annelida
Class : Oligochaeta
Order : Haplotaxda
Sub order : Lumbricina
Super family : Megascolecidae
Genus : *Pheretima* [Kingberg (1905)]
Species : (1) *Pheretima elongata* [Bahl 1956]
(2) *Pheretima hawayana* [Bahl 1957]
(3) *Pheretima pasthuma* [Bahl 1960]
(4) *Pheretima taprobania* [Bahl 1960]

These species are endemic species.

D.H.J.W.K. Samaranayake and R.M.S.S. Rajapakse

7.2. Effect of bud breaking agent, hydrogen cyanamide (Dormex) on yield of tea

A series of trials were conducted in which the plant growth regulator, hydrogen cyanamide or 'Dormex' (containing 49% a.i.) was sprayed after pruning onto the pruned frames at 0, 1%(1 l Dormex in 100 l water i.e.5 l in 500 l water ha^{-1}) and at 2%. The bushes more drenched thoroughly using kanapsack sprayers.

7.2.1. *Up-country, Talawakele (1382 m amsl) St. Coombs Estate, Talawakele, Field No: 7*

Spraying was done on 1) day of pruning (21.04.95) and 2)three days after pruning(24.04.95) on clones TRI 2025 and DT1. The treatments were replicated three times and there were 100 bushes per plot.The design was of the split plot type. The yield obtained in the first year (Nov.95 to Oct.96) is presented in Table 21.

TABLE 21 - *Effect of Dormex on yield of tea (kg made tea ha^{-1})*

Treatments	*Yield*	*% increase over control*
Clone TRI 2025		
T1 Unsprayed control for DOP	1575	
T2 Sprayed on DOP at 1%	1830	16
T3 Sprayed on DOP at 2%	1715	09
T4 Unsprayed control for 3 DAP	1536	
T5 Sprayed 3 DAP at 1%	1756	14
T6 Sprayed 3 DAP at 2%	1694	10
Clone DT1		
T1 Unsprayed control for DOP	1871	
T2 Sprayed on DOP at 1%	2011	7

T3 Sprayed on DOP at 2%	2127	14
T4 Unsprayed control for 3 DAP	1770	
T5 Sprayed 3 DAP at 1%	2072	17
T6 Sprayed 3 DAP at 2%	1880	6
LSD(P=0.05)	211	
CV(%)	14	

Note: DOP = Day of pruning ; DAP=Days after pruning

A.Kathiravetpillai, and U.P. Abeysekara

7.2.2. *Mid- country, Kandy (762 m amsl)*

7.2.2.1 *Hantane Estate, Hantane , Factory Division, Field No.7(seedling tea)*

7.2.2.2 *Galphele Estate , Panwila , Field No. 9A (clone TRI 2023)*

Dormex was sprayed on 1) day of pruning (18.5.95 at Hantane and 18.8.95 at Galphele) and 2) seven days after pruning (25.5.95 at Hantane and 25.8.95 at Gaphele). The design was of the RCBD type with treatments replicated five times. There were 100 and 50 bushes per plot respectively at Hantane and Gaphele.Table 22 presents the yield obtained in the first year (Oct.95 to Sept. 96 at Hantane and Dec.95 to Nov.96 at Galphele).

TABLE 22 - *Effect of Dormex on yield of tea (kg made tea ha^{-1})*

Treatments	*Hantane*	
	Yield	*% increase over control*
T1 Unsprayed control for DOP	1176b	
T2 Sprayed on DOP at 1%	1352ab	15
T3 Sprayed on DOP at 2%	1411a	20
T4 Unsprayed control for 7 DAP	1179b	
T5 Sprayed 7 DAP at 1%	1451a	23
T6 Sprayed 7 DAP at 2%	1411a	20
CV(%)	7.6	

Treatments	*Galphele*	
	Yield	*% increase over control*
T1 Unsprayed control for DOP	3893b	
T2 Sprayed on DOP at 1%	4448a	14
T3 Sprayed on DOP at 2%	4272ab	10
T4 Unsprayed control for 7 DAP	3947b	
T5 Sprayed 7 DAP at 1%	4181ab	6
T6 Sprayed 7 DAP at 2%	4101ab	4
CV(%)	12.5	

Note: DOP = Day of pruning ; DAP=Days after pruning
Means followed by the same letter are not significantly different from each other

A.Kathiravetpillai, A.P.D.A. Jayasekera and S.N.Wijesekara

7.2.3. Low country , Galle (30 m amsl)

7.2.3.1. *TRI substation , Talgampola, Field No. 7.*

Dormex was sprayed on 1) day of pruning (22.06.95) and 2) seven days after pruning (29.06.95) on clone TRI 2027 , The design was of the RCBD type with treatments replicated five times. There were 40 bushes per plot. The yield obtained in the first year (Nov. 95 to Oct. 96). is given in Table 23.

TABLE 23 - *Effect of Dormex on yield of tea (kg made tea ha^{-1})*

Treatments	*Yield*	*% increase over control*
T1 Unsprayed control for DOP	3250	
T2 Sprayed on DOP at 1%	3564	10
T3 Sprayed on DOP at 2%	3492	7
T4 Unsprayed control for 7 DAP	3269	
T5 Sprayed 7 DAP at 1%	3822	17
T6 Sprayed 7 DAP at 2%	3515	8
LSD(P=0.05)	481	
CV(%)	10	

Note: DOP = Day of pruning ; DAP=Days after pruning

A.Kathiravetpillai, J.A.S.K.V. Jayasinghe and P.K.Jayawickrema

8. Meetings/Seminars

Dr A. Kathiravetpillai and Ms. R.M.S.S. Rajapakse addressed the RSC Kandy on 'Shade management in mid-grown tea' and 'Earthworms in tea plantations' respectively at a seminar held in Hantane on 29th March.

Mr P.B. Ekanayake addressed or attended the following:

Addressed the RSC Galle along with Ms. R.M.S.S. Rajapakse on 'Weed management in tea lands' and 'Earthworms in tea plantations' respectively at a seminar held in Galle on 26th January.

Attended a workshop on 'SALT' held at the Auditorium, National Builders, Kundasale on 23rd April.

Addressed the RSC, Kandy on 'Intercropping in tea lands' at a seminar held in Kandy on 17th July.

Presented a paper on 'Use of glyphosate in tea lands' at a seminar organised by Monsanto Ltd. on 5th August.

Presented a paper on 'Improvement of degraded soils in tea plantations of mid-country' at a seminar held at the SLAAS Auditorium on 30th August.

Addressed the 7th MPTS Workshop on 'Tea and food security' on 24th October.

Attended a workshop on 'Farming Systems' along with Dr. M.A. Wijeratne and organized by the International Rubber Research Board held at Beruwela on 4th and 5th November.

Dr. M.A. Wijeratne addressed seminars on 'Soil management', 'Rehabilitation', 'Harvesting' and 'Pruning' at RSC meetings held in Kandy, Galle, Maliboda, Sapumalkande and Bogawantalawa.

He also presented a paper on 'Prospects, constraints and strategies' at a Workshop on 'Development of Agriculture in Ruhuna held at the University of Ruhuna, Kamburupitiya on 5th October.

Mrs. J. Balasuriya addressed Managers of Maskeliya Planatations Ltd., on 'Harvesting based on phyllochron' at a seminar held on 15th October.

She also attended a series of workshops on 'Biodiversity Skills Enhancement' organised by the March for Conservation, IVCN and the Ministry of Transport, Environment and Women's Affairs.

Ms. M.S.D.L.de Silva addressed NIPM trainees on "Weed management in tea plantations" on 21st November and 19th December.

Ms. R.M.S.S. Rajapakse addressed the Superintendents/Asst. Superintendents of Namunukula Plantations Ltd., on 'Improving soil fertility by introduction of earthworms' on 21st August.

Mr. A.R. Amerasekere attended a workshop on 'Participatory Rural Appraisal' held in Nuwara Eliya from 27th to 31st May.

9. Overseas Visit

Dr. M.A. Wijeratne presented a paper on 'Tea Industry' at an International Conference on 'Climate change in Asia and the Pacific' in Manila, Philippines held from 15 - 19 January.

10. Publications

AMERASEKERA, A.R., and KATHIRAVETPILLAI, A. (1995). Multipurpose uses of shade trees in tea plantations. Proceedings of Multipurpose Tree Species in Sri Lanka - Development of Agroforestry Systems.

EKANAYAKE, P.B. (1996). Hedgerows for machines. TRI Update, 1 (1), January 1996.

EKANAYAKE, P.B. (1996). Biological control of cooch grass. TRI Update, 1 (3), December 1996.

WIJERATENE, M.A. (1996). Vulnerability of Sri Lankan tea production to global climate change. Water, Air and Soil Pollution, 92, 87 - 94.

WIJERATNE, M.A. (1996). Some adaptations of the tea plant to dry environments. pp. 174 - 187. In 'Adapting to climate change: An International Perspective', eds. J.B. Smith, N. Bhatti, G. Menzuhulin, R.Benioff, M.I. Budyko, M. Compos, B. Jallow, F. Fijsberman, Springerverlag, New York Inc.

WIJERATNE, M.A. (1996). Plucking strategies. TRI Update, 1 (1), January 1996.

BIOCHEMISTRY DIVISION

Acting Head - I.S.B.Abeysinghe

1. General

Dr N.L. Herath, relinquished the post of Head, Biochemistry Division w.e.f 24th February.

Mr H. Jayaweera was promoted to the position of Experimental Officer (Grade 1V) w.e.f. 1st June.

Mrs B.W.S.Kariyawasam, Research Officer, and Ms. P.S.F. Perera, Technical Assistant, resigned from the services of the Institute w.e.f 1st and 31st December respectively.

Mr A. M.T. Amarakoon, Research Assistant, completed the local research component of his post-graduate programme and left for the UK on 8th May to continue his Ph.D. programme based on the "Therapeutic properties of black tea constituents to human health" at the Dept. of Human Nutrition of the University of Southampton, UK.

Dr I.S.B.Abeysinghe served as a member of the Committee appointed by the Ministry of Plantation Industries on Quality, Standards and Grades of tea produced and exported by Sri Lanka. He also served as a member of the Technical Committee on Tea appointed by the Sri Lanka Standards Institute for the preparation of the forthcoming 17th Committee meeting of the ISO/TC34/SC8.

Ms. P.Vasanthy, undergraduate from the University of Jaffna completed her research project in February 1996. Mr G. G. Waruna, NDT trainee underwent a training from March to July 1996 in the Division. Ms Anoma Abeykoon an undergraduate from the Faculty of Agriculture, University of Peradeniya commenced her research project in November 1996.

2. Project B/PDEV - *Product Development*

Project Leaders - I.S.B.Abeysinghe and A.C.Liyanage

2.1. Attempts to improve the tea character of the TRI formulated hot water soluble instant tea

This project has been resurrected with various combinations of withered leaf and BOP as the starting material. A desirable product was obtained when 10% withered leaf was used with 90% BOP in the initial extraction. The tasters remarks on this product as against the instant tea made with 100% BOP were favourable.

A .C. Liyanage, H. Jayaweera, M.W.Silva and I.S.B. Abeysinghe

2.2. Attempts to increase the soluble solid content in the TRI formulated liquid tea concentrate

A dilution ratio of 1:6 was achieved. When stored at room temperature and at 4°C to study the stability of the product, a precipitate was observed within a couple of weeks. Experiments are being carried out to overcome this problem.

A.C.Liyanage, H.Jayaweera, M.W.Silva and I.S.B.Abeysinghe

3. Project D/BIOC - *Divisional Activities*

Project Leaders - I.S.B.Abeysinghe and A.C.Liyanage

3.1. Studies on the interaction of tea with milk

In the tea trade it is well known that teas of certain marks interact better with milk than others thereby fetching higher prices. Experiments were initiated to find out the reasons/factors responsible for the interaction of milk with tea.

Samples were collected from tea brokers and the opinion of professional tea tasters were obtained in respect of the interaction of these samples with milk thereafter, these were categorized as those which take milk well and those that do not. The samples were analysed for chemical parameters such as total polyphenols, theaflavins,(TF) and thearubigins (TR). The results of these analyses are given in Tables 1 and 2.

From these results it is clear that samples which interact well with milk contain higher amounts of total polyphenols, TF and TR than those which do not interact well with milk thereby indicating that the higher the total polyphenol content the higher the interaction with milk. In the *Annual Report for* 1995 we reported that the binding properties of oxidised polyphenols such as TF with a - casein and ß - casein is much greater than TR's.When TF and TF gallates are considered, ITF have stronger binding properties than TFMG and TFDG.

It is observed that underfermented teas from the Nuwara Eliya region also take milk well indicating that even unoxidised polyphenols such as catechins may have strong binding properties similar to TF's. Experiments are under way to find out the nature of the unoxidised polyphenols responsible for interaction with tea.

TABLE 1- *Chemical parameters of the samples that takes milk well*

Sample	*TP mgg^{-1}*	*TF%*	*TR%*
JK30	221.0	1.22	15.84
JK31	206.2	1.24	17.41
JK39	210.6	1.52	16.65
JK42	226.6	1.24	16.88
JK43	217.1	1.42	16.30
JK44	221.4	1.38	15.00

TABLE 2-*Chemical parameters of samples that do not take milk well*

Sample	*TPmg/g*	*TF%*	*TR%*
JK13	195.4	0.91	12.12
JK14	195.8	1.05	14.50
JK45	190.2	1.05	14.90
JK79	206.7	1.00	13.50
JK80	190.2	1.82	8.99
Strathspy	194.1	-	-

TP=Total Polyphenols, TF=Theaflavins, TR=Thearubigins

I.S.B. Abeysinghe and H.Jayaweera

3.2. Chemical/ biochemical method in the control of the Shot-hole Borer *(Xyleborous fornicatus).* in the tea plant

As part of the ongoing studies on the control of the SHB experiments were carried out to find out the relationship between polyphenols and caffeine.

The polyphenol content of tea bark was shown to be greater than that of the stem wood. While the healthy tea stem of clone TRI 2025 had a greater polyphenol content than the infected one, similar differences were not seen between healthy and infected clone TRI 2023. Polyphenols of tea stems seemed to have some antifungal effect. When mixed with caffeine, polyphenols did not reduce its inhibitory effect on fungal growth.

The caffeine content of infected stems of tea was found to be higher than that of healthy stems. The highest concentration was found in infected stems and the lowest in healthy stems. The difference in caffeine content between healthy and infected stems of clone TRI 2025 was much less than that in the more resistant clone TRI 2023.

Since caffeine content of both clones was much higher than the concentration which inhibits growth of the fungus, a search was made for a factor which could reduce caffeine activity. The effect of tannic and on the antifungal activity was studied Although tannicand was found to show lower anti-fungal activity than caffeine, the presence of tannic and lowered the anti-fungal activity itself. No activity was observed at a polyphenol: caffeine ratio of 2:1. It was also shown that the inhibition of sporulation by caffeine was decreased by adding polyphenols, inhibition being least at the above polyphenol:caffeine ratio. However caffeine:polyphenol mixtures showed only their individual peaks in HPLC, suggesting that inhibition of caffeine activity by polyphenols did not involve the formation of a tightly bound complex.

The crude saponin mixture from tea stems was shown to have no effect on the growth of the ambrosia fungus, spore germination increasing in comparison with control. The effect of saponins on the beetle development was studied by incorporating saponin into the growth medium. No clear differences between control and treated were observed in the number of emerging females.

I.S.B. Abeysinghe, V. Kumar and S. Kumar

3.3. Identification and use of semio chemicals in the tea plant

A project was initiated to find out the volatile chemicals present in tea which might attract or repel Shot- hole Borer beetle with a view to using these volatiles in the control of SHB damage. For this study Attampitiya Estate, Bandarawela and St. Coombs Estate, Talawakele were selected.

Initially for the analysis, infested and uninfested stem and leaf samples from TRI 2025 (susceptible), TRI 2023 (tolerant) and *Grevillia robusta* were collected from these estates. These samples were extracted in dicloromethane and analysed for volatile chemicals using a Gas Chromatograph (GC). GC profiles of the infected and uninfected samples were different and there were 4 unidentified compounds present in the infected samples. Five of the volatiles present in bark and leaves were identified using authentic samples. For the identified compounds olfactory studies are being carried out in the Entomology Division.

This is a collaborative project with the Entomology Division.

I.S.B.Abeysinghe and J.Jayasundara

3.4. Development and the application of the isozyme technique for the identification of tea clones

Conditions for the extraction of tea leaves have been optimised and several gel/electrode buffers have been tried out. Tris citrate/lithium borate pH 8.3 buffer systems gave the best resolution. Initially eight enzyme systems were tested on clone 2025, esterase, acid phosphatase (Acph), aspartate amino transferase (AAT), leucine amino peptidase (LAP), alcohol dehydrogenase (ADH), malate dehydrogenase. Except for ADH the rest of the enzyme systems produced bands.

Clones 2025, 3015 and 4052 were tested with esterase and AAT to check if there is a variation within a clone. For the loci under reference, it appeared that there was no somoclonal variation.

The above enzyme systems were tested on fifteen clones: Yabukita, Assam 4/10, Sasanqua, DT1, DN, K145, 2025, 2023, 2024, 3015, 3016, 3069 4006, 4052 and 777. LAP did not show any polymorphism. Peroxidase appeared to be monomeric. Polymorphism was seen to a certain degree with esterase, Acph and AAt. However, these results need to be confirmed. GPI showed very distinct polymorphism. The clones with similar banding pattern with GPI could be grouped in the following manner; Assam, 2024; 2025, 3069, 3020, 4006; 3015, 3016, DT1, DN, K145; Yabukita; 4052; 2023; 777. There was no response to MDH.

A few other clones were tested for GPI. These clones too showed very distinct polymorphism. They could be grouped in the following manner according to the banding pattern. Yabukita; 4078, 3072/ 3047, 3048/ 3013, 3049, 4071, 4079.

This project is funded by the Council of Agricultural Research Policy.

A.C.Liyanage and P.S.F.Perera

3.5 Studies on the flavour profiles of Uva seasonal teas

Seventeen estates from the Uva region were selected for the purpose of constructing an aroma profile for the Uva region. Samples were collected from these selected estates weekly during the period June-September and analysed for aroma profiles using a Gas Chromatograph. The analysis of the results are presently in progress.

I.S.B.Abeysinghe and J.Jayasundera

3.6 Clonal effect on the manufacture of Uva and Dimbulla seasonal teas.

It is a well known fact that the clonal response (especially in relation to quality) to extreme environmental conditions prevailing during the Uva and Dimbulla quality season is different. In order to study the climatic effect on Uva seasonal teas a project was initiated at Uva Highlands Estate Bandarawela on clones TRI 2025 and TRI 2024.

Climatic conditions such as air temperature, humidity,wind speed, radiation, soil temperature prevailing during the Uva quality season was monitored using an automated weather station.

Green leaf from TRI 2025 and TRI 2024 were collected weekly and transported to the Technology Division, TRI, Talawakele where miniature manufacture was carried out. Made tea samples were graded and the grade BOP was used for the analysis of the aroma profile using a Gas Chromatograph. The Quality Index for these samples was calculated using the following formula.

$$\text{Quality Index (QI)} = \frac{\text{Linalool content}}{\text{Trans 2-hexenal content}}$$

Results of the analysis for Uva Highlands and for St.Coombs are given in Tables 3 and 4 respectively.

For St. Coombs it is seen that under the prevailing weather conditions during the quality season, clone TRI 2025 performed much better than TRI 2024 as far as the flavour was concerned. But for the Uva region both clones performed equally well during the quality season. From these results it is evident that under stress conditions TRI 2025 performed better than TRI 2024 in both the Dimbulla as well as Uva areas.

TABLE 3- *Quality indices for TRI 2025 and TRI 2024 for St.Coombs Estate, Talawakele*

Week	*TRI 2024* QI	*TRI 2025* QI
1	0.23	0.44
2	0.39	0.70
3	0.27	0.42
4	0.24	0.66
5	0.22	0.39
6	0.15	0.49
7	0.16	0.43
8	0.16	0.40
9	0.16	0.21
10	0.19	0.46
11	0.28	0.38
12	0.14	0.22
13	0.13	0.27

TABLE 4- *Quality indices for TRI 2025 and TRI 2024 for Uva Highlands Estate, Bandarawela*

Week	*TRI 2024*	*TRI 2025*
1	1.35	1.09
2	0.91	0.81
3	1.00	1.69
4	1.04	0.97
5	0.99	1.43
6	0.76	0.77
7	0.66	0.84
8	0.74	0.50
9	0.55	0.59

I.S.B.Abeysinghe and J.Jayasundera

3.7. Effect of foliar application of phosphorus on the quality of made tea.

Experiments were continued in order to study the effect of foliar application of phosphorous on plant phosphorous status, the quality of made tea and its effect on clone and their effect on clonal improvement in terms of black tea quality. Two different sources of P (TSP and DAP) and rates (2% and 4%) were used. Water spray was the control and the clones used were CY9 and DT1.

The quality of the made tea was assessed by analysing its liquor characters, desirable flavors and organoleptic properties after the 1st, 2nd and 3rd week of application.Tables 5 and 6 give the quality parameters for clones DT1 and CY9 after 2 weeks of foliar applications.

TABLE 5 - *Quality parameters in clone CY 9 two weeks after foliar application*

Treatments	*TF%*	*TR%*	*TC*	*QI*
2% DAP	1.00	13.21	2.64a	0.42a
4% DAP	0.95	12.99	2.80ba	0.43ba
2% TSP	0.99	12.47	2.65ba	0.55bc
4% TSP	0.83	12.03	2.30ba	0.48c
Control	0.67	11.01	2.47b	0.53c
LSD(P=0.05)				
CV%	23.2	7.50	5.33	24.5

TABLE 6 - *Quality parameters in clone DT1 two weeks after foliar application*

Treatments	*TF%*	*TR%*	*TC*	*QI*
2% DAP	1.00	12.12	2.62a	0.43a
4% DAP	1.32	15.48	3.70ba	0.55ba
2 % TSP	1.06	12.42	3.49ba	0.37bc
4% TSP	0.95	10.44	3.17ba	0.41bc
Control	1.00	11.22	2.78b	0.61c
LSD(P=0.05)				
CV%	34.5	14.7	10.8	3.21

I.S.B. Abeysinghe, J. Jayasundara and H. Jayaweera

Last year we reported that for clone DT1, 4%DAP treatment gave the most desirable quality characteristics compared to the other treatments. From the above results it can be seen that after the second week of foliar application significant differences were observed for total colour in clone CY9; 4% DAP treatment gave the highest value for total colour and it is significantly different from 2% DAP, 2%TSP, 4%TSP and the Control. Similar observations were made for clone DT1 suggesting that foliar application of 4% DAP may increase the colour of the liquor after 2 weeks of application. Further work is in progress to confirm these observations.

4. Meetings/Seminars

Dr (Mrs) A.C.Liyanage addressed the RSC 2 seminar on the 'Study of the changes of polyphenol oxidase and peroxidase activity during drying and storage of tea' on 16th March at the Darawella club.

Dr.I.S.B. Abeysinghe attended an International seminar on 'The problems of monitoring the pesticide residue in exportable commodities viz. rice, tea, fish and minor crops' held in Colombo from 4th to 9th April.

Dr I.S.B Abeysinghe and Dr (Ms)A.C.Liyanage attended a Biotechnology Working Group Meeting at CRI, Lunuwilla on 19th September.

Dr I.S.B Abeysinghe and Dr (Ms)A.C.Liyanage attended a Biotechnology Conference at NARESA on 20th September.

Ms J. Jayasundara and Ms P.S.F.Perera attended a national workshop on 'Separation Techniques and Spectroscopy in Organic Chemistry' at the Institute of Fundamental Studies Kandy from 31st October to 1st November.

Dr I.S.B.Abeysinghe attended an International Symposium on 'Bioactive Natural Products' in Kandy from 11th to 15th November.

Dr (Ms)A.C.Liyanage and Ms J. Jayasundara attended the 6th Annual Congress of the PGIA held in Kandy from 21st to 22nd November.

5. Overseas Visits

Dr N.L.Herath completed his sabbatical leave in Japan in February 1996.

ENTOMOLOGY DIVISION

Actg. Head - Sushila I. Vitarana

1. General

A Task Force for Integrated Pest Management of Shot-hole Borer was set up in July and its research activities were identified along with the principal investigators for each activity.

Mrs I.Aladeniya, Experimental Officer, continued at her temporary posting as Promotion Assistant, Ceylon Tea Bureau, London, on secondment basis for the third year in succession.

Mr K.M.Mohotti, Research Assistant, returned to the island in February to commence the local project component of his split-program of studies leading to a PhD.

Mrs S.I.Vitarana served on the organizing committee of the International Seminar and on "Problems involved in Monitoring of Pesticide Residues in exportable commodities viz. Tea, Rice, Fish and Minor Export Crops", held in Colombo from 4th to 9th April, jointly organized by the Commonwealth Science Council and NARESA.

Mrs Vitarana continued to represent the Director on the National Pesticides Technical and Advisory Committee and also, served as the TRI co-ordinator for Agricultural Research Project of Council of Agricultural Research Policy of Sri Lanka.

Mrs Vitarana continued to function as the Convenor/Secretary of the Consultative Committee on Estates and Advisory and Extension Services of the institute.

She also, functioned as the TRI coordinator for the 8th Diploma course of the Plantation Management Course of the National Institute of Plantation Management.

Mrs S.M.Nagahaulla, Research Officer, returned to the island in July to commence the local component of her studies leading to a PhD.

Ms S.M.Samarasinghe, Experimental Officer, continued with her practical project of the MPhil program.

Dr L. D. Amarasinghe acted for the Head of the Division from 18th October to 31st December when Mrs Vitarana underwent a training abroad in Advanced Techniques in Nematology at the Institute of Nematology of National Research Council of Italy. Mrs Vitarana also visited "Koppert BV",Rotterdam and the University of Amsterdam and held discussions with their Acarologists on the usage of bio-control agents of tea mites and the Bayer Crop Protection Centre, Monheim, Germany to discuss substitutes for methyl bromide as a nematicide.

It is with deep regret that we record the demise of Mr W A M Dharmasena on 10th October. He joined the institute as a Technical Assistant in the Entomology Division in 1964 and served in four stations during a tenure of 32 years of service working in both the Entomology and Nematology Divisions. At the time of his death he was an Experimental Officer in Grade III.

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

Project Leader - Sushila I. Vitarana

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

The objective of this programme is to screen new release clones against the different species of nematodes that cause damage to tea. This is a continuous programme with different batches of clones being testeo each year.

2.1.1. N 1 A - *Screening TRI 4000 series 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 -(1996)*

(16 treatments x 4 replicates in Randomized Complete Block Design, Nematology Experimental Area, TRI, Talawakele)

Thirteen test clones and three standards namely TRI 2024 (susceptible), TRI 2025 (tolerant) and DT 1 (resistant) were being raised in the nursery for planting in infested soil. The test clones included: TRI 4002, 4003, 4004, 4005, 4014, 4015, 4019, 4024, 4042, 4047, 4053,4088,and 4089.

The screening proper is scheduled to commence in January 1997; the experimental beds were planted with TRI 2024 to build up the nematode population.

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

2.1.2. N 1 B - *Screening TRI 4000 series clones against the Burrowing nematode, Radopholus similis with reference to build up of nematode population in root and soil and growth of tea plant (1994)*

(16 treatments x 6 replicates in RCBD, TRI Mid country Station, Hantane)

Anthurium plants were established in the fumigated experimental beds in the previous year.The beds were inoculated with pure lab cultures of *R.similis* in January for the third time and the nematode population allowed to build up.

The following test plants were being raised in the nursery at Talawakele: TRI 4002,4014,4020,4047,4048,4049,4051, 4052,4054, 4059 and TRI 2025 as the standard. Screening proper is scheduled for January 1997.

S.I.Vitarana, W.A.M.Dharmasena, U.B.Herath, B.Sureshkumar and G.P.Udumulla

2.2.A Nematicidal Agents

N 314 - *Adaptive Research Trial, Coccagalla Estate, Metigahatenna (in collaboration with the Advisory Officer, TRI Uva Station).*

An adaptive trial was conducted to evaluate whether proven nematicides could be used to eradicate nematodes in an already established tea nursery,if promising, this method could be used to salvage infested plants of large nurseries. The experiment was laid down at a nursery infested with *P.loosi;* the plants were 8-9 months old and exhibited symptoms of nematode damage. The following treatments were carried out on 6th February.

T1 = 'Suscon Fore" at 0.5 g per plant
T2 = 'Suscon Fore" at 1.0 g per plant
T3 = 'Suscon Fore" at 1.5 g per plant
T4 = "Nemacur" at 0.5 g per plant (repeated after 6 months)
T5 = "Nemacur" at 1.0 g per plant (repeated after 6 months)
T6 = "Nemacur" at 1.5 g per plant (repeated after 6 months)

Recovery from damage was monitored by observing shoot and root growth and disappearance of lesions in the roots (Table 1).

TABLE 1.- *Nematode counts in soil (100 g) and root (1.0 g) (average of 2 replicates) after treatment*

Treatment	*At 18 weeks*		*At 22 weeks*		*At 27 weeks*		*At 42 weeks*	
	Soil	*Root*	*Soil*	*Root*	*Soil*	*Root*	*Soil*	*Root*
T1	00	17	NP	NP	03	160	1.5	80
T2	85	269.5	NP	NP	62	387	31	194
T3	22	377	NP	NP	14	60	01	30
T4	00	29.5	00	33	02	00	01	00
T5	05	17	05	26	00	00	00	00
T6	00	13.5	00	00	00	00	00	00

NP - Not processed due to high counts at the previous assessment and as the plants showed obvious symptoms of damage

The plots receiving Nemacur at 1.5 and 1.0 g per plant showed zero counts of nematodes in the soil and in the roots from the 22nd and 27th weeks respectively:

'Suscon Fore' failed to bring about eradication of nematodes. Plants treated with 1.5 g Nemacur recovered from damage and exhibited normal growth by 27 weeks. (At this nursery the source of infection was the supply of water and corrective measures were suggested as in the case of the new nursery).

S.I.Vitarana, D.D.Liyanage, N.Navaratne and M.B.A. Perera

2.2.(B)To find substitutes for methyl bromide for eradication of plant parasitic nematodes with environmentally acceptable fumigants and biological control agents

2.2.1. N 315 - *Isolation of endemic biological control agents of tea nematodes and formulating methods of augmenting their activity*

This study was undertaken with a view to isolate endemic biological control agents of tea nematodes such as fungi, bacteria and soil micro-organisms. Laboratory cultures were initiated in December. This study is in progress

D.D. Liyanage, N. Navaratne and U.B.Herath.

2.3. Cultural Control

2.3.1. Studies on botanicals

The plant species earlier proved to be immune to *Pratylenchus loosi, Radopholus similis* and *Rotylenchulus reniformis* were screened to check for the presence of any nematicidal properties.

N 296 - *To test for nematicidal properties of non susceptible plants on Pratylenchus loosi -1994*

(10 treatments x 5 replicates, Nematology Experimental Area, TRI, Talawakele).

T1 - *Teckoma stans,*
T2 - *Cestrum nocturnum* (Queen of the night),
T3 - *Plectranthus zeylanicus* (Irriweriya),
T4 - *Piper longum* (Tippili),
T5 - *Kaempferia galanga* (Inguru piyali),
T6 - *Cajanus cajan* (ICPL 84045 & ICPL 87),
T7 - *Arachis* sp.,
T8 - *Hibiscus rosa sinensis*
T9 - TRI 2024
T10 - Fallow

The experiment was terminated after the final assessment and the results are given in Table 2.

TABLE 2 - *Nematode counts in non-host plants at end of one year from inoculation*

Plant species	*Nematode count (mean/plant)*	
	Root (1 g)	*Soil (100 g)*
Teckoma stans,	00	00
Cestrum nocturnum	00	00
Plectranthus zeylanicus	2.6	80.6
Piper longum	00	00
Kaempferia galanga	1.75	7.3
Cajanus cajan	78	3.25
Arachis sp.,	00	1.6
Hibiscus rosa sinensis	04	1.2
TRI 2024	24.9	38.4
Fallow	00	00

The results showed that *Teckoma stans, Cestrum nocturnum* (Queen of the night) and *Piper longum* ("Tippili") had nematicidal properties against *P.loosi*..

W.A.M.Dharmasena, G.P.Udumulla and B.Sureshkumar

N 297 - *To test for nematicidal properties of non susceptible plants on Radopholus similis -1994*

(9 treatments x 5 replicates, TRI, Talawakele)

T1 - *Teckoma stans,*
T2 - *Cestrum nocturnum* (Queen of the night),
T3 - *Plectranthus zeylanicus* (Irriweriya),
T4 - *Kaempferia galanga* (Inguru piyali),
T5 - *Cajanus cajan* (ICPL 87),
T6 - *Cajanus cajan* (ICPL 84045),
T7 - *Hibiscus rosa sinensis*
T8 - TRI 2025
T9 - Fallow

The results of this study are given in Table 03

TABLE 3-

Plant species	*Nematode count (mean / plant)*	
	Root (1 g)	*Soil (100 g)*
Teckoma stans	00	24.25
Cestrum nocturnum	00	00
Plectranthus zeylanicus	100	5.5
Kaempferia galanga	00	1.0
Cajanus cajan (ICPL 87)	00	0.6
Cajanus cajan (ICPL 4045)	60	40.0
Hibiscus rosa sinensis	00	00
TRI 2025	04	8.0
Fallow	-	00

The final assessment showed that *Teckoma stans, Cestrum nocturnum* and *Hibiscus rosa sinensis* had nematicidal properties against *R.similis.*

W.A.M.Dharmasena, U.B.Herath and A.K.Prematunga

2.3.2. - Studies on Soil ammendments alternatives to rehabilitation of land by grass to eradicate soil borne parasitic nematodes

N.316 - *Adaptive Research trial, Agrakanda Estate, Agrapatna*

An adaptive trial was initiated in a nematode infested abandoned land with the following treatments in a split- plot factorial design while mana grass was planted in another block of 2 ha for concurrent rehabilitation :

The experimental design is as follows :

2S x 2N x 4I, where,

S = the main treatments of soil amendments at planting
S_1 = Bottom 3/4 of hole filled with equal volumes of soil + decomposed tea refuse
S_0 = No soil amendment.

N = Nematicidal treatment,
N_0 = No nematicide
N_1 = Nemacur (7 g) in planting hole

I = Insecticidal treatment to control white grubs that are attracted to the organic matter in the planting hole
I_1 = Suscon Fore (2 g)
I_2 = Suscon Fore (3 g)
I_3 = Suscon Fore (4 g)
I_4 = Suscon Fore (5 g)

Planting of 2 ha of test block was carried out in August. The experiment is in progress.

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

2.3.3. Substitutes for methyl bromide for eradication of plant parasitic nematodes of tea with environmentally acceptable fumigants and biological control agents of tea nematodes

(Part funding for this study was expected from the NORAD through Environment Authority)

N 315 A & B - *Isolation of endemic biological control agents of tea nematodes such as fungi, bacteria and soil micro organisms with a view to formulating methods of augmenting their activity.*

Work was in progress by way of culturing *P. loosi* at Talawakele and *R.similis* at Hantane laboratories is in progress from December 1995 and February 1996 respectively.The cultures were to be used in isolating the biological control agents, in due course.

S.I.Vitarana, D.D.Liyanage, N.Navaratne, U.B.Herath, B.Sureshkumar and A.K.Prematunga

2.3.4. Studies on biological control agents

Field studies of the PhD project based on biological control of tea nematodes using *Pasteuria penetrans,* commenced in February.

Six experiments have been laid down up to November and the work is in progress.

K.M.Mohotti, D.D.Liyanage, N.Nawaratne, P.K.Jayawickrema and G.P.Udumulla

3. Task Force on Integrated Management of Shot-hole Borer

The status of the pest, the history of pest damage and the control measures adopted in the past and research carried out in relation to the borer was analytically reviewed at an internal colloquium held in July. The following research activities and the principal investigators were identified:

Activity	*Principal investigator and collaborator*
1. Method for assessing borer damage	K.Thirugnanasuntharan
2. Biochemical basis of borer resistance of tea and other plants.	S. Abeysinghe and L.D.Amarasinghe
3. Pruning aspects on minimizing damage	A. Kathiravetpillai
4. Activity of systemic fungicides in reducing the fungal growth in galleries	A. Balasooriya and L.D.Amarasinghe
5. Efficacy of foliar potash in reducing borer activity	G.D.Wimaladasa
6. Identification and use of trapcrops	A.Kathiravetpillai
7. Screening of ecologically safe insecticides as fire-fighting tools	L.D.Amarasinghe and K.Thirugnanasuntharan
8. Screening of bio-control agents	L.D.Amarasinghe
9. Selection and field screening of tea clones for borer resistance	K.Thirugnanasuntharan and L.D.Amarasinghe

Emphasis was placed on biochemical studies in collaboration with Prof Vijaya Kumar, Department of Chemistry, University of Peradeniya. Mrs S.I.Vitarana functioned as the Convenor/Secretary to the Task Force up to October and Mr. K.Thirugnanasuntharan took over thereafter. The Task Force held three meetings to review the progress of work; experiments under this programme are reported by the individual principal investigators in relevant sections in this report.

4. PROJECT B/SHBO -*Studies on pest ecology and productivity of tea lands in relation to the management of the shot-hole borer*

Project Leader - K.Thirugnanasuntharan

4.1. Resistance of tea clones to the borer (in collaboration with Plant Breeding Division)

Clonal blocks of TRI 4000 series in Phase I stage at Liddesdale, 'Venture', Lippakelle and Gordon were assessed this year. The study is in progress.

K.Thirugnasuntharan, S.W.Gunadasa, A.Abeysekera and P.D.P.de Silva

4.2. Effect of systemic fungicides on borer build up

The effect of systemic fungicides on the growth of the ambrosia fungus which is the food of the brood of the borer, is being studied in order to assess their indirect effect on the development of the borer. This study is in collaboration with the Plant Pathology Division.

4.2.1. E 248 - *Kenilworth Estate, Ginigathena*

This trial was initiated in January 1994. Three post treatment assessments were carried out during the year. The results at the end of the 3-year period showed no significant difference between treatments and the trial was terminated.

K.Thirugnanasuntharan, L.S.Abeysinghe, A.Abeysekera, P.D.P.de Silva and S.B.Vithana

E 292 - *TRI Uva sub Station, Passara.*

In this trial, initiated in November, overgrown nursery plants of the susceptible clone TRI 2025 were being treated with two systemic fungicides each at three concentrations applied by two methods at three weekly intervals. It is planned to artificially introduce the borer beetles to the plants in 1997. The study is in progress.

K.Thirugnanasuntharan, A.Balasuriya, A.Abeysekera and P.D.P.de Silva

4.3. Effect of high potash fertilizer

Effect of high potash application in combination with two levels of nitrogen in two formulations in a split plot design is being studied at Halgolla Estate, Yatiyantota, in collaboration with the Soils and Plant Nutrition Division.

4.3.1. E 249 - *Halgolla Estate, Yatiyantota*

Effect of high potash application in combination with two levels of nitrogen in two formulations in a split- plot design is being studied in mature tea.

Three assessments on borer infestation were carried out prior to prune in June. The results at the end of the pruning cycle did not show any significant difference between the treatments. The experiment was terminated.

K.Thirugnanasuntharan, L.S.Abeysinghe, A.Abeysekera and P.D.P.de Silva

However, a study on the effect of high potash on nursery plants was initiated in collaboration with Soils and Plant Nutrition Division this year.

The experiments were located in the mid-country and in the Uva and the design was of the factorial type as follows :

Treatments : 3C x 4K x 3R, where,
3C = 3 clones : TRI 2025 (susceptible)
DN (moderately susceptible)
TRI 3041 (at Attampitiya): TRI 4070 (at Hantane) resistant

4K = 4 potash levels : at 0 , 2.8 , 5.6 , 8.4 g.

3R = 3 replicates

Treatment commenced at the time of bagging of soil in the nursery and were repeated fortnightly commencing, 2 months from planting of cuttings. The locations were as follows :

E289 - *Attampettia Estate, Attampettiya.*

E290 - *TRI Mid-country Station, Hantane.*

L.S.K.Hettiarachchi, L.D.Amarasinghe, K.Thirugnanasuntharan, L.S.Abeysinghe, A.R.Abeysekera, B. Sureshkumar and U.B.Herath

5. 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.Amarasinghe

5.1. Control of the borer

For all laboratory testing of shot-hole borer, the population was raised on artificial diet preparation.

N.Navaratne and Y.Konaratne

5.1.1. E 266 - Screening of insecticides against SHB

During the year, the experimental plots that were scheduled to be pruned in March were completed. Plots that were pruned in October '95, received the chemical treatments after 9 months from prune in May. The details of the treatments have been given in the *Annual Report for* 1995.

Visual observations of branch growth and shot-hole borer infestation were carried out once a month in October, November and December. The post-treatment assessments of branch sampling for shot-hole borer infestation are to be initiated from January 1997. This experiment is in progress.

L.D.Amarasinghe, L.S.Abeysinghe, A.Abeysekara, B.S.Vithana and P.de Silva

5.1.2. E 275 -Screening of insecticides against SHB - 1994

(Field No.3, NP Division, New Peacock Estate)

The chemical treatments are the same as for E 266.

T1 - Admire SL200 at 500 ml ha^{-1}
T2 - Admire SL200 at 750 ml ha^{-1}
T3 - Ekalux 25EC at 1000 ml ha^{-1}
T4 - Ekalux 25EC at 2000 ml ha^{-1}
T5 - Chlorpyrifos 20EC at 4500 ml ha^{-1}
T6 - Chlorpyrifos 20EC at 1500 ml ha^{-1}
T7 - Untreated control

Insecticide treatments for the 1994 planted block were given in March. Visual observations on branch breakage and gallery formation due to shot- hole borer were made in October and November. The experimental lay out for the block planted in 1995 was completed. Both experiments are of the Complete Randomized Block Design. The experiment in these two blocks are in progress.

L.D. Amarasinghe, L.S.Abeysinghe, W.Dharmasena, U.B.Herath and P.de Silva

5.1.3. E 294 - *Use of bio-control agents in reducing shot-hole borer*

This study was initiated during the latter part of the year.

Three isolates of fungi namely *Paecilomyces* spp., *Paecilomyces fumosoroseus* and *Metarhizium anisopliae* were obtained from the Horticultural Research and Development Institute, Gannoruwa and tested against the brood of shot-hole borer in tea branches in the laboratory. Each isolate collected from HORDI was sub-cultured on CDA media and the pure cultures were obtained prior to application on shot - hole borer infested branches.The dilution were made once the fungal spore formation took place on the plates. Each treatment including the untreated control was replicated 3 times and for each replicate 10 infested branches were included. The assessments on brood mortality were done after 10 and 20 days by split opening 5 branches each. It was observed that none of the above treatments had given any control of the shot-hole borer as this fungus had not reached the galleries inside.

L.D.Amarasinghe, S.I.Vitarana, L.S.Abeysinghe and N.Navaratne

5.2. Clonal Studies

5.2.1. E 270 - Laboratory screening of clones for SHB resistance

The objective of this study was amended as there were no differences in ambrosia fungal development on crude extracts of different tea clones. However,

the possibility of the development of ambrosia fungal varieties in each tea clone at each agro-climatic region were studied using the ambrosia fungal development on PDA media.

L.D.Amarasinghe, S.M.Nagahaulla, L.S.Abeysinghe, A.Abeysekera and S.B.Vithana

5.2.2. Host volatiles for mass trapping

(a) Identification of kairomones

Bark volatiles of the following categories of samples are to be included in this study:

1. Infested and uninfested branches and leaves of clone TRI 2025 and TRI 2023 collected from the Uva region during the dry season

2. Infested and uninfested branches and leaves of clone 2025 and TRI 2023 collected from up-country region during the dry season.

3. Infested and uninfested branches and leaves of *Grevillia robusta* collected from the Uva during the dry season.

4. Infested and uninfested branches and leaves of *Grevillia robusta* collected from up-country region during the dry season.

Samples belonging to category 1 above collected from Attampettiya Estate and handed over to the Biochemistry Division and the following volatile chemicals were identified for bioassay work.

1. Geraniol
2. Linalool
3. Methyl salicylate
4. Phenyl acetaldehyde
5. t-2 Hexanol

These volatiles were tested for shot-hole borer adult female beetles using the olfactometer to determine the following:

1. Threshold concentration of each chemical to attract the beetles.

2. Concentration at which the chemical is repellent to the beetles.

3. Chemical or chemical combination that is mostly attracted to the beetles.

Data is being collected and the study is in progress.

L.D.Amarasinghe, Y.Konaratne and I.S.B.Abeysinghe

(b) Effect of presently recommended shade trees as diversionary hosts to the borer (in collaboration with Agronomy Division)

Three experiments have been initiated in the Uva, low and mid-country in fields planted with TRI 2025, on a paired-plot basis:

	Site	*Shade combination*
E 286 -	Attampettiya Estate, Ettampitiya; Field No. 14, 2nd Division	*Grevillea robusta* and *Erythrina lithosperma*
E 287 -	Kiruwanaganga Estate, Deniyaya; Field No.1,Sirimedura Div.	*Albizia moluccana* and *Gliricidia sepium*
E 288 -	New Peacock Estate, Pussellawa; Field No.6,NP Div.	*Grevillea robusta* and *Erythrina lithosperma*

A.Kathiravetpillai, L.D.Amarasinghe, K.Thirugnanasuntharan, L.S.Abeysinghe, A.R.Abeysekera, B.Sureshkumar and U.B.Herath

(c) **Effect of times and methods of pruning in reducing** shot-hole borer (in collaboration with Agronomy Division)

Three experiments have been initiated in the Uva, low and mid-country:

E 283 -	Attampitia Estate, Ettampitiya; Field No 7 ,1 st Div.	Pruning in October
E 284 -	Kiruwanaganga Estate, Deniyaya; Field No.1.	Pruning in October
E 285 -	New Peacock Estate, Pussellawa; Field No,6. N.P.Division	No operations

A.Kathiravetpillai, L.D.Amarasinghe,K.Thirugnanasuntharan, L.S.Abeysinghe, A.R.Abeysekera, B.Sureshkumar and U.B.Herath

5.3. Clonal selection for resistance to the UCLWT

Work was initiated in Field No.5 of Lower Div. of Mocha Estate. During the year, 113 seedling bushes were selected from this field. Root samples were bioassayed by two methods as follows, using about 20-25 samples per method.

1) Bioassay of individual tea roots to termites (replicated 4 times)

2) Bioassay of total of 20-25 roots collected from each bush affected by termites (replicated 3 times)

Both methods showed that none of the samples were completely resistant to this termite.

This experiment will be continued to complete 200 samples.

L.D.Amarasinghe, L.S.Abeysinghe and P de Silva

5.4. Control agents for up-country live-wood termite

E 277 - *Testing chemical and biological insecticides against the up-country live-wood termite in VP tea at Brunswick Estate, Maskeliya*

Two more treatments have been added for this experiment:

1. *Heterorhabditis megidis* at 1 million larvae/bush
2. Chlorpyrifos at 0.2 ml/bush

Heterorhabditis megidis is an entomopathogenic nematode formulated in a marketable form.

Post-treatment assessments were initiated from January 1996.

The results showed that treatments of Admire and *M.anisopliae* are comparable to each other in controlling the termites. The results were presented at the 192nd E&E forum held in April. This experiment was terminated.

L.D. Amarasinghe, L.S. Abeysinghe, N.Navaratne, A. Abeysekara and P.de Silva

5.5. Early detection of up-country live - wood termite

With the assistance of the Electronic Engineer, a new detector, namely High Gain Instrumentation Amplifier (HGIA) was assembled, Field tests were carried out in Brunswick and Mocha Estates. The Electronic Engineer, held a laboratory and field demonstration at the TRI on the use of this detector, in December. Further development of the equipment is in progress.

K.Thirugnanasuntharan and P.de Silva

6. 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

6.1. Clonal Screening

Susceptibility of clones to the live wood termites were being studied in replicated plot trials designed in collaboration with the Plant Breeder as well as in mother bush blocks established in the low-country .

The screening sites include Watapotha, St.Joachim, Noragolla, Hulandawa,Berubeula, Endane, Talangaha, Diyadawa and Hapugastenne Estates and the TRI stations at Kottawa and Deniyaya

Assessments on factors other than termite infestation such as the incidence of wood-rot, die-back, callussing, scavenger activity and recovery after prune are being carried out.

6.1.1. LE 22 (ix) - *Talangaha Estate*

TABLE 4 - *The incidence of wood-rot, die-back and callus on prune cuts is given Table 4.*

Clone	*Wood rot(%) (Average)*	*Die back(%) (Average)*	*Callus (%) (Average)*
NIL 211	35.75 a	44.50 bc	19.75 a
NIL 12	40.00 a	42.00 c	18.00 ab
NIL 262	37.75 a	52.50 ab	9.75 abc
TRI 2026	41.00 a	49.75 abc	9.25 abc
NIL 53	38.25 a	55.25 a	6.50 bc
TRI 3029	39.25 a	56.25 a	4.50 c
NIL 274	42.50 a	54.75 a	2.75 c
TRI 3052	39.50 a	58.25 a	2.25 c
LSD - 11.32	LSD - 10.22	LSD - 12.23	

NB- The number of bushes = 98
Note : Means followed by the same letter are not significantly different from each other.

There were no termite galleries encountered at this assessment in any one of the clones.

The yield data is presented in Table 5.

TABLE 5.- *Yield data (kg)*
(12 months from April 1995 - March 1996)

Clone		*Mean yield*	
TRI	3052	146.80	a
TRI	2026	140.29	ab
TRI	3029	119.82	bc
NIL	262	100.56	cd
NIL	12	97.12	cd
NIL	53	88.09	d
NIL	211	85.53	d
NIL	274	80.27	d
		LSD - 22.946	

Note: Means followed by same letter are not significantly differ from each other.

S.I.Vitarana, S.M.Samarasinghe, R.Perera and A.K.Prematunga

6.1.2. LE 40 (b) - *Kottawa*

Prune time assessment was carried out in June. As some of the blocks had more than 50% casualties (due to stem canker and drought effects) the assessment was confined to 16 clones (out of the original 30) in two replicates and the data is presented in Table 6.

TABLE 6 - *Termite infestation at Kottawa*
(No.bushes infested ; 36 bushes per plot)

Clone	*Branch infestation*		*Collar Infestation*	
	Rep.I	Rep.II	Rep.I	Rep.II
TRI 4005	-	-	-	1
2026	1	-	2	6
4049	-	-	-	-
4077	-	-	-	-
4063	1	1	-	-
4052	-	-	-	-
4053	1	-	-	-
4054	1	1	-	-
4055	1	2	-	4
4002	3	-	-	-
4061	1	-	-	-

4048	1	-	-
4058	-	1	-
4068	-	-	-
4004	-	-	-
2025	-	-	-

Of the test clones, TRI 4055 was the most susceptible with galleries in some of its bushes having reached ground level. Collar infestation was also, encountered in TRI 4005. Thus, TRI 4055 and 4005 can be referred to as highly susceptible to the low-country live-wood termite.

The clones TRI 4054, 4002, 4053, 4063, 4061 and 4058 can be referred to as moderately susceptible; since their galleries were confined to the branches, the pest could be managed with sanitation prune on these clones.

The single infested bush of TRI 4048 exhibited a healed gallery showing its promise as a resistant clone like TRI 4004, 4049, 4052, 4068, 4077.

S.I.Vitarana, S.M.Samarasinghe, R. Perera and A.K. Prematunga

LE 40 (d) - Diyadawa Estate, Deniyaya

TABLE 7 - *Incidence of wood-rot, die-back and callus on prune cuts*

Clone	*Wood rot*	*Die back*	*Callus*
TRI 4063	38.11 a	31.32 efgh	31.32 efgh
4033	28.62 ab	53.07 ab	20.44 h
4089	27.69 ab	50.51 abcd	25.46 gh
4056	27.45 ab	39.81 bcdef	37.73 defg
4055	26.82 abc	40.96 bcdef	37.01 defg
4071	26.06 abc	49.32 abcd	28.31 fgh
4024	25.65 abc	47.15 abcd	31.01 efgh
4034	25.34 abcd	48.45 abcd	29.00 fgh
4028	24.20 abcd	50.77 abcd	28.63 fgh
4036	21.14 abcd	36.85 defg	45.29 bcde
4003	19.03 abcde	52.02 ab	26.12 gh
4053	17.23 bcde	39.23 bcdef	45.57 bcde
4018	17.02 bcde	52.83 ab	31.51 efgh
4059	15.33 bcde	42.13 bcdef	40.16 cdefg
2025	13.55 bcde	44.10 bcde	42.62 cdef

4047	13.20 bcde	37.73 cdef	49.06 bcd
4031	12.17 bcde	46.16 abcd	38.49 defg
4005	11.54 bcde	41.54 bcdef	46.15 bcde
2027	10.56 bcde	37.75 cdef	48.50 bcd
4048	10.13 bcde	31.05 efgh	54.95 abc
4054	7.67 cde	29.21 fgh	58.38 ab
4088	7.67 cde	18.69 h	67.39 a
4070	5.77 de	23.06 gh	65.10 a
4066	0.00 e	60.00 a	29.99 fgh
4004	0.00 e	51.44 abc	38.55 defg
	LSD - 19.57	LSD - 14.15	LSD- 15.12

Note : Means followed by same letter are not significantly different from each other.

S.I.Vitarana, S. M. Samarasinghe, A. K. Prematunga and R.Perera

LE 40 (e) - *Diyadawa Estate, Deniyaya*

TABLE 8 - *Incidence of wood-rot, die-back and callus on prune cuts*

Clone		*Wood rot*	*Die back*	*Callus*
TRI	4088	5.11 a	31.6 a	55.79 a
	4063	25.40 a	40.9 a	30.88 b
	4089	23.57 a	50.0 a	29.26 b
	4028	26.57 a	50.6 a	26.41 b
	4024	21.83 a	54.7 a	25.40 b
		LSD - 25.91	LSD -20.85	LSD - 23.55

Note: *Mean followed by same letter are not significantly different from each other.*

S.I.Vitarana, S.M.Samarasinghe, A.K.Prematunga and R.Perera

6.2. Clonal Selection

Selection for termite resistance is being carried out in heavily infested old seedling tea fields in the low-country since 1978 (Hapugastenne, Poronuwa).

6.2.1. LE 50 - *Hapugastenne Estate, Ratnapura, Field No.5. Lower Amunutenna Division*

From a total of 113 selections carried out up to 1986, the best have been planted in a testing area replicated twice amidst termite affected tea typical of the low-country. Vacancy count was taken and plants necessary for infilling were established in a nursery at the estate.

S.I.Vitarana, S.M.Samarasinghe, R.Perera and A.K.Prematthunga

LE 78 - *Hapugastenne Estate Ratnapura Field No.4, Hathdaraganga Division*

Selection work commenced in March. Fifty bushes resistant to termites and having good bush characters were selected. Cuttings from these mother bushes were propagated in the nursery in October.

S.I.Vitarana, S.M.Samarasinghe, R.Perera and A.K.Prematthunga.

6.3. Laboratory Screening of extracts of plant origin and susceptibility of termites

LE 80 - *Bio-assaying of plant extracts for their kairomonal and allomonal properties.*

This study forms part of a M Phil programme undertaken at the Post Graduate Institute of Agriculture. Chemical extraction of stem material of clones TRI 2023, 2025,2026,3069,3055,3041, 2027 and S 106 was carried out both at the TRI laboratories and at the Chemistry Department, University of Peradeniya.

Bioassaying of the extracts using olfactometers proceeded concurrently at TRI Low-country Station.

The study is in progress.

S.M. Samarasinghe, Vijaya Kumar and Savithri Kumar

7. Project C/NEMA - *Analytical Services*

Project Leader : Sushila I Vitarana

7.1. Analytical services

During the period under review 472 estates and experimental samples were analyzed and 49 letters and 40 reports were sent out.

D.D.Liyanage, N.Navaratne, B.Sureshkumar, U.B.Herath and G.P.Udumulla

7.2 N288, N289 and N290 - In-vitro culturing of nematodes

Pure cultures of different species of tea nematodes are maintained in the laboratory for detailed experimental work. Carrot callus tissue, callus tissue developed from excised root tips of corn and callus tissue developed from excised root tips of tomato are the media for *R.similis, P.loosi* and *R.reniformis* respectively.The method adopted for *P.brachyurus* is the same as for *P.loosi.*

N.Navaratne , U.B.Herath and Y.Konaratne

8. Project D/ENTO - *Divisional Activities*

Project Leader - Sushila I. Vitarana

8.1. Acaricidal trials on tea mites

8.1.1 E 276 *Testing the efficacy of acaricides compatible with the mite predators. Deveronside Estate, Rakwana, (clones TRI 2023 and 2026)*

Treatments are as follows:

1. Neemazal	200 ml ha^{-1}
2. Sanmite	75-100 g ha^{-1}
3. Mitac 20EC	500 ml ha^{-1}
4. Bioneem	1 lha^{-1}
5. Nissorun	900 ml ha^{-1}
6. Neemazal	300 ml ha^{-1}
7. Omite	1 l ha^{-1}
8. Sulphur (Haymite)	5 g ha^{-1}
9. Untreated control	(spray volume 900 lha^{-1})

Counting of both predatory and pest mites was completed for one pre and two post treatment assessments and the experiment terminated. The results showed no statistically significant difference between treatments. It was arranged to repeat this experiment.

S.I.Vitarana, A.K.Prematthunga, R.Perera, B.S.N.Vithana, P.de Silva, S.Abeysinghe and A.Abeysekara

8.1.2. Biological control of tea mites

Well designed trials in relation to dosages, times of release, radius of activity and their residual activity were carried out as follows:

E 272 - ***Lauderdale Estate, Rakwana***

To study the radius of efficacy of Phtoseiulus persimilis and Amlyseius californicus on Oligonychus coffeae

Study radii = 05, 10, 15, 20 and 40 and 25, 30, 35, and 40 bush radius

The results indicated that there was no statistically significant difference between radii. Therefore, the minimum number of points for predator release could not be deduced from the current study.With a fair amount of certainty it can be said that the predators could be released in one spot at the centre of a mite pocket if the population is distributed uniformly.

E 273 - ***Deveronside Estate, Rakwana***

To study the optimum dosage of Phytoseiulus persimilis and Amlyseius californicus to control Olygonychus coffeae

Study dosage : T1 - Pp at 1350 mites /block
T2 - Pp at 2000 mites / block
T3 - Pp at 2700 mites / block
T4 - Ac at 1350 mites / block
T5 - Ac at 2000 mites / block
T6 - Ac at 2700 mites / block
T7 - Control

Pp -Phytoseiulus persimilis
Ac -Amlyseius californicus

There was no statistically significant difference between dosages. Also, the predators could be recovered from even the control plots which were 12-15m (40 - 50 ft) away from the nearest treatment. This indicates that these predators have a very high speed of migration.

It is suggested that the release dosage of predators should be calculated based on the population level of pest mite. These observations would be used in future studies.

S.I.Vitarana, A.K.Premathunga and R.Perera, B.S.N.Vithana, P.de Silva, S.Abeysinghe and A.Abeysekara

ME.02 - ***Field No. 7, Factory Division, Hantane Estate, Kandy***

The study conducted at Deveronside Estate was being repeated at this site.

S.I.Vitarana, U.B.Herath, B.Sureshkumar and S.Sunthereshwaran

8.1.3. *Revision of ecology of tea mites with special reference to their natural control agents.*

The following aspects are being studied in a project conducted as part fulfilment of the requirements for a PhD, degree by Ms S.M.Nagahaulla:

1. Distribution patterns of tea mites
2. Dispersing behaviour of mites
3. Natural mortality factors
4. Survey of natural enemies of mites
5. Survey of pathogenic agents
6. Effect of abiotic dispersing agents
7. Effect of physical factors on the biology of mites

S.M.Nagahaulla and P.D.P.de Silva

8.2. *Corporate Trials on chemical control of scavenging termites ME 01 - Duckwari Estate, Madulkelle*

This experiment was initiated in November 1994 on a field scale in order to evaluate the termiticidal activity of a new formulation of nitroguanadine marketed under the trade name "Admire", as against chlorpyrifos and common salt which are known termiticides. The study was terminated in May 1996 and the results are presented in Table 9.

TABLE 9 - *Effect of termiticides on scavenging termites*

Treatment	*Bushes with damage symptoms 1*	*Bushes with fresh activity 2*	*Bushes with actively feeding termites*
T1- Chlorpyrifos	327.5 ba	175.00 ba	25.00 a
T2- "Admire" 0.03%	144.5 c	77.00 c	3.50 a
T3- "Admire" 0.05%	258.5 b	143.50 b	13.00 a
T4- Salt 12.5gx1	290.0 ba	163.00 ba	22.00 a
T5- Untreated	348.0 a	189.00 a	19.00 a
LSD(P=0.05)	88.30	40.89	13.067

Note: *Means followed by same letter are not significantly different for each other.*

1 = Total of bushes exhibiting collar damage, branch damage or both collar and branch damage.

2 = Total of bushes exhibiting fresh earthen runways and earth-caps

Note: *Means followed by same letter are not significantly different from each other.*

"Admire 200" at 0.05% dilution proved to be the best and effective up to 18 months from treatment.

S.I.Vitarana, T.Yatawatte, W.A.M.Dharmasena, B.Sureshkumar and U.B.Herath

Repeat experimentation to confirm the above results is planned at the same site using the same plots as well as at another site, Hagalla Estate; the latter experiment will be identified as "ME 04". Chemical application of repeat trials are scheduled for early 1997.

S.I.Vitarana, T.Yatawatte, B.Sureshkumar and U.B.Herath

9. Miscellaneous work

9.1. Distribution of Poronuwa series of clones

Nursery plants of 22 clones of the Poronuwa series identified as promising for live-wood termite active areas in the low - country were distributed to Talangaha Estate and Kottawa to establish mother bush blocks of 50 - 100 bushes.

9.2. Seminars, Symposia, Field days and Lectures

Mrs S. I.Vitarana delivered a seminar on'Control of Tea Tortrix and Tea mites'with the help of video presentations for the benefit of the planters of Agrapatana Plantations Ltd. at Agras Club in February.

She addressed the Badulla District Planters' Association meeting at Madulsima in April on the theme 'Dry- weather Pests and their Control measures'.

Mr K.Thirugnanasuntharan gave a lecture in June on' Tea Entomology' and conducted a practical session for the planter trainees of the 8th Diploma of the Plantation Management Course - Tea Module of the NIPM.

He attended a two day symposium of the Entomology Working Group at Peradeniya in July and delivered a talk on' Entomological Research' at the TRI. Dr L.D.Amarasinghe too participated at this symposium.

Mr Thirugnanasuntharan and Dr(Ms) L.D.Amarasinghe presented papers entitled "Review on Shot-hole Borer Research" and "Present status of the Shot-Hole Borer problem in tea in Sri Lanka", respectively at an internal colloquium held in July to reorganize the research program on this pest.

Mr Thirugnanasuntharan gave lectures on ' Tea Pests and Diseases' to plantation trainees from Norwood, Wanarajah and Campion Estates in October and November and gave a lecture and conducted a demonstration on ' Shot-hole Borer Assessment' for the benefit of plantation executives of Helbodde Estate in November.

Dr (Ms) Amarasinghe gave a lecture on 'Insect, mite and nematode pests of tea' to the planter trainees of private estates under the auspices of the NIPM in October and another lecture on Tea Pests', to the 2nd year undergraduates at the Department of Crop Science, University of Peradeniya in November.

PLANT PATHOLOGY DIVISION

Officer in Charge - A. Balasuriya

1. General

Mr T.S.Gunasekara has requested for an extension to his study leave from April, in order to complete his post-graduate studies in the UK which was granted. However, he did not report back to work at the end of this period. Ms N.K.Karunatillake reported back to work in April, after her maternity leave.

The following trainees underwent a four month period of training in the division.

Ms U.A.P.A.Dilrukshi, Ms N.K.Kahaduwa (NDT, Ampara), Ms O.K.D.L. Padmini Kumari, Agriculture School, Wariyapola, Mr A.K.Dasanayake, Agriculture School, Pulliyankulama, Mr.I.L.M.Abeywickrama, Mr.W.V.P.Mahinda (NDT, Ampara), Ms C.R.Nakandala (NDT,Kuliyapitiya), Mr D.Weeratunge (NDT, Ampara).

2. Project: D/PLPA - *Divisional Activities*

(Project Leader - A.Balasuriya)

2.1. *Leaf Diseases*

2.1.1. *Blister Blight*

2.1.1.1. P/BB1 - Residue levels Test - Hexaconazole (Contaf 5E) (St.Coombs)

A triazole product (hexaconazole), to be marketed as Contaf 5% EC, was tested for its residues in made tea. These tests were undertaken in India. There were some residues recorded in the control treatments, However, it was found that, the amount of residues were as low as 0.1 ppm or even below (Table 1) 7 days after spraying of the chemical at the recommended rate of application (85 ml 170 l^{-1} of water ha^{-1}).

TABLE 1 - *Residue levels after spraying with Hexaconazole (Contaf 5E)*

Treatment	*Post spray interval*	*Residues (mg kg^{-1})*
Control	-	0.11
85 ml ha^{-1}	1	0.37
170 ml ha^{-1}	1	0.72
85 ml ha^{-1}	3	0.17
170 ml ha^{-1}	3	0.39
85 ml ha^{-1}	7	0.08
170 ml ha^{-1}	7	0.15
85 ml ha^{-1}	14	0.06
170 ml ha^{-1}	14	0.12
LSD (P=0.05)	-	0.06
CV%	-	14.1

A.Balasuriya and A.R.Ratnayake

2.1.1.2 P/BB2 - Fungicide Screening Trial (St.Coombs)

Objective; To screen new fungicides introduced in the market, and/or new dosage rates of the tested products.

This was completed by end October, after 15 rounds of treatments and 11 assessments of blister blight and yield. Since Sandofan and Bumper products claim systemic properties, the trial was repeated at fortnightly intervals; however there were no significant differences in the degree of control among the fungicides. But when these were sprayed at weekly intervals, they were able to control infection significantly (Table 2). These fungicides will be used in a repeated trial to confirm these observations.

TABLE 2 - *Control of Blister Blight incidence, by Bumper and Sandofan*

Treatments	*Assessments (% 3rd leaf infected)*								
	1	2	3	4	5	6	7	8	9
Control	33.1	21.1	38.4	57.2	59.5	53.4	64.0	31.1	33.9
Sandofan	22.3	10.9	22.7	35.6	32.1	23.6	34.1	17.3	19.9
Bumper	21.8	8.7	27.3	31.9	26.5	17.7	26.5	20.1	10.4
LSD									
(P=0.05)	10.4	6.6	13.0	12.4	8.5	16.0	12.9	8.8	9.2
CV%	27.8	37.4	28.0	20.7	15.2	35.9	31.1	24.9	29.8

A.Balasuriya, D.Pallemulla and A.Ratnayake

P/BB3 - Clonal Resistance/Susceptibility

Objective: To screen clones in Phase II and III trials of the Plant Breeding Division and to give them an appropriate rating.

Three existing trials located in Stockholm, Venture and Sheen Estates were selected for this purpose. They were assessed on four occasions each, at fortnightly intervals. Several assessment methods were employed using 100 shoots each. The ratings are summerised in table 3.

1. First leaf infected
2. Second leaf infected
3. Third leaf infected
4. Total blisters on first leaf
5. Total blisters on second leaf
6. Total blisters on third leaf
7. Total blisters on entire shoot

This was extended to two Phase I trials located in St.Coombs and Venture estates but discontinued after two and three rounds respectively, due to lack of assessable material

TABLE 3 - *Relative ranking of clones in their resistance / susceptibility to Blister Blight, based on the total number of blisters/shat (3 leaves and bud)*

Clone		*Score*		*Clone*		*Score*
TRI	3015	0.88		TRI	3018	0.31	
K	145	0.75	**Highly**	TRI	3017	0.31	
TRI	3014	0.63	**Susceptible**	TRI	4071	0.31	
TRI	4075	0.38		TRI	4085	0.25	**Moderately**
TRI	3020	0.38		TRI	4079	0.25	**Susceptible**
DN		0.38		TRI	4089	0.25	
TRI	3016	0.38	**Susceptible**	TRI	4076	0.25	
TRI	3069	0.38		TRI	4072	0.25	
TRI	4006	0.38		TRI	3048	0.25	
TRI	3013	0.38		TRI	4053	0.25	
TRI	2025	0.33		TRI	4078	0.25	
TRI	3072	0.1		TRI	3019	0.25	
TRI	4052	0.13	**Resistant**	TRI	4063	0.19	
TRI	3073	0.13					
TRI	4067	0.13					
N 2		0.06	**Highly Resistant**				
DT 1		0.00					

Scoring ranged from 0.00 - 1.00, indicating respective position of clones from Highly Resistant to Highly Susceptible.

A.Balasuriya, D.Pallemulla and A.Ratnayake

P/BB4 - Control of Blister Blight using ordinary salt, NaCl
(St. Coombs - Field 9);

Objective: There is speculation that ordinary salt (NaCl) can be used to control Blister Blight with some success. This is being already practiced by some growers. Our aim was to establish this, and quantify same.

NaCl, at three concentrations (1.0, 2.5 and 5.0%) were tested along with the standard copper (Perenox). This trial was concluded after, 13 rounds of assessments (three, pre- and ten, post-spray). Arrangements were made with the Soils and Plant Nutrition Division (SPND) to analyse soil and leaf Na levels periodically to determine whether there is any build up of Na arising from the treatments.

Blister infection levels after different treatments are indicated in Table 4. NaCl at 5% level, gave a competitive control of blisters only on two occasions, though not

significantly different from standard copper. Significantly better control was achieved with standard copper on five rounds. The balance five rounds have not yielded any significant difference from the copper treatment (only 7 assessments are listed in table 4). Therefore, it may be possible to consider using NaCl (at 5%) to control blister in tea, as an economical option to standard fungicides provided that there is no build up of Na in soil and on foliage. This could be further assessed when the analytical results are made available by the SPND.

TABLE 4 - *%, Blister Blight infections when treated with table salt (NaCl) compared with standard copper*

Treatment	*9th Sep.*	*16th Sep.*	*23rd Sep.*	*30th Sep.*	*7th Oct.*	*14th Oct.*	*28th Oct.*
Copper	19.3	15.0	16.7	20.7	20.3	10.0	0.3
NaCl 1.0%	34.3	28.3	37.0	22.3	22.3	17.3	4.0
NaCl 2.5%	34.7	20.3	32.3	34.0	29.7	16.7	4.3
NaCl 5.0%	34.0	26.3	33.3	40.0	17.3	9.0	4.7
Mean	30.6	22.5	29.8	29.3	22.4	13.3	3.3
Signific.	**	*	**	NS	NS	*	*
LSD P=0.05	5.7	9.1	7.0			6.0	2.8
CV%	9.3	20.2	11.7			22.5	41.8

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

2.2 Stem Diseases - Wood Rot

2.2.1. Hypoxylon Wood Rot

2.2.1.1 P/WRH1 - Survey on Wood rot

Objective: Present observations pre-supposed that the 'Hypoxylon Wood Rot' is restricted to certain Agro-climatic Zones and conversely, to certain elevations only. It is intended here to establish this. It is also intended here to find out, which other wood rots are extensive and the spread of such wood rots.

Hypoxylon wood rot was observed on six other estates: Diyanillakelle, Waverly, Hauteville and Norwood on clone K 145 and on Spring Valley, Badulla and on Hope Estate, Hewaheta on some old seedling bushes. This was the first report of hypoxylon from the Uva (1500 m) and Hewaheta (1600 m) districts.

In Norwood Estate, a new affinity of the Thorny Stem Blight (TSB) disease to clone N2 was also detected.

A.Balasuriya

Disease Survey in Diyagama East Estate

Table 5, shows that the severity of the disease due to *Hypoxylon* has increased from a score of 515 to 684 (32.8%) under natural field conditions, during a period of 34 months under observation while the number of healthy (uninfected) bushes have reduced by 67%.

TABLE 5 - *The rate of increase of Hypoxylon wood rot damage under natural conditions at Diyagama East Estate, clone K 1/45*

	Mar.94 1st count	Nov.95 2nd count	Jan.97 3rd count	at 20m in-crease	at 14m in-crease	at 34m in-crease
Uninfected	91	37	30	59.3	(18.9)	(67.0)
Slightly infected	43	54	47	25.6	13.0	9.3
Moderately infected	32	48	44	50.0	8.3	37.5
Heavily infected	128	153	167	19.5	9.2	30.5
Dead	6	8	12	33.3	50.0	100.0
Total No. of bushes	300	300	300	-	-	-
Disease score	515	641	684	-	24.5	32.8

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2.2.1.2. P/WRH2 (NE) - Chemical Control of Hypoxylon Wood Rot, using Hydrated lime, Protective paints and Systemic Fungicides:

Objective To determine the efficiency of chemical control of 'Hypoxylon Wood Rot', when the bush is already very badly affected by same, particularly in the absence of any previous prophylactic treatments.

With two further rounds of assessments during the year, the scheduled number of assessments were completed (Tables 6 and 7).

TABLE 6 - *Effect of manual and chemical treatments on wood rot/bush health parameters (19 March '96, assessment).*

Treatment	*Chlorotic -Scorched*			*Infected*	*Uninfected*		
	<1	*1-3*	*3-5*	*<1*	*1-3*	*1-3*	*3-5*
MM	.17	1.50	.17	.17	1.92	31.8	7.5
HL	.00	1.25	.00	.00	1.17	30.5	9.3
P	.00	0.33	.17	.17	1.33	29.0	8.5
S	.00	1.50	.00	.17	2.00	28.3	9.2
PS	.33	1.67	.00	.00	1.67	29.3	6.7
C	.00	2.00	.17	.00	1.17	37.3	9.3
MM x P	.00	0.33	.33	.33	2.33	27.0	6.7
MM x S	.00	2.00	.00	.33	2.33	25.0	8.3
MM x PS	.67	1.67	.00	.00	2.33	26.7	5.7
MM x C	.00	2.00	.33	.00	0.67	48.3	9.3
HL x P	.00	0.33	.00	.00	0.33	31.0	10.3
HL x S	.00	1.00	.00	.00	1.67	32.7	10.0
HL x PS	.00	1.67	.00	.00	1.00	32.0	7.7
HL x C	.00	2.00	.00	.00	1.67	26.3	9.3
Main Treat.	NS	NS	NS	NS	NS	NS	NS
Sub Treat.	NS	NS	NS	NS	NS	NS	***
LSD (P=0.05)							0.85
Interaction	NS	*	NS	**	**	**	***
LSD (P=0.05)		1.73		0.30	1.50	14.49	1.2
CV%		70.7		0.42	54.6	26.2	8.0

MM = Manual Mossing
HL = Hydrated Lime
PP = Protective Paint
SS = Systemic Fungicide Spray
PS = Protective Paint & Spray
CC = Control

TABLE 7 - *Effect of manual and chemical treatments on wood rot/bush health parameters (20 Nov. '96, assessment).*

Treatment	*Chlorotic - Scorched (cm)*			*Infected (cm)*		*Uninfected (cm)*	
	<1	1-3	3-5	<1	1-3	1-3	3-5
MM	0.58	1.50	0.0	0.0	3.83	29.9	4.08
HL	0.25	0.83	0.1	0.1	3.42	28.6	4.08
P	0.17	1.00	0.0	0.2	3.50	28.8	5.33
S	0.17	1.67	0.0	0.0	2.83	28.3	2.67
PS	1.00	0.67	0.0	0.0	4.33	26.7	4.50
C	0.33	1.33	0.2	0.0	3.83	33.2	3.83
MM x P	0.33	0.67	0.0	0.0	6.00	33.3	4.33
MM x S	0.33	2.00	0.0	0.0	2.00	25.0	3.00
MM x PS	1.33	1.00	0.0	0.0	4.33	27.3	4.33
MM x C	0.33	2.33	0.0	0.0	3.00	34.0	4.67
HL x P	0.00	1.33	0.0	0.3	1.00	24.3	6.33
HL x S	0.00	1.33	0.0	0.0	3.67	31.7	2.33
HL x PS	0.67	0.33	0.0	0.0	4.33	26.0	4.67
HL x C	0.33	0.33	0.3	0.0	4.67	32.3	3.00
Main Treat.	NS	NS	NS	NS	NS	NS	NS
Sub Treat.	***	NS	NS	NS	NS	NS	NS
LSD (P=0.05)	0.33						
Interaction	***	**	*	*	**	NS	NS
LSD (P=0.05)	0.47	1.24	0.30	0.30	2.70		
CV%	63.2	59.8	400.0	400.0	41.9		

Abbreviations are the same as in Table 6.

2.2.1.3 P/WRH3 (DGW) - Chemical Control of Hypoxylon Wood Rot, using Hydrated Lime and Systemic Fungicides at two levels of the 'K' fertilizer.

Objective: 'K' is known to help in tissue build up of woody plants. Therefore, it is intended here to test this phenomenon in the control of the disease in combination with some cultural measures and fungicides.

Two rounds of fertilizers were applied during the year and one assessment was completed. This trial has been completed (Table 8).

TABLE 8 - *Effect of chemical and fertilizer treatments on wood rot/bush health parameters (17 Dec. '96, assessment).*

Treatment	*Wilted/ Chlorotic/ Scorched/ (cm) 1-3*		*Infected (cm) 3-5*	*Uninfected (cm) 3-5*	*Healthy bushes > 75*	*Infected at collar*	*Infected above collar*
HL+	4.4	9.8	14.3	2.3	1.2	6.1	2.8
HL-	3.3	6.4	20.2	4.7	1.6	5.6	2.8
K1	3.3	6.3	16.3	3.0	1.2	6.5	2.3
SK1	2.7	7.7	19.8	3.5	2.0	4.8	3.2
K2	3.8	9.3	15.5	4.8	1.2	5.7	3.2
SK2	5.7	9.2	17.2	2.7	1.2	6.3	2.5
HL+xK1	3.3	9.3	14.3	1.7	2.0	5.0	3.0
HL+xSK1	3.3	8.0	16.3	0.7	0.7	7.0	2.3
HL+xK2	5.3	10.7	15.3	4.3	0.7	6.7	2.7
HL+xSK2	5.7	11.3	11.0	2.7	1.3	5.7	3.0
HL-xK1	3.3	3.3	18.3	4.3	0.3	8.0	1.7
HL-xSK1	2.0	7.3	23.3	6.3	3.3	2.7	4.0
HL-xK2	2.3	8.0	15.7	5.3	1.7	4.7	3.7
HL-xSK2	5.7	7.0	23.3	2.7	1.0	7.0	2.0
Main Treat.	NS	NS	NS	NS	NS	NS	NS
Sub Treat.	NS	*	NS	NS	NS	NS	NS
LSD (P=0.05)		2.0					
Interaction	NS	.1%	NS	1%	5%	**	*
LSD (P=0.05)		2.8		3.5	2.0	2.9	2.0
CV%		19.4		56.5	81.3	28.0	40.0

HL+ = With Hydrated Lime HL- = Without Hydrated Lime
K1 = Standard K fertilizer K2 = K fertilizer double
SK1 = Spray and K1 SK2 = Spray and K2

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2.2.1.4 P/WRH4 (Nuwara Eliya Estate - Oliphant Division) - **Observational experiment on training of the bush frame;**

Objective: To discourage any shoots arising at or near ground level of the bush, by periodic removal of same, 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 Hypoxylon, the total infection could be removed from the bush through what is known as rejuvenation pruning.

An observational area of three blocks were selected and the basal shoots of alternate rows removed. Any further basal branches emerging were repeatedly removed on four occasions.

2.2.1.5. P/WRH5 (Diyagama West Estate) - **The estimation of loss of yield due to Hypoxylon infection in K 145;**

Objective Assuming all the available growing points in a given bush are capable of producing a harvestable shoot over a period of 6-8 weeks, it was intended to harvest individual bushes separately over such period and correlate the bush productivity to the degree of infection by Hypoxylon wood rot.

Sixty bushes with varying degrees of infections were selected in the field and the yield and shoot count of every bush were recorded weekly, over a period of eight weeks from October to November.

Table 9 shows that a healthy bush (of about 30 years of age) could have 7-8 live branches on the frame which can be reduced to 3 at the height of infection. Such badly infected bushes, in the mean time could harbour about 5 snags of broken frame branches. Over a 8-week cumulative harvest period, the number of pluckable shoots have been reduced from 260 to 200 per bush, a reduction of 30%. The impact of the level of infection on the final yield has been further aggravated by the drop in unit weight of the individual shoots from 0.136 to 0.130 g (about 4%).

TABLE 9 - *Productivity loss assessment in bushes of clone K 145 under varying levels of Hypoxylon wood rot damage*

Visual infec-tion	*No. of bushes*	*Live bran-ches*	*Dead bran-ches*	*Cumulative total at 6 wks*		*Cumulative total at 8 wks*	
				Flush count	*Flush dry wt.(g)*	*Flush count*	*Flush dry wt'(g)*
Healthy	9	7	0	196	29.35	256	35.05
<30%	12	6	1	201	29.81	263	35.49
30-60%	12	5	2	192	27.35	248	33.11
60-90%	15	4	3	184	23.49	245	29.24
>90%	12	3	5	150	21.12	202	26.28
r=	-	0.997	0.988	0.852	-	0.834	-
Significance	-	***	**	**	-	**	-

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3. Connected activities

A susceptible clone and a resistant clone were selected to make extracts using N-hexane, dichloromethane and methanol. These extracts were used to determine the response of Hypoxylon fungus, when incorporated into the PDA medium at a strength of 500 ppm.

TABLE 10 - *Response of the Hypoxylon fungus to different solvent extracts, from resistant and susceptible clones.*

Clone	*Solvent*	*Growth rate /day (cm) up to 10 days*	*Growth rate /day (cm) up to 20 days*
PK 2	Methanol	0.40	0.40
PK 2	N-Hexane	0.63	0.42
PK 2	Dichloromethane	0.64	0.45
HS 10A	Methanol	0.46	0.41
HS 10A	N-Hexane	0.56	0.44
HS 10A	Dichloromethane	0.54	0.44
Control	No extract	0.49	0.39
CV%		7.67	5.03
LSD(P=0.05)		0.07	0.04

Dichloromethane extracts of both clones (susceptible and resistant) gave significantly higher rates of growth of the fungus than the control treatment (Table 10). However, the N-hexane extract of clone HS 10A too showed a significantly higher rate of growth. This is to be repeated with a range of concentrations in order to establish the findings.

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General Wood rot

P/WRG2 (UH) - **Chemical control of Wood Rot using Systemic Fungicides and Protective Paints, at two levels of 'K' fertilizer.**

Objective: 'K' is known to help in tissue build up of woody plants. This phenomenon is tested here to control the General Wood Rot condition, in combination with systemic fungicides and protective paints.

Two applications of fertilizers were given during the year. The third assessment to estimate the extent of damage due to general wood rot, under the different treatments was completed. The final assessment of wood rot was not done due to shortage of staff; this will be carried out in early 1997.

A.Balasuriya, D.Pallemulla and A.Ratnayake

SHB - Ambrosia Control Studies

P/AMB2 (Kenilworth) - **Efficiency of some selected systemic fungicides as an indirect measure of controlling SHB damage, compared to the standard (insecticide), on tea recovering from pruning.**

Objective To determine the efficacy of systemic fungicides in their ability to control, *Monacrosporium ambrosium* fungus, that is found within SHB galleries which provides the main, if not sole food source for the larvae of the beetle.

The Entomology Division carried out several borer assessments to study the effects of treatments in its control. The dissected samples were assayed on two occasions to compare the incidence of *Ambrosia* fungus after the treatments. In the second round it was not possible to assay the fungal (*Ambrosia*) occurrence since all galleries showed excessive contamination by other organisms with indications of secondary rotting (reddish or black). This trial was terminated due to inconclusive results; this will be repeated with modifications.

P/AMB3 (Passara Sub Station) - **Efficiency of systemic fungicides as an indirect measure of controlling SHB damage.**

A trial was initiated in collaboration with the Entomology Division under the newly formulated IPM task force on SHB.

Two year-old nursery plants were obtained from an estate close to the Passara sub-station for this purpose. The treatments included two fungicides (Folicur and Contaf-F), at three concentrations (0.05, 0.5 and 2.5%) applied by two methods (foliar spray and soil drench) with a control. Thus there were a total of 13 treatment combinations replicated twice with five plants per replicate. After the third treatment in early January 1997, the Entomology staff will commence introducing beetles and make periodical assessments.

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4. Related activities

In-vitro rearing of beetles have commenced using artificial diets to monitor their behaviour in response to fungicides. Initial progress of this study has been very encouraging. This is being continued.

A.Balasuriya, D.Pallemulla and N.K.Karunatillake

Die-back in K 145

A study was commenced to investigate the die-back reported on several occasions in clone K 145. The fungus responsible was found to be *Pestalotia theae*.

The stalks left behind on the bush after the flush is harvested have to either fall off or dry out. During the wet season this tends to attract *Pestalotia*, which could sometimes extend to some of the growing points causing a die-back and a resultant loss in productivity.

Four clones (DT 1, N 2, K 145 and CY 9) available in close proximity were selected to study whether the stalks left behind on the bush show some extension growth or fall off. This exercise was concluded after a period of eight weeks, as some stalks started falling.

There were some stalk extensions and contractions (figures in parenthesis) in all the clones tested at different times (Table 11). However, only clone K 145 has maintained continuous stalk extension growth after an initial contraction. By the 8th week except in K 145 and CY 9, in DT 1 and N 2 clones, drying up of stalk ends commenced. When these finally start rotting such volumes of decaying material may be attracting a normally non pathogenic organism like *Pestalotia* to invade them. This needs further investigation.

TABLE - 11 *Comparison of stalk-end extensions from the point of plucking over a period of eight weeks*

	Extension (Contraction) of shoot length (cm)				
Clone	*16 Oct.*	*18 Oct.*	*21 Oct.*	*28 Oct.*	*22 Nov.*
K 145	(0.001)	0.046	0.044	0.021	0.041
DT 1	0.020	0.011	0.011	0.028	(0.139)
CY 9	(0.019)	(0.003)	0.004	0.033	(0.102)
N 2	0.020	0.034	0.026	0.032	(0.020)

nb: The figures within parenthesis indicate reductions in length

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Mycorrhiza

A study was conducted on tea root and soil samples obtained from Need Wood Estate Haldummulla, to determine the incidence of VAM under the concept of Bio-tea, which is being practiced in this property since 1989. Fairly low levels of this symbiont were observed confirming our previous observation that under high soil organic C levels, the natural VAM activity tends to be lower.

High Forest Problem

Two group visits and four individual visits were made to this property on fact finding and material collection missions. The Pathology Division is currently testing the hypothesis of a possible bacterial involvement.

TRI Update

Two short articles were written to the TRI Update. One on 'BLISTER BLIGHT - BE ALERT', drawing attention of the concerned to the salient aspects of Blister Blight Control and the second on 'MYCORRHIZA AND TEA' highlighting beneficial aspects of mycorrhiza to tea crop.

5. Seminars/Lectures

Mr A.Balasuriya addressed or attended the following:
Addressed a seminar on 'New Diseases', at the RSC II, at the Darawala Club, on 14/03/96.

Attended the RSC-Uva , seminar held at the Uva club on 26th March.

Attended a seminar organised by the Agrapatana Plantations Ltd., held at the TRI Auditorium on 16th September.

Conducted a lecture/practical session for the NIPM trainees at the TRI Auditorium. Conducted a lecture for the second year Agricultural students at the Faculty of Agriculture in Peradeniya, on Tea Diseases.

6. Visitors

Mr Kingsley Thomas of Harrisons Chemicals Ltd. accompanied by Messrs Weerasekara and Purijjala visited the division on a familiarization tour.

Dr Ingo Kohler and Mr.K.D.Schulz of Bayer AG, Germany, visited with Messrs U.Gangoda and M.R.Zaheed on a fact finding mission.

A group of university students (Chemistry Society) from the University of Peradeniya visited the division in September.

The second year students of the Faculty of Agriculture visited the division on two days in four groups, for an exposure into the practical aspects of tea diseases.

A group of planters from Aitken Spence Ltd. visited the division for a field day.

Two groups of planters, one from Bogawantalawa and the other from Detoloya, visited the division.

7. Acknowledgements

The co-operation and the assistance extended to us by all estates where experiments and studies are being undertaken is gratefully acknowledged. A special word of thanks to the Managers of Nuwara Eliya, Diyagama West, and Uva Highlands Estates, where a major part of our field trials were undertaken.

PLANT PHYSIOLOGY DIVISION

Acting Head - A. Anandacoomaraswamy

1. General

Ms J. Mohotti returned to the TRI after completing her initial Ph.D. program at the University of Reading and at the Rothamstead Experimental station, UK to carry out her project component on 'Partitioning of assimilates and organ growth in relation to shade and nitrogen nutrition of plants with special reference to tea'.

Ms Deepika Gawaramana and Ms Shammalie Hewasinghe of the Faculty of Agriculture, University of Peradeniya carried out their 500 series project in the Division.

2. Studies on Photosynthesis and Dry Matter partitioning

2.1. Partitioning of assimilates in relation to aging of clonal tea in a pruning cycle, St Coombs Estate - (1992)

The annual yield for clones TRI 2025 and DT1 is presented in Table 1.

TABLE 1- *Effect of age on yield (kg ha^{-1})*

Clone Year from prune	*TRI 2025*	*DT1*
1	1192	1276
2	2338	2341
3	2305	2175
7	2198	2125
LSD(P=0.05)	310	250
CV %	11.2	9.2

During the current year, there were no plants in the fourth year after prune. The results suggest that the yield increased substantially from the first to the second year.

Ms. V.Sithakaran

2.2. Effect of resting before pruning on root starch, TRI 2023 New Peacock Estate- (1995)

The Monthly variation of root starch of this observation trial is presented in Table 2.

TABLE 2- *Starch content (%) of roots*

Treatments	*Root starch(%)*				
	Dec.	*Jan.*	*Feb.*	*Mar.*	*Apr.*
Control (No resting)	27.4	22.3	11.4	13.8	11.1
One month resting	28.2	11.7	13.4	14.9	9.6
Two months resting	28.4	19.0	11.0	14.1	11.6

These plots were brought into plucking in February. There was no difference in yield observed between treatments during the first year.

A. Anandacoomaraswamy and D.M.S. Navaratne

2.3. Resting before pruning and root starch accumulation in tea, Gonakelle Estate (1995)

In this observation study, the effect of resting tea (TRI 2025) before pruning and of continuous plucking on root starch was investigated. Resting of the plot commenced in September '95. The root starch content is presented in Table 3.

TABLE 3- *Starch Content (%) of Roots*

Treatments	*Root starch(%)*		
	Dec.	*Jan.*	*Feb.*
Control (No resting)	17.0	17.1	21.5
Resting	20.5	25.0	15.5

The rested plots had higher root starch up to January 1996 compared to those plucked continuously.

Ms D.M.S.Navaratne

2.4. Resting before pruning and root starch accumulation in tea (K145), Mattakelle Estate.

Root starch was monitored from April to October by the Agronomy Division(Table 4). Resting of the plots commenced in May and the plots were pruned on 24th June.

TABLE 4- *Starch content (%) of roots*

Treatments	*Root starch(%)*						
	Apr.	*May.*	*Jun.*	*Jul.*	*Aug.*	*Sep.*	*Oct.*
Control (No resting)	35.4	30.1	25.3*	21.3	21.3	-	13.2
Resting	36.5	29.8	50.3*	25.3	40.3	16.2	

*Pruned

The results indicate that resting substantially increased the root starch.

A. Anandacoomaraswamy and D.M.S. Navaratne

2.5. C^{14} Studies

No investigation were conducted under this project this year as the Scintillation counter was out of order.

V. Shanmugarajah

2.6. Effect of soil moisture on physiological parameters of young tea.

In this experiment, the effect of three soil moisture levels, W1-near field capacity,- maintained by irrigating daily W2- in between field capacity and permanent wilting point- maintained by irrigating weekly and W3- near permanent wilting point maintained by irrigating fortnightly, were tested for their effect on photosynthetic parameters of two clones TRI 2025 and CY 9. The photosynthetic parameters tested were light and CO_2 response curves; the daily transpiration was also measured.

The photosynthetic parameters for light and CO_2 response curves are presented in Tables 5 and 6 respectively.

TABLE 5- *Photosynthetic parameters for light response curves*

Treatments	*LUE*	*Pmax*	*Rd*	*Theta*
		(micro mole $CO_2 m^{-2} s^{-1}$)		
1. TRI 2025 W1	0.11	9.29	1.09	0.41
2. TRI 2025 W2	0.08	3.20	0.52	0.48
3. TRI 2025 W3	0.13	0.67	0.43	0.01
4. CY 9 W1	0.04	6.48	0.01	0.01
5. CY 9 W2	0.12	1.53	0.06	0.84
6. CY 9 W3	0.04	2.26	1.56	0.99

LUE= Light Use Efficiency
Pmax= Maximum Net Assimilation Rate
Rd= Dark respiration

Theta is the ratio of physical to total resistance to diffusion of CO_2 to the carboxylation site.

TABLE 6- *Photosynthetic parameters for CO_2 response curves*

Treatments	*CUE*	*Amax* (*micro mole $CO_2 m^{-2} s^{-1}$*)
1. TRI 2025 W1	0.03	60.9
2. TRI 2025 W2	0.01	17.7
3. TRI 2025 W3	0.01	4.6
4. CY 9 W1	0.05	38.2
5. CY 9 W2	0.01	5.8
6. CY 9 W3	0.01	7.6

CUE= Carbon dioxide Use Efficiency
Pmax= Maximum Net Assimilation Rate

For both light and CO_2 response curves, net maximum photosynthesis was highest under no stress conditions but was less with water stress.

The daily transpiration rate and water requirement are given in Table 7.

Table 7 - *Transpiration rate and water requirement (ml/plant/day)*

Treatments	*Transpiration*	*Water requirement*
1. TRI 2025 W1	40	55
2. TRI 2025 W2	30	40
3. TRI 2025 W3	15	20
4. CY 9 W1	40	55
5. CY 9 W2	25	35
6. CY 9 W3	25	35

The transpirational water requirement for survival of the plant is calculated by assuming that water is not lost by evaporation and deep drainage and with a water application efficiency of 75%. Under up-country conditions, for clone TRI 2025 water should be applied at 7 day intervals at the rate of 300ml/plant whereas for clone CY 9 it could be applied at the rate of 500ml/plant at 14 day intervals. This amount of water should be applied directly into the root zone.

A. Anandacoomaraswamy, W.A.J.M. De. Costa. M.D.W.Gawarammana and D.M.S.Navaratne

3. Tea physiology and potassium nutrition

3.1. Effect of potassium on recovery from pruning, St Coombs Estate-(1993)

This experiment is in the fourth year of the current cycle. The yield is presented in Table 8.

TABLE 8- *Effect of N:K ratio on yield (made tea kg ha^{-1})*

Main treatments		*Sub treatments*	*Yield*
(a)	Pre - prune	2:1	1788
		1:1	1894
		1:2	1936
		1:3	2181
(b)	Post- prune	2:1	1931
		1:1	1922
		1:2	1669
		1:3	1948
(c)	Pre- and Post- prune	2:1	1730
		1:1	1930
		1:2	2014
		1:3	1989
LSD(P=0.05)			151
CV(%)			8

There was no significant difference between the timing of application of fertilizer. However, there was an indication that low N:K ratios gave higher yields.

V.Sithakaran

3.2. Potassium nutrition on physiology of young tea (TRI 2025)

An experiment was initiated in the nursery to study the physiological responses of young plants. The plants were fertilized with T 65 nursery fertilizer mixture to maintain the following levels of K.

1. No potassium
2. Recommended level of K
3. 1/4th of the recommended level of K
4. 1/2 the recommended level of K
5. Double the recommended level of K
6. Treble the recommended level of K

Growth measurements are being taken at 2 monthly intervals.

V. Shanmugarajah

4. Drought Mitigation

4.1. Drought mitigation in mature tea, St Coombs Estate, (1995)

An antitranspirant 'Green Miracle' - A long chain fatty acid alcohol, was evaluated in a field experiment for drought mitigation. The following foliar applications were given monthly from January to April. The yield from January to December is presented in Table 9.

TABLE 9- *Annual yield of tea*

	Treatments	*Yield (kg ha^{-1})*
1.	Control (water spray only)	5401
2.	Green Miracle(1%)	5383
3.	Green Miracle(1%)+ Potassium chloride (1%) + Urea(1%)	4977
4.	Potassium chloride (1%) + Urea(1%)	4837
LSD(P=0.05)		NS
CV (%)		9.1

There was no significant difference between any of the treatments probably due to well distributed rainfall experienced during the early part of the year.

A. Anandacoomaraswamy and V. Sithakaran

5. Effect of retention of crow's feet (mudichchis) on yield St Coombs Estate

An experiment was initiated in October to investigate whether retention or removal of crow's feet (mudichchis) has any influence on yield. A field that was is in the first year of the current cycle was selected. Paired comparison was employed. In one set of bushes, crow's feet (25/bush) were removed while in the other set it was retained. The yield for the period November to December is presented in Table 10.

TABLE 10- *Yield of Tea*

	Treatments	*Yield (kg made tea ha^{-1})*
1.	Retention of crow's feet	535
2.	Removal of crow's feet	558
	LSD(P=0.05)	NS
	CV(%)	20

There was no significant difference between the treatments for the two months period.

A. Anandacoomaraswamy, A. Kathiravetpillai and V. Sithakaran

6. Modeling tea yields from weather data

Weather measurements (air temperature, relative humidity, solar radiation, wind and soil temperature) continued at St Coombs, Court Lodge and Uva Highland Estates.

A . Anandacoomaraswamy and D.M.S.Navaratne

7. Seminars/Lectures

Dr A. Anandacoomaraswamy and Mr. S.A.B Ekanayake presented a paper on 'Effect of land degradation on productivity of tea' at the annual session of the soil science society held at SLAAS, Colombo.

Ms T. Loga, Dr A. Anandacoomaraswamy and S. Rajadurai on 'Effect of leaf nitrogen and soil moisture on photosynthesis of young clonal tea' at the 52nd Annual Session of Sri Lanka Association for the Advancement of Science, in November.

8. Publications

Anandacoomaraswamy, A. De Costa, W.A.J.M., Gawarammana, M.D.W and D.M.S.Navaratna(1996). Effect of soil moisture stress on physiological parameters of young tea. Proc. 193rd Experiments and Extension Forum held on 30th August 1996 at TRI, Talawakelle 17-34.

Anandacoomaraswamy, A (1996). Simulation of Water use by Tea in relation to Yield. Abstract published in the Workshop in Tea Production held from 15th-18th March organized by the Agricultural University of Austria(BOKU), Institute of Meteorology and Physics, Turkenschanzstrasse, 18 A-1180, Vienna, Austria

Loga, T., Anandacoomaraswamy. A and Rajadurai, S (1996). Effect of leaf nitrogen and soil moisture on photosynthesis of young clonal tea. Presented at the 52nd Annual Session of Sri Lanka Association for the Advancement of Science, November 1996.

PLANT PROPAGATION AND PLANT BREEDING DIVISION

Officer-in-Charge - V.Shanmugarajah

1. General

On completion of the local research component Mrs K.Amarakoon left for UK to continue her studies for the Ph.D programme at Southampton University.

On a management decision, the Tissue Culture Unit at Hantane became part of this Division from 1st July. Mrs S.K.Sathiyapala was away in Japan continuing her postgraduate studies. Messers T.M.Sarathchandra and P.D.Upali attached to the Tissue Culture Unit at Hantane were transferred initially for a period of 3 months from August and September respectively, to the Head Office. At the end of 3 months Mr Sarathchandra was transferred back to Hantane and Mr Upali was requested to continue for another month. Dr (Mrs) K.Hirimburegama of the University of Colombo continued to be the consultant for the Tissue Culture Unit.

Two NDT students from Hardy Senior Technical Institute, Ampara completed their training and one from Kuliyapitiya Technical College commenced his training in this division.

2. Project B/CLON - The development of new clones

Project Leader - V. Shanmugarajah

2.1. Polyclonal/Biclonal seed

2.1.1. VP 52 - *Evaluation of polyclonal seed from the seed gardens at Karandupona and Urumiwella - Field No. 9, St. Coombs Estate, Talawakele - (1990)*

and

VP 58 - *Evaluation of polyclonal seed - Field No. 9, St.Coombs Estate, Talawakele - (1991)*

Refer Phase I.

2.1.2. VP 64 - *Evaluation of polyclonal seed - Venture Estate, Norwood (1992)*

2.1.3. VP 65 - *Evaluation of polyclonal seed - Carolina Estate, Watawala - (1992)*

2.1.4. VP 66 - *Evaluation of polyclonal seed. Luckyland Estate, Udapussellawa - (1992)*

Visual assessments of growth and performance were made.

2.1.5. VP 78 - *Evaluation of Biclonal and polyclonal seed from El-Teb, Halpe and St. Coombs Estates in Field No. 12, St. Coombs Estate, Talawakele - (1996)*

The source, the parent from which the seeds were collected and the number of seedlings planted in July/August are given below.

Source	*Parent*	*No. of Seeding*
El-Teb	2025)	23
Halpe	2023)	
	S 2043)	11
	S 106)	
St Coombs	2023	10
	2024	22
	2043	22
	1114	6
	DT 95	5
	Assam 4/10	6

(M. Ratnayake, Umah Sritharan, S.W.Gunadasa, B.A.Rathnagoda and V.Shanmugarajah)

2.1.6. LVP 49 - *Evaluation of polyclonal seed from Karandupona and Urumiwella seed gardens. St. Joachim Estate, Ratnapura - (1991)*

Refer Phase I.

2.1.7. LVP 53 - *Evaluation of polyclonal seed on Hapugastenne Estate - (1991)*

2.1.8. LVP 69 - *Evaluation of polyclonal seed from Karandupona and Urumiwela 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)

The bushes were brought into plucking.

A.K.M. Jayasena, M. Ratnayake, S.W. Gunadasa, and J.H.N. Piyasundara

2.1.9. VP 74 - *Evaluation of biclonal seed from El-Teb seed garden in Uva (DN x 2025) in Field No. 14, St.Coombs Estate, Talawakele - (1995)*

and

Polyclonal seed from Sapumalkande seed garden in St.Joachim Estate, Ratnapura - (1995)

Growth of the bushes were monitored.

M.Ratnayake, S.W.Gunadasa, Umah Sritharan and B.A.Rathanagoda

3. Controlled Hybridisation Experiments

1. Crosses of 1980/1981 (see VP 39)
2. Crosses of 1982/1983 (see VP 43)
3. Crosses of 1984 (see VP 44)
4. Crosses of 1985/1986 (see VP 45)

3.1. VP 39 - *Evaluation of seedlings obtained from the crosses of 1980/1981*

See VP 67, VP 70, VP 71, LVP 66 and LVP 72

3.2. VP 43 - *Evaluation of seedlings from the crosses of 1982/1983*

See VP 72 and LVP 67

3.3. VP 44 - *Evaluation of seedlings from the crosses of 1984*

See VP 73 and LVP 68

3.4. VP 45 - *Evaluation of seedlings from the crosses of 1985*

Refer under Phase I.

V.Shanmugarajah, Umah Sritharan, B.A.Rathnagoda, M.Ratnayake and S.W.Gunadasa

4. Testing of clonal progenies (Phase 1)

4.1. Low-country

4.1.1. LVP 55 - *Evaluation of clones from Aislaby and Hugoland seed (LVP 30, Deniyaya - 1983) on Handford Estate, Deniyaya - (1991)*

4.1.2. LVP 56 - *Evaluation of clones from VP 37 (St. Coombs) in Field No. 5, St. Joachim Estate, Ratnapura - (1992)*

4.1.3. LVP 57 - *Evaluation of clones from polyclonal seed established on Parambe (LVP 42), in Field No. 5 St. Joachim Estate, Ratnapura - (1992)*

4.1.4. LVP 58 - *Evaluation of clones from Aislaby seed (LVP 28, 1983 St.Joachim Estate) in Field No. 5, St. Joachim Estate, Ratnapura - (1992)*

4.1.5. 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)*

LVP 56, LVP 57, LVP 58 and LVP 59 - The bushes were pruned, weight of the prunings recorded, visual scoring for shot-hole borer carried out and cuttings from these bushes were propagated in the nursery for the Phase II trial.

A.K.M. Jayasena, J.H.N.Piyasundara, M.Ratnayake, S.W.Gunadasa and V.Shanmugarajah

4.1.6. LVP 61 - *Evaluation of clones from polyclonal seed established on Parambe (LVP 42), in Field No. 2A & 5N, St. Joachim Estate, Ratnapura - (1993)*

The yields of the 21 highest yielding clones along with control clones over 48 plucks are given in Table 1.

TABLE 1 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
186	5344
160	5184
109	4432
281	4405
375	4360
342	4331
298	4263
253	4205
243	4089
285	4067
66	4036
322	3867
10	3840
168	3704
289	3649
171	3439
106	3357
297	3353
215	3308
173	3244
2023 (control)	3241

A total of 37 clones yielded more than the control clone TRI 2027 which gave a yield of 2253 kg.

4.1.7. LVP 62 - *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)*

The yields of the 22 highest yielding clones along with control clones over 48 plucks are given in Table 2.

TABLE 2 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone		*Yield*
23		4418
12		4170
63		3924
11		3865
13		3709
59		3666
64		3554
54		3435
2025	(control)	3317
55		3077
10		2931
72		2886
2023	(control)	2858
51		2850
36		2803
49		2647
2027	(control)	2589
47		2520
58		2403
70		2380
67		2354
52		1956
53		1479
30		1389

4.1.8. 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)*

The yields of the 14 highest yielding clones along with control clones over 48 plucks are given in Table 3.

TABLE 3 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone		*Yield*
2023	(control)	5998
21/23		4877
14/17		4877
1/2		4868
30/70		4665
31/1		4653
14/11		4152
29/23		4133
8/8		3996
14/19		3980
8/9		3971
24/4		3812
19/22		3811
2025	(control)	3761
11/11		3750
15/18		3602
2027	(control)	3590

4.1.9. LVP 64 - *Evaluation of clones from ASM 1988 Introduction seed; Field No. 2A, St. Joachim Estate, Ratnapura - (1993)*

The yields of the 8 highest yielding clones along with control clones over 48 plucks are given in Table 4.

TABLE 4 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone		*Yield*
5		2967
2023	(control)	2934
10		2857
2025	(control)	2321
12		2108
19		1750
18		1628
6		1530
16		1435
11		1059
2027	(control)	781
LSD	(P=0.05)	0.38
CV %	= 35.68	

A.K.M. Jayasena, M.Ratnayake, Umah Sritharan and J.H.N.Piyasundara

4.1.10. LVP 66 - *Evaluation of clones from VP 39 in Field No. 2A, St.Joachim Estate - (1994)*

The yields of the 12 clones yielding more than the control clone TRI 2027 over 28 plucks from 10.6.96 to 30.12.96 are given in Table 5.

TABLE 5 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone		*Yield*
2023	(control)	4303
115		3412
95		3310
222		3300
38		3278
249		3241
139		3193
216		2830
113		2755
2026	(control)	2735
129		2734
251		2691
255		2659
218		2584
2027	(control)	2515

4.1.11. LVP 67 - *Evaluation of clones from VP 43 in Field No. 2A, St.Joachim Estate, Ratnapura - (1994)*

The yields of the 11 highest yielding clones along with the controls over 28 plucks are given in Table 6.

TABLE 6 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
708	3999
510	3460
709	3310
571	3294
745	3177
763	3118
2023	3097
583	2990
710	2905
617	2851
632	2841

Forty four clones yielded more than the control clone TRI 2027 which yielded 1300 kg.

4.1.12. LVP 68 - *Evaluation of clones from VP 44 in Field No. 2A, St.Joachim Estate - (1994)*

The yields of the six highest yielding clones along with the controls over 28 plucks are given in Table 7.

TABLE 7 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone		*Yield*
971		3428
951		2915
2025	(control)	2890
952		2889
2026	(control)	2830
2023	(control)	2596
920		2552
1037		2536
935		2365

4.1.13. LVP 71 - *Evaluation of clones from polyclonal seed LVP 45 and LVP 46, in Field No. 2A & 5N, St. Joachim Estate, Ratnapura - (1994)*

The yields of the 28 highest yielding clones along with the controls over 24 plucks from 12.6.96 to 26.12.96 are given in Table 8.

TABLE 8 - *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
5/38	4667
6/28	4625
13/30	4558
4/16	4371
4/40	4221
15/40	4011
5/30	3818
7/33	3640
3/12	3568
14/51	3444
6/24	3422
6/2	3353
11/46	3319
4/4	3301
3/13	3196
2/4	3163
1/12	3156

6/13		3137
3/38		3017
15/51		2972
3/2		2937
6/32		2899
1/9		2899
6/36		2848
3/15		2803
15/36		2705
6/29		2634
4/13		2621
2026	(control)	2594

4.1.14. LVP 72 - *Evaluation of clones from VP 39 in Field No. 2A, St.Joachim Estate, Ratnapura - (1994)*

The bushes were brought into plucking.

4.1.15. LVP 73 (LVP 49/LC/I) - *Evaluation of clonal selections from Urumiwela and Karandupona (LVP 49) in Field No. 1, St. Joachim Estate, Ratnapura - (1996)*

Promising selections from the seedlings planted in Field No. 5 were propagated and planted in August in Field No. 1. The details are as follows:

Number of selections - 473
Number of plants - 7 (per replicate)
Number of replicates - 2
Control clones: TRI 2025, 2026, 2027

A.K.M. Jayasena, M.Ratnayake, S.W.Gunadasa, J.H.N. Piyasundara and V.Shanmugarajah

4.2. Up-country

4.2.1. VP 49 - *Evaluation of clones from VP 37 (St. Coombs) in Lamiliere Division, St.Coombs - (1990)*

Refer Phase II.

4.2.2. VP 51 - *Evaluation of clonal selections from VP 37 and from Aislaby, Hantane and Hugoland seed (VP 38) in Field No.4, St.Coombs Estate, Talawakele - (1990)*

As there were no promising clones this trial was terminated.

V.Shanmugarajah, M. Ratnayake, Umah Sritharan, S.W. Gunadasa and B.A.Rathnagoda

4.2.3. VP 55 and VP 56 - *Evaluation of clonal selections from Aislaby, Hugoland and Hantane seed (VP 38) in Field No. 9, St. Coombs Estate, Talawakele - (1991)*

The bushes were pruned for propagation of cuttings for Phase II trial.

4.2.4. VP 60 - *Evaluation of clones from VP 37in Field No. 10, St. Coombs - (1992)*

Plucking was terminated at the end of the first cycle and the bushes were rested for pruning.

4.2.5. VP 61 - *Evaluation of clones from ASM 1988 Introduced Seed in Field No. 10, St. Coombs Estate, Talawakele - (1992)*

Plucking was terminated at the end of the first cycle and the bushes were rested for pruning.

4.2.6. VP 63 - *Evaluation of clones developed from VP 37 and from Aislaby seed. Venture Estate, Norwood - (1992)*

The yields of the 38 highest yielding clones along with control clones over 29 plucks are given in Table 9.

TABLE 9 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
651	6224
582	5839
A 20	5285
283	5003
264	4786
147	4627
460	4522
629	4395
A 136	4306
350	4197
449	4076
558	4072
474	3979
A 2	3833
148	3702
593	3680
583	3593
268	3494
433	3298
324	3293

574	3273
A 135	3247
161	3247
443	3200
A 27	3175
A 140	3156
595	3152
457	3069
A 15	3046
A 17	2967
A 147	2962
272	2940
A 8	2932
163	2893
220	2884
252	2869
507	2780
2027 (control)	2727
2025 (control)	2724

4.2.7. VP 67 - *Evaluation of clones from VP 39 in Field No. 10, St.Coombs Estate, Talawakele - (1993)*

The yields of the 22 highest yielding clones along with control clones over 44 plucks are given in Table 10.

TABLE 10- *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
197	1962
295	1940
97	1937
219	1932
265	1917
252	1908
310	1878
254	1878
268	1839
241	1829
267	1828
332	1778
258	1748
121	1729
261	1722
179	1710
278	1705
322	1688
250	1670
178	1659
288	1646
292	1632
2025 (control)	1618

4.2.8. VP 69 - *Evaluation of clones developed from ASM 1988 Introduction seed in Field No.10, St.Coombs Estate, Talawakele - (1993)*

The yields of the clones along with the controls are given in Table 11.

TABLE 11 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
34	2554
14	2165
23	1991
5	1834
16	1706
25	1653
B II	1624
B I	1534
10	1469
12	1366
B III	1341
18	1321
30	1242
24	1226
11	1226
9	1222
6	1205
19	1035
8	662
LSD (P=0.05)	
CV % = 32.26	

4.2.9. VP 70 - *Evaluation of clones from VP 39 in Venture Estate, Norwood - (1993)*

The recording of yields has commenced.

S.W.Gunadasa, M.Ratnayake, B.A.Rathnagoda, Umah Sritharan and V.Shanmugarajah

4.2.10. VP 71 - *Evaluation of clones from VP 39 in Field No. 14, St.Coombs Estate, Talawakele - (1994)*

Visual assessment of growth was carried out and the plants were given the final cut across.

4.2.11. VP 72 - *Evaluation of clones from VP 43 in Field No.14, St.Coombs Estate, Talawakele - (1994)*

The recording of yields has commenced.

4.2.12. VP 73 - *Evaluation of clones from VP 44 in Field No. 14, St.Coombs Estate, Talawakele - (1994)*

Visual assessment of growth was carried out and the plants were given the final cut across.

4.2.13. VP 75 (VP 45/UC/I) - *Evaluation of clones from VP 45 in Field No. 14, St. Coombs Estate, Talawakele - (1995)*

Seven plants each of 26 clones planted in 1995 were tipped first, weight of the tipped shoots recorded and visual assessment of growth was carried out.

4.2.14. 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, Talawakele - (1995)*

First tipping was done on the seven plants each of 48 clones planted in 1995, weight of the tipped shoots recorded and visual assessment of growth was carried out.

4.2.16. VP 77 (VP 58/UC/I) - *Evaluation of clones from polyclonal seed from the seed gardens of Karandupona and Urumiwela (VP 58), in Field No. 12, St Coombs Estate, Talawakele - (1996)*

Promising selections of the above were planted in July/August.

Number of selections	-	100
Number of plants	-	7 (per replicate)
Number of replicates	-	2
Control clones	-	2025 and DT 1

4.2.17. VP 78 (LVP 49/UC/I) - *Evaluation of clones from polyclonal seed from the seed gardens of Karandupona and Urumiwela (LVP 49), in Field No. 12, St Coombs Estate, Talawakele - (1996)*

Promising selections of the above were planted in July/August.

Number of selections	-	200
Number of replicates	-	2
Control clones	-	TRI 2025 and 4006

V.Shanmugarajah, M.Ratnayake, S.W. Gunadasa B.A.Rathnagoda and Umah Sritharan

4.3. Uva

4.3.1. UVP 8 - *Evaluation of clones from ASM 1988 Introduction seed from St.Coombs Estate, at TRI substation, Passara - (1993)*

5. Clonal Trials (Phase II)

5.1. Up-country

5.1.1. VP 41 and VP 42 - *Testing 60 clones at St. Coombs Estate, Talawakele - (1984)*

Shoots harvested from these plots were issued to estates and smallholders for establishing '4000' series multiplication plots.

5.1.2. VP 49 (VP 49/UC/II) - *Evaluation of clones from VP 37(St. Coombs) in Lamiliere Division, St.Coombs Estate, Talawakele - (1996)*

Promising selections were planted in July/August.

Location	- Field No. 12
Number of selections	- 34
Number of plants	- 24 (per replicate)
Number of replicates	- 2
Control clone	- TRI 2025

5.1.3. VP 62 - *Testing ten 4000 series clones at St. Coombs Estate, Talawakele*

Recording of yields was concluded and the bushes rested. These will be used as mother bushes for supplying cuttings.

V.Shanmugarajah, M.Ratnayake, S.W.Gunadasa, Umah Sritharan and B.A.Rathnagoda

5.2. Low-country

5.2.1. LVP 43 - *Testing 42 clones on Diyadawa Estate, Deniyaya. - (1990)*

Plucked along with the rest of the field.

5.2.2. LVP 60 - *Testing nine clones at Golinda estate, Kegalle*

Plucking was continued.

A.K.M. Jayasena, M.Ratnayake, S.W. Gunadasa, and J.H.N. Piyasundara

5.3. Uva

5.3.1. UVP 7 - *Testing 38 clones at TRI substation, Passara (Pelagahatenne)*

Shoots were harvested from these plots and issued to Estates and smallholders for establishing '4000' series multiplication plots.

M.B.A. Perera and V.Shanmugarajah

6. Evaluation of '3000' and '4000' series clones (Phase III trial)

6.1. Up-country

6.1.1. VP 50 - *St. Coombs Estate, Lamiliere Division - (1990)*

Shoots were issued to estates and smallholders from these plots.

6.1.2. *Stockholm Estate, Nissanka Uyana - (1991)*

The yields of the clones along with control clones are given in Table 12.

TABLE 12 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone		*Yield*
3020		3549
3048		3289
2025	(control)	3049
3016		2914
3069		2876
DN	(control)	2804
3017		2634
3015		2601
3019		2341
3018		2314
3013		2288
K145	(control)	2242
3014		1867

CV % = 42.95

6.1.3. *Gordon Estate, Udapussellawa - (1991)*

The yields of the clones along with controls over 37 plucks are given in Table 13.

TABLE 13 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone		*Yield*
3015		3345
PK2	(control)	3154
2025	(control)	2927
3016		2508
3017		2495
3018		2115
DT1	(control)	2101

6.1.4. VP 59 - *St. Coombs Estate, Field No. 10 - (1992)*

Plucking was continued.

6.1.5. *Venture Estate, Norwood. Field No. 9A - (1992)*

Plucking was continued.

6.1.6. *Venture Estate, Norwood. Field No. 10 - (1993)*

Plucking commenced and yields are being recorded. Blister blight assessment was carried out by the Pathology Division.

6.1.7. *Sheen Group, Pundaloya. Field No.3 NC 5 A* - (1992)*

* - in the *Annual Report for* 1995 the Field number had been inadvertently reported as NC 59A instead of NC 5A.

The yields of the clones along with control clones are given in Table 14.

TABLE 14 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
2025	3366
4083	2508
4075	2430
3069	2411
4076	2396
DT 1	2128

V.Shanmugarajah, S.W. Gunadasa, M.Ratnayake, Umah Sritharan and B.A. Rathnagoda

6.2. Uva

6.2.1. *Verellapatana Estate - Doomo Division - 1988*

No recording of yield was done.

6.2.2. *Smallholdings in Bandarawela, Hali-ela and Boralanda - (1992)*

Plucking was continued and clone TRI 3035 was observed to be doing well in Boralanda.

6.2.3. *TSHDA - Hali-ela - (1992)*

Plucking was continued.

6.2.4. *Hakgala Estate, Boragas -(1993)*

Handed over to estate.

M. Ratnayake, S.W. Gunadasa and B.A. Rathnagoda

6.3. Mid-country wet zone

6.3.1. *Hantane Estate - (1991)*

6.3.2. *Smallholdings in Ukuwela, Danture, Teldeniya, Dodanwela and TSHDA nursery, Muruthalawa.*

Plucking was continued in the smallholdings in Ukuwela and in TSHDA, Sooriyagoda, Muruthalawa.

M. Ratnayake, S.W. Gunadasa and B.A.Rathnagoda

6.4. Low-country

6.4.1. LVP 38 - *Watapotha Estate - (1988)*

The yields of the clones along with controls over 46 plucks (from 4.1.96 to 27.12.96) are given in Table 15.

TABLE 15 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
2023 (control)	5306
4047	3409
4055	3025
4054	3003
DG 39 (control)	2955
KEN 16/3 (control)	2949
4056	2796
4059	2683
4053	2633
3020 (control)	2137
LSD (P=0.05)	0.65
CV % = 29.28	

6.4.2. *Smallholding at Dehiowita*

The yields of the clones along with controls over 68 plucks (from 6.7.95 to 26.12.96) are given in Table 16.

TABLE 16 - *Yield of clones (kg ha^{-1} yr^{-1})*

Clone	*Yield*
4053	6901
4061	6708
4006	6158
4059	6056
2023	6055
4055	6031
4033	5291
2025	5109
2027	4861
4004	4854

6.4.3. LVP 65 - *St.Joachim Estate, Ratnapura - Multiplication rows of 4000 series and estate clones.*

Cuttings from these plots were issued to estates and smallholders.

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 evaluation trials. The estates to which the cuttings have been issued, the clones and the approximate number of cuttings issued are given below.

7.1. Up country

Estate	*Clone*	*Shoots*
Mousakelle	3013, 3014, 3020, 3069 3072, 3073	100 - 200 each
	4006, 4052 , 4053, 4063 4071, 4078, 4079	200 each
Watagoda	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 - 200 each
Gouravilla	3047, 3069	250 each
	4006, 4079	250 each
Poonagalla	4052, 4053, 4067, 4071 4078	400 each

Norwood	3013, 3046, 3047, 3049 3052, 3069, 3072, 3073	1000 - 4500 each
	4006, 4052, 4053, 4063 4067, 4071, 4079	1100 - 4000 each
	3013, 3014, 3042, 3047 3048, 3049, 3052, 3072 3073	4000 each
	4006, 4052, 4053, 4067 4071, 4078, 4079,	7000 each
Cocogalla	3013, 3014, 3017, 3020 3041, 3049, 3069, 3073	200 - 6200 each
	4006, 4047, 4052, 4053 4067, 4070, 4071, 4078 4079	200 - 1200 each
Unugala	3013, 3014, 3020, 3047 3048, 3049, 3073	200 each
	4006, 4053, 4070, 4078	100 - 200 each
Downside	3013, 3014, 3020, 3049 3069, 3073	200 each
	4006, 4053, 4067, 4071 4078, 4079	200 each
Welimada	4006, 4042, 4046, 4047 4053, 4070, 4071, 4078	100 - 200 each
Shannon	3013, 3014, 3015, 3016 3017, 3018, 3019, 3020	100 - 200 each
	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4083, 4085	100 - 200 each
Ankumbura	4046	300
Monticristo	4006, 4046, 4047, 4053 4067, 4071, 4078	100 - 400 each
Melford	4006, 4024, 4042, 4046 4052, 4053, 4067, 4071 4078	100 - 400 each

Delta	4006, 4024, 4042,4046 4052, 4053, 4067, 4071 4078	100 - 1200 each
Kalugalla	4006, 4024, 4042, 4046 4052, 4053, 4067, 4071 4078	100 - 400 each
Gartmore	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4083, 4085	100 - 200 each
Kolapatana	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4083, 4085	100 - 400 each
Mattakelle	4052, 4053, 4063, 4067 4071, 4078, 4079, 4083 4085	25 - 100 each
Concordia	4052, 4053, 4056, 4067 4070, 4071, 4072, 4073 4078, 4085	25 - 100 each
Liddesdale	3014, 3025	100 each
	4045, 4046, 4047, 4052 4066, 4070	100 each
Attampettiya	3013, 3014, 3018, 3019 3020, 3069	50 - 100 each
	4042, 4046, 4047, 4053 4070, 4071, 4078	50 - 100 each
Binoya'B'	3013, 3014, 3015, 3016 3017, 3018, 3019, 3020 3069, 3072, 3073	50 - 100 each
	4006, 4052, 4053, 4063 4071, 4078, 4079, 4083	50 - 150 eac
Ireby	3048, 3072, 3073 4006, 4052, 4053, 4071	1000 each 500 - 1000 each
Doteloya	3014, 3019, 3029	50 - 100 each
	4006, 4019, 4024, 4042 4046, 4053, 4067, 4071 4078	50 - 100 each
M.R.A.U.Yatigammana	4006	500

7.2. Low - country

Estate	*Clone*	*Shoots*
Rye/Wikiliya	4014, 4047, 4049, 4053	
Balangoda	4055, 4061, KP 202	100 each
Kelani	4061, 4049, 4053, 4055	
Yatiyantota	4047, 4554, 4059, 4062	
	4014, 3046	100 each
Dumbara	4053, 4061, 4047, 4062	
Ingiriya	4049, 4059, 4055, 4014	
	4006, S 106	50 each
Gikiyanakanda	4014, 4047, 4053, 4049	
Naboda	4055, 4059, 4062, 4061	
	H 1/58, S 106	50 each
Pelawatta	4059, 4062, 4014, 4006	50 each
Pelawatta	4061	100 each
	4055	150 each
Watapotha	4046, 4042, 4014, 3065	50 each
Nivitigala	4047, 4049	100 each
Keeragala	2027	1000 each
Kuruwita		
Hemingford	4049, 3025	100 each
Parakaduwa	4059, 4047, 4042, 4046	
	4014, 4006	50 each
Yataderiya	4049, 4059, 4006, 4014	
Undugoda	4046, 4042	50 each
	3025, 4047	100 each
Balangoda Group	4055, 4061, 4047, 4053	
Balangoda	4006, 4059, 4062, 4042	
	4014, 4046	50 each
Pampegama	4055, 4061, 4053, 4006	
Parakaduwa	4062, 4042, 4014, 4046	
	4049, 4002, 4047, 4059	50 each
Agronomy Division	4061, 2027, 3025, 2025	400 each
TRI		
St Joachim	20 series clones	500 each
Ratnapura		

Smallholders

Name	*Clone*	*Shoots*
A.Rajapaksha	4059	50 each
Ratnapura	62/6, 4047, 4055, 3041	
	3055	100 each
	4061	75
	3014	30
G.M.Piyadasa	4059, 4047, 4055, 4061	
Ratnapura	4014, 4053, 3041, 3055	
	62/6	50 each
Green Rock Estate	3055, 3014, 3046	200 each
Dehiowita	4055, 4049	50 each
	SJ 02	100
	S 106, 2027	200 each
K.M.Kulathunga	3014	100
Ratnapura	3046	250
Mr Janaka	2027, 4014	50 each
Pelmadulla	4049, 4047, 3014	250 each
	4055, 3025	100 each
Sirisena Wijesingha	4053, 4049, 3055	200 each
Haldummulla	3046, 3014, 4006, 2025	100 each
Kumara Sugathapala	3025, 3055, 3041, 3047	
Ratnapura	3014, 3046, 4014, 4047	
	4002, 4062, 4059, 4054	
	4055, 4053, 4061, 4049	50 each
Upula Hemapala	3055, 3041, 3047, 3025	
Wavalawatha	3014, SJ 02, S 106	50 each
W.Udumulla	3055, 3041, 3047, 3025	
Ratnapura	3014, SJ 02, S 106	50 each
Padma Hemapala	3055, 3041, 3047, 3025	
Kuruwita	3014, 4059, 4042, SJ 02	
	S 106	50 each
Samitha Attigala	3041, 3055, 3060, 3047	
	3046, 3014	50 each
D.M Piyadasa	S 106	100 each
Ratnapura		

G.D.S.Ajithkumar	3055, 3014, 3046, 3041		
Ratnapura	S 106	100	each
Mr Kulathunga	2025	500	
Eheliyagoda	3025	100	
	62/9	50	
	2025	300	
L.D.Dharmaratna	2027	300	
Homagama			
E.W.Fernando	2025	300	
Ratnapura			
V.P.P.Abeyratne	3014, 3055, 2027, 2025		
Gallale	4014, 4047, 4055, 4059		
	4061, 4062, 4053	50	each
W.V.Kusumsoma	4047, 4067, 4062, 4055		
Gallale	4053, 3014, 2025, 2016	50	each
J.A.S.P.Abeywickrema	4061, 2027	100	each
Kuruwita	4014, 4046	50	each
	3055	150	each
	3014	200	each
W.Rajapakse	2027	500	each
Ratnapura			

8. Project B/TC - Tissue Culture

While work is in progress at the Hantane laboratory, a culture room has been organised within a short time and *in vitro* culture of clone TRI 4006 has been commenced at Talawakele.

8.1. *Development of roots on in vitro tea shoots (R 1.1)*

This experiment was initiated to investigate the effect of culture composition and the root development on in vitro shoots. Treatments:

1. MS 1/2)
2. MS 1/2 + 0.5 IBA) with IBA dip
3. MS 1/2 + 1.0 IBA)
4. MS 1/2 + 1.0 IBA + 0.5 NAA)

5. MS 1/2)
6. MS 1/2 + 0.5 IBA) without IBA dip
7. MS 1/2 + 1.0 IBA)
8. MS 1/2 + 1.0 IBA + 0.5 NAA)

The experiment was of RCD with 25 replicates.
The results are presented in Tables 1 and 2.

TABLE 1 - *Root development on shoots produced in vitro of clones CY 9 and DG 7 (3 months in culture)*

Medium (mgl^{-1} hormone)	*% rooting without dipping in IBA*	*% rooting with dipping in IBA*
MS 1/2	0	50 - 60
MS 1/2 + 0.5 IBA	0	0
MS 1/2 + 1.0 IBA	0	10
MS 1/2 + 1.0 IBA + 0.5 NAA	40 - 50	-

The results indicate that 50 - 60 % and 40 - 50 % rooting was obtained with treatments Nos 1 and 8 respectively.

TABLE 2 - *The effect of culture composition and dipping in IBA on root development*

Treatment	*Number of roots Month*			*Length (cm) of roots Month*		
	1	2	3	1	2	3
MS 1/2 with IBA dip	2.0 a	4.0 a	5.0 b	0.25 a	1.0 b	1.5 b
MS 1/2 without IBA dip	1.0 a	3.0 a	4.0 b	0.25 a	1.0 b	1.7 b

Values are means of 25 replicates. Means followed by the same letter are not significant at P = 0.05

8.2. *Regeneration ability of tea leaf callus (SE 96 2.2)*

This experiment was commenced to investigate whether 2,4-D has any carry over effect on regeneration. The leaf callus of clone TRI 3016 was subcultured on the following media:

1. MS + IBA + BAP
2. MS + IAA + BAP

The experiment was of RCD with 20 replicates. Visual observations are being carried out fortnightly and the experiment is in progress.

8.3. *Somatic embryogenesis on leaf callus culture (SE 96 2.3)*

In view of the promising results obtained earlier an attempt was made to maintain the suspension and to get proembryos in large numbers and to regenerate plants from somatic embryos which could be applied for breeding purposes. The treatments are:

1. MS + 2-4 D + BAP
2. MS + green coconut water

This experiment is in progress.

8.4. *Quantification study on multiplication of tea clones (ME 95)*

Pure cultures of 20 shoot meristems of clones DG 7 and CY 9 were used. The pathway is as follows:

In vitro shoot meristem —> multiplication up to 6th subculture ——> quantification —> continuous subculturing —> plant regeneration

The number and length of the shoots were recorded at the time of subculturing up to the 6th subculture. A multiplication rate of 2 to 2.5 for clones DG 7 and CY 9 was observed.

T.M.Sarathchandra and K.Sarathchandra

8.5. *Quantification of micropropagation through shoot tip culture*

Twelve cultures of 4 clones, DG 7, DT 1, TRI 3016 and TRI 3019 were subcultured thrice. Power failures during the period of this study affected clone TRI 3019 very badly and the experiment is being continued with the cultures of the other three clones. Three subcultures were done.

8.6. *Quantification of micropropagation through seedlings*

Four subcultures were done in this experiment with 14 seedlings. Power failures during the period of this experiment affected the growth and proliferation. The number of cultures maintained in rooting and multiplication media was 144; the number of cultures rooted was 113 (about 78 %) and rooted cultures were acclimatized. The experiment is in progress.

8.7. *Plant regeneration from cotyledon callus cultures*

Fresh cotyledons of DG 39 x TRI 2023 seeds collected from biclonal seed garden at Hantane were cultured in solid and liquid media consisting of 2,4-D, kinetin and green coconut water. This experiment too was affected by the power failures and the cultures in liquid medium turned brown. Though affected, the cultures in the solid medium recovered after resumption of power. These cultures were transferred to regeneration medium consisting of BAP, kinetin and IAA. Some of the callus cultures have produced adventitious shoots and this experiment is in progress.

8.8. *Field performance of tissue cultured plants*

Recording of yields and of the condition of the buds of individual plants of the first batch (15 plants) planted at Hantane in 1993 was carried out.

A growth assessment was carried out before a second set of 28 plants were planted at Hantane.

A growth assessment of the 24 plants planted at Talawakele in 1994 was carried out and the plants were given a cut at 50 cm (20 inches) and brought into plucking. Fresh and dry weight of the leaves and stem removed were recorded.

8.9. *Chemical and bio test - High Forest Problem*

With a view to determine the cause of the High Forest Problem by chemical and bio tests, embryos from seeds of high jat clones TRI 2024, 2025, 2043 and DN and from seeds of low jat seedlings from Melfort Estate, Pussellawa were excised and cultured. This study is in progress.

P.D.Upali

9. Visitors

Dr K.A.Malik, Director of the National Institute for Biotechnology and Genetic Engineering visited the Division in May/ June and had discussions with the staff on tissue culture and on biotechnology/ genetic engineering.

Dr (Mrs) K.Hirimburegama, Senior Lecturer in Botany, University of Colombo and our Advisor in Tissue Culture visited the Division. She gave a seminar for the staff of the Institute on 'Prospects of Micropropagation of Tea in Sri Lanka'. She was accompanied by Prof Wolfgang Gohde of the University of Munstar, Germany, inventor of an instrument 'Flow Cytometer' for determining the ploidy level of plant material.

Students from the Faculty of Agriculture, University of Peradeniya visited the Division and the nursery.

10. Seminars / Training Programmes

Mr V.Shanmugarajah addressed -

- the executives of the Agrapatna Plantations on 'Nursery management' on 15.03.96.

- the members of Uva RSC on 'Clones for Uva' on 26.03.96.

He also delivered a lecture to the NIPM students on 'Selection, Breeding and Propagation' on 28.05.96.

A one day training programme for the M.Sc students of the University of Colombo was conducted by the Tissue Culture Unit in June.

11. Publications

SARATHCHANDRA, T.M.S and SARATHCHANDRA, K. (1996). Root formation on *invitro* micropropagated shoots of *Camellia sinensis* (L). *S.L.J.Tea Sci.* (in press)

SHANMUGARAJAH, V, VITARANA, S.I., RATNAYAKE, M., GUNADASA, S.W. and UMAH SRITHARAN. (1996). Clones: An update on performance and suggestions for appropriate combinations. Proc. 193rd Experiments and Extension Forum, 5 Aug. 1996, pp 7 - 16.

SHANMUGARAJAH, V. and VITARANA, S.I. (1996). Clones of TRI 3000 and 4000 series. TRI Update, Vol 1 (3) Dec. 1996.

SOILS AND PLANT NUTRITION DIVISION

Acting Head - L.S.K.Hettiarachchi

1. General

Mr W.M.S.Wijethunge was transferred to Hantane sub station with effect from 05th March 1996, in order to establish a unit of Soils and Plant Nutrition Division (SPND). A unit of SPND was established in Hantane sub station.

Mr A.K.N.Zoysa, Research Assistant proceeded to the Massey University, New Zealand in March, after completing his local research component at TRI, to complete his post - graduate study.

Dr G.D.Wimaladasa was promoted to the post of Deputy Director (Research) (Production) with effect from 01st August 1996, and Dr L.S.K.Hettiarachchi was appointed as Acting Head of the division with effect from 02nd September, 1996.

The following students underwent a four training programme on the analysis of soil, plant and fertilizer samples: Mr N. Vidanapathirana, NCA trainee from Technical College, Kuliyapitiya commencing from 2nd week of January; Mr C.Pathirage, NCA trainee from Techincal College, Kuliyapitiya commencing from 2nd week of March; Mr E.A.P.D. Edirisinghe, final year Chemistry special undergraduate, University of Colombo commencing from 2nd week of March; Mr S.Dahanayake, NDT trainee from Technical College, Kuliyapitiya commencing from 2nd week of July; Messrs N.P. Wasantha Kumara and K.A.E.P. Fernando, NCA trainee from Technical College, Kuliyapitiya commencing from 3rd week of November; Messrs R.M.A. Ratnayake and C.Maddekanda, NDT trainees from 2nd week of November; Messrs R.M.A. Ratnayake and C.Maddekanda, NDT trainees from Hardy Techincal college, Ampara commencing from 1st week of December.

Dr L.S.K.Hettiarachchi continued to serve as a member of the Working Group on Fertilizer at the Sri Lanka Standards Institution.

2. 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 to maximize the productivity.

Field experiments have been carried out and reported under B/FERT whereas the laboratory and glasshouse experiments carried out have been under D/AGCH. Developments in relation to soil and plant chemical aspects, and soil, plant and fertilizer analyses carried out have been reported under C/ANAL.

2.1. Soil and Fertilizer Nitrogen Studies

2.1.1. Application of different proportions of sulphate of ammonia and urea on soil/plant sulphur status and yield of tea, St.Coombs Estate, Talawakele - Clone TRI 2025 (1980).

The yield obtained during the period of 4th year of the 4th cycle is given in Table 1.

Generally, application of N at 360 kg ha^{-1} yr^{-1} increased the yield significantly, compared to 240 kg ha^{-1} yr^{-1}. But no consistent pattern in yield differences were observed between any of the treatment combinations although the yield differences between 100 SA/0 urea at 360 kg N ha^{-1} yr^{-1} and the rest of other combinations were greater than the LSD value.

TABLE 1 - *Effect of different proportions of SA/urea on yield (made tea kg ha^{-1} yr^{-1}) of mature tea*

Levels of N (kg ha^{-1} yr^{-1})	*Proportions (%) of*		*Yield (made tea kg ha^{-1} yr^{-1})*
	SA (N)	*Urea (N)*	
240	100	0	676
	75	25	682
	50	50	714
	25	75	708
	0	100	700
360	100	0	893
	75	25	741
	50	50	713
	25	75	728
	0	100	746
LSD (P = 0.05)			101
CV %			8

The effect of application of SA/urea on sulphur status of soil (0-15 & 15-30 cm) is given in Table 2.

TABLE 2 - *Effect of application of different proportions of SA/urea on sulphur status (mg kg^{-1}) in soil at 0-15 and 15-30 cm depths*

Level of N (kg ha^{-1} yr^{-1})	Proportions (%) of		So^{2-}-S (ma^{4} kg^{-1})	
	SA (N)	Urea (N)	0-15 cm	15-30 cm
240	100	0	132	267
	75	25	160	380
	50	50	146	282
	25	75	102	248
	0	100	67	144
360	100	0	154	288
	75	25	171	383
	50	50	117	264
	25	75	115	262
	0	100	68	169
L.S.D.			76.7	153.9
CV% =			36	33

The So^{2-} 0-S levels were markedly increased at both 0-15 and 15-30 cm soil depths with increased proportions of SA in SA/urea combinations at both N levels. Flush (bud first and second leaf) and mature leaf samples collected from the plots that received different proportions of sulphate of ammonia and urea, and the replicates

were composited in order to make one representative sample. The flush samples were manufactured through miniature model and samples were analysed for S Status. (Table 3)

TABLE 3 - *Effect of application of different proportions of SA/urea on sulphur status of matura leaf, flush and made tea.*

Level ($kg\ ha^{-1}\ Yr^{-1}$)	*Proportions (%) of* SA (N)	Urea (N)	*S concetration (%)* Flush	Mature leaf	Made tea
240	100	0	0.44	0.42	0.42
	75	25	0.37	0.38	0.41
	50	50	0.37	0.40	0.43
	25	75	0.34	0.39	0.42
	0	100	0.41	0.41	0.37
360	100	0	0.40	0.39	0.48
	75	25	0.42	0.38	0.48
	50	50	0.38	0.38	0.48
	25	75	0.37	0.37	0.44
	0	100	0.37	0.34	0.39

No consistent differences in S concentration of flush, mature leaf and made tea samples were observed.

Plants from these plots were pruned in the first week of June and pruning weights are given in Table 4.

TABLE 4 - *Effect of application of different proportions of SA/urea on pruning weights.*

Level of N ($kg\ ha^{-1}\ yr^{-1}$)	*Proportions (%) of* SA (N)	Urea (N)	*Pruning weight* ($t\ ha^{-1}$)
240	100	0	14.6
	75	25	15.6
	50	50	16.3
	25	75	16.1
	0	100	17.1
360	100	0	16.3
	75	25	17.3
	50	50	17.2
	25	75	17.7
	0	100	16.6
LSD (P = 0.05)			2.94
CV %			10.4

No significant differences in pruning weight were observed due to any of the treatments. This experiment is in progress.

S.Ananthacumaraswamy and L.S.K.Hettiarachchi

2.1.2. Application of very high levels of urea and sulphate of ammonia on soil/plant nutrient status and yield of tea, St.Coombs Estate, Talawakele - Clone TRI 2025 (1980).

This is an observation trial established in 1990 to study the ill effects of high levels of nitrogen. Plants from these plots were pruned in the first week of June, therefore the yield obtained for the period December 1995 to June 1996 i.e. 5th year of the 1st cycle is 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* (*made tea* $kg\ ha^{-1}\ yr^{-1}$)	
	Urea	*SA*
0	610	647
300	790	773
600	790	893
900	942	1020
1200	987	1045
1500	1132	1315

During the above period, in general, the yields were increased with the increasing N rates. In general the yields of SA treated plots were higher than that of urea treated plots.

This experiment is in progress.

G.P.Gunaratne and L.S.K.Hettiarachchi

2.1.3. Improvement of soil organic matter status and efficiency of uptake of inorganic fertilizer nutrients by incorporation of different sources of organic-manure, Bearwell Estate, Talawakele - Clone TRI 2025 (1990).

The yield obtained in the 1st year of the 2nd cycle is presented in Table 6.

TABLE 6 - *Effect of levels and sources of organic manure at 0 and 240 kg N* $ha^{-1}\ yr^{-1}$ *on the yield (made tea kg* $ha^{-1}\ yr^{-1}$*) of tea.*

Level of organic manure ($t\ ha^{-1}\ yr^{-1}$)	*5 t*		*10 t*	
Level of N ($kg\ ha^{-1}\ yr^{-1}$)	*0*	*240*	*0*	*240*
Compost	1424	1417	1399	1399
Cow dung	1373	1440	1414	1433
Mana	1400	1387	1411	1398
Gautemala	1356	1403	1421	1412
Control 1 (no fertilizer and organic manure addition)				1348
Control 2 (no organic manure addition)				1231
LSD(P=0.05)	NS			
CV %	4			

So far, no overall effect was observed due to application of N and/or organic matter in this year. This experiment is in progress.

S.M.Dissanayake, A.K.N.Zoysa and L.S.K.Hettiarachchi

2.1.4. Effect of different levels of nitrogen (0-720 kg ha^{-1} yr^{-1} N at 120 kg N increment) with and without (0 and 5 t ha^{-1} yr^{-1}) compost manure on soil/plant - N status and yield of tea, St.Coombs Estate, Talawakele - Clone DT1 (1992).

The yield obtained in the 4th year of the 1st cycle is given in Table 7.

TABLE 7 - *Effect of different levels of nitrogen with and without compost on yield*

Treatments *N level*	*Yield (made tea kg ha^{-1} yr^{-1})*
120	2050
240	2105
360	2137
480	2231
600	2135
720	2041
LSD (P=0.05)	131
CV %	4
Sub	
No compost	2119
5 t ha^{-1} yr^{-1} compost	2114
LSD (P=0.05)	NS
CV%	4

So far, no significant differences in yield were observed due to incorporation of compost. Although no consistent significant increases in yield were observed with the elevation of N rates, trend exist up to 480 kg ha^{-1} yr^{-1} N. This experiment is in progress.

R.G.A.Wijayawardhana and L.S.K.Hettiarachchi

2.2. Soil and Fertilizer Potassium Studies

2.2.1. Split application of nitrogen and potassium fertilizer in mature tea in relation to N/K antagonism, St.Coombs Estate, Talawakele - Clone TRI 2025 (1990).

The yield obtained in the 1st year of the 2nd cycle is presented in Table 8.

So far, no significant differences in yield were observed either due to split applications or due to K fertilizer rates, although differences between some mean yields were greater than the LSD value. This experiment is in progress.

TABLE 8 - *Effect of split application of potassium on yield of tea*

K fertilizer applied (%)		*Yield (made tea kg ha^{-1} yr^{-1})*	
Initially	*6 weeks after*	*K - Fertilizer (kg K_2O ha^{-1} yr^{-1})*	
		120	240
100	0	1012	975
80	20	1073	1050
60	40	990	1091
40	60	982	1065
20	80	1029	969
0	100	1044	1050
LSD (P=0.05)			104
CV %			7

G.P.Gunaratne and L.S.K.Hettiarachchi

2.2.2. Effect of application of locally available rock - K sources (mica and feldspar) with MOP at 3 solubility levels (100, 50 and 25% for acidulated and 50 and 25% for non - acidulated) on yield of tea, Giragama Estate, Pilimatalawa - Clone TRI 2025 (1992).

This experiment was carried out by the Earth Science Department of IFS, Hantane, in collaboration with Soils and Plant Nutrition Division for a post-graduate training program. The investigations have been concluded and the results will be made available once the thesis is produced and accepted.

2.2.3. Effect of application of increasing levels of potash (60-360 kg ha^{-1} yr^{-1}) at 60 increments with N (240 and 360 kg ha^{-1} yr^{-1}) on soil/plant K and Mg status and yield of tea, Halgolla Estate, Yatiyantota - Clone TRI 2025 (1984).

The yield obtained in the 4th year of the 3rd cycle are given in Table 9.

TABLE 9 - *Effect of application of increasing levels of potassium (kg ha^{-1} yr^{-1} K_2O) with two nitrogen sources on the yield (made tea kg ha^{-1} yr^{-1})*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})*
1. Main	
N 240	2442
N 360	2619
LSD (P=0.05)	121
CV.%	13
2. Sub (K_2O)	
K 60	2450
K 120	2496
K 180	2470
K 240	2577
K 300	2579
K 360	2610
LSD (P=0.05)	NS
CV %	13
3. Sub - Sub	
Urea	2347
SA	2713
LSD (P=0.05)	121
CV %	13

In this year, significant increases in yield were found both due to application of N at 360 kg ha^{-1} yr^{-1} compared to 240 kg ha^{-1} yr^{-1}, and application of SA based N compared to urea based N (i.e. sources). But, no significant differences were observed with the elevation of K rates.

This experiment is in progress.

G.P.Gunaratne and L.S.K.Hettiarachchi and G. D. Wimaladasa

2.2.4. The effect of application of potash (48 to 480 kg K_2O ha^{-1} yr^{-1}) with and without Mg (0 and 60 kg ha^{-1} yr^{-1} MgO) fertilizer, on soil/plant K/Mg status and yield of tea, Glenanore Estate, Haputale - TRI 2025 (1991).

The yield obtained in the 1st year of the 2nd cycle is given in Table 10.

TABLE 10 - *Effect of different N:K_2O ratios and MgO on yield of tea*

Main treatments (kg ha^{-1} yr^{-1})				
N	*K_2O*	*MgO*	*N:K_2O*	*Yield (made tea kg ha^{-1} yr^{-1})*
240	48	0	5:1	1653
240	48	60	5:1	1634
240	60	0	4:1	1676
240	60	60	4:1	1704
240	80	0	3:1	1671
240	80	60	3:1	1700
240	120	0	2:1	1659
240	120	60	2:1	1645
240	240	0	1:1	1735
240	240	60	1:1	1668
240	360	0	2:3	1692
240	360	60	2:3	1694
240	480	0	1:2	1644
240	480	60	1:2	1673
LSD (P=0.05)				NS
CV %				5

So far, no significant difference in yield was observed either with different N:K_2O ratios or with the application of MgO at 60 kg ha^{-1} yr^{-1}.

The effect of N:K_2O ratios and of MgO on soil K and Mg status are given in Tables 11 and 12 respectively.

TABLE 11 - *Effect of different N:K_2O ratios and MgO on soil K status at two soil depths*

Level (kg ha^{-1} yr^{-1})				*Soil K (mg kg^{-1})*	
N	*K_2O*	*MgO*	*N:K_2O*	*0-15 cm*	*15-30 cm*
240	48	0	5:1	175	152
240	48	60	5:1	135	119
240	60	0	4:1	200	142
240	60	60	4:1	185	166
240	80	0	3:1	165	132
240	80	60	3:1	160	168
240	120	0	2:1	220	182
240	120	60	2:1	180	145
240	240	0	1:1	205	185
240	240	60	1:1	185	177
240	360	0	2:3	260	205
240	360	60	2:3	245	202
240	480	0	1:2	295	275
240	480	60	1:2	230	202
LSD (P=0.05)				65	64
CV %				25	29
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				217	182
60				189	170
LSD(P=0.05)				25	NS
CV %				25	29

Generally soil K levels increased with the elevation of ground K fertilizer rates at both depths; this effect was marked particularly beyond 120 kg K_2O ha^{-1} yr^{-1}. On the other hand, lower soil K levels were found where when 60 kg MgO was applied compared to no application of Mg.

TABLE 12 - *Effect of different N:K_2O ratios and MgO on soil Mg status at two soil depths*

Level (kg ha^{-1} yr^{-1})				*Soil Mg (mg kg^{-1})*	
N	*K_2O*	*MgO*	*N:K_2O*	*0-15 cm*	*15-30 cm*
240	48	0	5:1	144	120
240	48	60	5:1	181	130
240	60	0	4:1	177	110
240	60	60	4:1	268	218
240	80	0	3:1	159	112
240	80	60	3:1	168	131
240	120	0	2:1	131	132
240	120	60	2:1	154	108
240	240	0	1:1	195	138
240	240	60	1:1	179	151
240	360	0	2:3	153	99
240	360	60	2:3	202	137
240	480	0	1:2	161	131
240	480	60	1:2	158	133
LSD (P=0.05)				59	60
CV %				27	36
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				160	20
60				187	145
LSD(P=0.05)				22	23
CV %				27	36

In the case of Mg, soil levels at 0-15cm depth were generally increased due to ground Mg fertilizer application at 60 kg ha^{-1} yr^{-1} compared to no Mg application, except at 480 kg K_2O ha^{-1} yr^{-1}. But no marked increases were observed at the 15-30cm depth.

The effect of N:K_2O ratios and MgO on leaf Mg and K is given in Table 13.

TABLE 13 - *Effect of different N:K_2O ratios and MgO on leaf Mg and K*

Level (kg ha^{-1} yr^{-1})				*Leaf nutrient (%)*	
N	*K_2O*	*MgO*	*N:K_2O*	*K*	*Mg*
240	48	0	5:1	1.18	0.37
240	48	60	5:1	1.14	0.36
240	60	0	4:1	1.23	0.37
240	60	60	4:1	0.99	0.40
240	80	0	3:1	1.29	0.34
240	80	60	3:1	1.25	0.40
240	120	0	2:1	1.23	0.35
240	120	60	2:1	1.47	0.37
240	240	0	1:1	1.36	0.36
240	240	60	1:1	1.26	0.38
240	360	0	2:3	1.32	0.33
240	360	60	2:3	1.28	0.38
240	480	0	1:2	1.33	0.35
240	480	60	1:2	1.33	0.37
LSD (P=0.05)				0.29	0.069
CV %				18	152
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				1.28	0.35
60				1.25	0.38
LSD(P=0.05)				NS	0.026
CV %				18	15

Magnesium concentration in the foliage was increased with the ground Mg fertilizer application at the rate of 60 kg ha^{-1} yr^{-1}. However, no significant increases in leaf K concentrations were observed with increasing K rates. Nevertheless leaf K concentrations at 60 kg MgO ha^{-1} yr^{-1}, were often lower than that of no Mg.

This experiment is in progress.

R.G.A.Wijayawardhana, G.P.Gunaratne, L.S.K.Hettiarachchi and G.D. Wimaladasa

2.2.5. The effect of increasing levels of potash (in 100 increments) with N (in 100 increments) fertilizer, on soil/plant N/K status and yield of tea, St.James Estate, Hali - ela - Clone TRI 2025 (1990).

The yield obtained in the 1st year of the 2nd cycle is given in Table 14.

TABLE 14 - *Effect of increasing levels of potash with N on yield of tea*

Level (kg ha^{-1} yr^{-1})		*Yield*	
N	*K_2O*	*N:K_2O*	*(made tea kg ha^{-1} yr^{-1})*
100	100	1:1	1299
200	100	2:1	1377
300	100	3:1	1458
400	100	4:1	1379
500	100	5:1	1458
100	300	1:3	1413
200	300	2:3	1425
300	300	3:3	1381
400	300	4:3	1454
500	300	5:3	1436
100	500	1:5	1411
200	500	2:5	1441
300	500	3:5	1294
400	500	4:5	1494
500	500	5:5	1363
LSD (P=0.05)			177
CV %			11

So far, no overall consistent differences in yield were observed due to ground application of N and K fertilizers with different N:K_2O ratios (N:K_2O = 1:1, 2:1, 3:1, 4:1, 5:1 and 1:3, 2:3, 4:3, 5:3 and 1:5, 2:5, 3:5, 4:5). Further, there were no yield increases with increasing N and/or K fertilizer rates. This experiment is in progress.

(R.G.A.Wijayawardhana, G.P.Gunaratne L.S.K.Hettiarachchi and G. D. Wimaladasa)

2.3. Soil and Fertilizer Phosphorus Studies.

2.3.1. Application of increasing levels of phosphate (0-120 kg P_2O_5 ha^{-1} yr^{-1} at 20 kg increments) fertilizer on soil/plant P status and yield of tea, St.Coombs Estate, Talawakele - Clone TRI 2025 (1989).

The yield obtained in the 1st year of the 2nd cycle and soil P levels are given in Tables 15 and 16 respectively.

TABLE 15 - *Effect of increasing levels of phosphate fertilizer on yield*

Level of P fertilizer (kg P_2O_5 ha^{-1} yr^{-1})	*Yield (made tea kg ha^{-1} yr^{-1})*
0	2353
20	2337
40	2260
60	2352
80	2280
100	2291
120	2382
LSD(P=0.05)	NS
CV %	9

Application of increasing levels of Phosphate fertilizer (ERP) did not have a significant effect on yield.

TABLE 16 - *Effect of increasing levels of phosphate fertilizer on soil P*

Level of P fertilizer (kg P_2O_5 ha^{-1} yr^{-1})	*Soil P (mg kg^{-1})*	
	0-15 cm	*15-30 cm*
0	7.8	27.4
20	12.7	13.0
40	14.1	23.5
60	16.0	18.0
80	19.6	23.4
100	19.2	23.3
120	23.2	16.5
LSD (P=0.05)	9.7	NS
CV %	46	75

In general, soil P levels at the 0-15 cm depth, extracted from borax solution (pH=1.5) increased with the elevation of ERP rates. But, no over all increases were observed from the 15-30 cm depth. This experiment is in progress

H.A.P.Warnasiri, A.K.N.Zoysa and L.S.K.Hettiarachchi

2.3.2. Application of increasing levels of phosphate fertilizer with two methods of application (Broadcast and Incorporated) on soil/plant P status and yield of tea, Walahanduwa Estate, Galle, clone TRI 2025 - (1994).

The yield obtained in the 2nd year of the 1st cycle is given in Table 17.

TABLE 17 - *Effect of increasing levels of surface applied and soil incorporated ERP on yield*

Levels of P fertilizer (kg P_2O_5 ha^{-1} yr^{-1})	*Yield (made tea kg ha^{-1} yr^{-1})*	
	Surface	*Incorporated*
0	4855	5024
20	4712	4653
40	5443	4576
60	5211	4947
80	5192	4566
100	4375	4631
120	5671	5085
LSD(P=0.05)	NS	
CV %	12	

No significant differences in yield were observed due to either the rates of P or mode of application i.e. surface applied and incorporated. This experiment is in progress

H.A.P.Warnasiri, A.K.N.Zoysa and L.S.K.Hettiarachchi

2.3.3. Effect of foliar application of phosphorus (0, 1, 2, 3 and 4% DAP and TSP) on plant P status, quality (Bio chemical parameters) and yield of tea, St.Coombs Estate, Talawakele, clones DT 1 and CY9 - (1992).

The yield obtained from December 1994 to September 1995 is presented in Table 18.

TABLE 18 - *Effect of foliar application of phosphate on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})*	
	Clone	
	CY9	*DT1*
Control	2339	2350
1 % TSP	2293	2239
2 % "	2459	2069
3 % "	2352	2198
4 % "	2356	2280
1 % DAP	2260	2176
2 % "	2298	2449
3 % "	2328	1990
4 % "	2216	2090
LSD (P=0.05)	279	245
CV (%0	5	5

No consistent differences in yield were observed due to foliar P feeds of any forms (i. e. TSP or DAP.)

R.G.A.Wijayawardhana and L.S.K.Hettiarachchi

2.4. Soil and Fertilizer Magnesium Studies

2.4.1. Application of increasing levels of kieserite on soil/plant nutrient status and yield of tea, St.Coombs Estate, Talawakele, clone TRI 2025 - (1990).

The yield obtained in the 5th year of the 1st cycle is given in Table 19.

TABLE 19 - *Effect of increasing levels of kieserite application on yield*

Level of kieserite (kg MgO ha^{-1} yr^{-1})	*Yield (made tea kg ha^{-1} yr^{-1})*
0	2579
15	2402
30	2440
45	2567
60	2338
75	2412
LSD (P=0.05)	NS
CV %	7

No significant difference in yield were observed due to different Mg fertilizer rates.

The effect of kieserite on soil pH and Mg levels is given in Table 20.

TABLE 20 - *Effect of increasing levels of kieserite on soil pH and Mg levels at two soil depths*

Level of kieserite	*pH*		*Soil Mg (mg kg^{-1})*	
(kg MgO ha^{-1} yr^{-1})	*0-15 cm*	*15-30 cm*	*0-15 cm*	*15-30 cm*
0	4.50	4.55	92	83
15	4.53	4.55	118	110
30	4.58	4.58	147	105
45	4.48	4.60	144	102
60	4.50	4.68	156	178
75	4.48	4.48	173	150
LSD (P=0.05)	NS	NS	57	69
CV %	4	6	27	38

No over significant differences were observed in soil pH levels due to different kieserite fertilizer rates. But, in general soil Mg levels increased markedly with the elevation of Mg fertilizer rates. This experiment is in progress.

H.A.P.Warnasiri and L.S.K.Hettiarachchi

2.4.2. Application of increasing levels of dolomite fertilizer at three frequencies (Cycle, Mid & Yearly basis) on soil/plant nutrient status and yield of tea, Field No.4, St.Coombs Estate, Talawakele, clone TC 9 - (1989).

The yield obtained in the 2nd year of the 2nd cycle is given in Table 21.

TABLE 21 - *Effect of increasing level of dolomite application on yield*

Level of dolomite	*Yield (made tea kg ha^{-1} yr^{1})*		
	Frequency of dolomite application		
(kg ha^{-1})	*Cycle*	*Mid-cycle*	*Yearly*
Control	2354	2354	2354
1250	2223	2248	2167
2500	2300	2258	2386
5000	2194	2209	2227
10000	2082	2154	-
LSD (P=0.05)		259	
CV %		7	

Lower yields were found in the plots that received dolomite at the rate of 10,000 kg ha^{-1} pruning-cycle^{-1}, both at cycle and mid-cycle frequency when compared to control. This experiment is in progress.

H.A.P.Warnasiri L.S.K.Hettiarachchi and G. D. Wimaladasa

2.4.3. Application of increasing levels of dolomite fertilizer at three frequencies (Cycle, Mid & Yearly basis) on soil/plant nutrient status and yield of tea, Field No.2, Morogolla Estate, Imaduwa, clone TRI 2025 - (1990).

The yield obtained in the 3rd year of the 2nd cycle is presented in Table 22.

TABLE 22 - *Effect of increasing levels of dolomite application on yield*

Level of dolomite	*Yield (made tea kg ha^{-1} yr^{-1})*		
(kg ha^{-1})	*Frequency of dolomite application*		
	Cycle	*Mid-cycle*	*Yearly*
Control	3226	3226	3226
1000	3203	3226	3210
3000	3240	3242	3210
5000	3212	3203	3234
LSD (P=0.05)	110		
CV %	2		

At this experimental site, no overall significant differences in yield were observed due to both levels and frequency of dolomitic limestone application. This experiment is in progress.

H.A.P.Warnasiri and L.S.K.Hettiarachchi

2.4.4. Effect of different particle sizes of applied dolomite fertilizer on soil pH, soil/plant Mg status and yield of tea, Matakelle Estate, Talawakele, clone TRI 2023 - (1991).

The yield obtained in the 5th year of the 1st cycle is given in Table 23.

TABLE 23 - *Effect of different sizes (BS) of dolomite particles on yield*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	Yield (made tea kg ha^{-1} yr^{-1})				
	2235	2116	2177	2170	2139
LSD (P=0.05)	NS				
CV %	5				

* Presently recommended particle size of dolomite fertilizer

No significant differences in yield were observed due to application of dolomitic limestone with different particle size combinations. This experiment is in progress.

H.A.P.Warnasiri and L.S.K.Hettiarachchi and G. D. Wimaladasa

2.4.5. Effect of different particle sizes of applied dolomite fertilizer on soil pH, soil/plant Mg status and yield of tea, Talangaha Estate, Nakiyadeniya, clone TRI 2025 - (1991).

The yield obtained in the 2nd year of the 2nd cycle and the soil Mg levels are presented in Tables 24 and 25 respectively.

TABLE 24 - *Effect of different sizes (BS) of dolomite particles on yield*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	Yield (made tea, kg ha^{-1} yr^{-1})				
	2777	2965	3092	2714	3042
LSD (P=0.05)			NS		
CV %			13		

* Presently recommended particle size of dolomite fertilizer

Even at this site, no significant differences in yield were observed due to application of dolomitic limestone with different particle size combinations.

TABLE 25 - *Effect of different sizes (BS) of dolomite particle on soil Mg levels*

	Particle size combinations of dolomite				
Thro': 30 BS	100	100	100*	100	100
Thro': 100 BS	100	75	50	25	0
	Soil Mg (mg kg^{-1})				
	61	79	54	38	43
LSD (P=0.05)			39		
CV %			47		

* Presently recommended particle size of dolomite fertilizer

In general, no differences in soil Mg levels were found due to application of dolomitic limestone with the different particle size combinations. This experiment is in progress.

H.A.P.Warnasiri and L.S.K.Hettiarachchi and G. D. Wimaladasa

2.4.6. 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, Kiruwanaganga Estate, Galle, clone TRI 2025 - (1993).

The yield obtained in the 3rd year of the 1st cycle and the soil Mg levels are presented in Tables 26 and 27 respectively.

TABLE 26 - *Effect of application of K and/or Mg from kieserite and Sul-Po-Mag on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})* *Level of Nitrogen (kg ha^{-1} yr^{-1})*	
	240	360
U 709 (Urea)	1738	1846
U 709 + Kieserite	1977	1835
U 750 Sul-Po-Mag	1873	1831
UT Mix. (Urea & SA)	1832	1692
T 1130 (SA)	2012	1802
LSD (P=0.05)	NS	
CV %	14	

No significant differences in yield were observed due to application of either Mg-enriched fertilizer mixtures or the two levels of nitrogen.

TABLE 27 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil Mg at 0-15cm depth*

Treatments	*N level (kg ha^{-1} yr^{-1})*	*Soil Mg (mg kg^{-1})* *0-15 cm*
U 709 (Urea)	240	8.3
U 709 + Kieserite	240	10.8
U 750 Sul-Po-Mag	240	8.0
UT Mix.(Urea & SA)	240	8.5
T 1130 (SA)	240	5.8
U 709 (Urea)	360	10.8
U 709 + Kieserite	360	10.3
U 750 Sul-Po-Mag	360	11.8
UT Mix. (Urea & SA)	360	5.8
T 1130 (SA)	360	4.8
LSD (P=0.05)		5.48
CV %		45

No increases in soil Mg levels were observed due to addition of Mg enriched NPK fertilizer mixtures such as U 709 + Kieserite and U 750 Sul-Po-Mag. In fact these levels are relatively low probably due to the plant uptake. This experiment is in progress.

S.M.Dissanayake, L.S.K.Hettiarachchi and G. D. Wimaladasa

2.4.7. 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, Hopton Estate, Passara, clone TRI 2025 - (1993).

The yield obtained in the 3rd year of the 1st cycle and the soil Mg levels are presented in Tables 28 and 29 respectively.

TABLE 28 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{1})*	
	Without dolomite	*With dolomite*
U 709 (Urea)	3499	3592
U 709 + Kieserite	3601	3751
U 750 Sul-Po-Mag	3762	3284
UT Mix. (Urea & SA)	3400	3339
T 1130 (SA)	3595	3436
LSD (P=0.05)	NS	
CV %	12	

No significant differences in yield was observed among any of these fertilizer-treatments, with (500 kg ha^{-1} at mid-cycle and pruning) and without dolomite.

TABLE 29 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil Mg at 0-15cm depth*

Treatments	*Soil Mg (mg kg^{-1})*	
	Without dolomite	*With dolomite*
	0-15 cm	*0-15 cm*
U 709 (Urea)	21.0	42.5
U 709 + Kieserite	29.3	47.8
U 750 Sul-Po-Mag	34.3	58.5
UT Mix. (Urea & SA)	27.8	32.0
T 1130 (SA)	20.5	22.5
LSD (P=0.05) at 0-15 cm depth	= 24.78	
CV %	51	

Addition of dolomitic limestone increased the soil Mg levels marginally, but not the Mg-enriched NPK mixtures, probably due to the supply of higher quantities of Mg from the dolomite. This experiment is in progress.

S.M.Dissanayake and L.S.K.Hettiarachchi

2.4.8. Effect of application of potassium and/or magnesium (U 709, U 709+Kie, U 750, UT Mix & T1130 & 2 levels of N - 240 & 360 kg ha^{-1} yr^{-1}) from Sul-Po-Mag and kieserite on soil/plant nutrient status and yield of tea, Waltrim Estate, Talawakele, clone TRI 2025 - (1994).

The yield obtained in the 2nd year of the 1st cycle and the soil Mg levels are presented in Tables 30 and 31 respectively.

TABLE 30 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1}) Levels of Nitrogen (kg ha^{-1} yr^{-1})*	
	240	*360*
U 709 (Urea)	3131	3079
U 709 + Kieserite	2976	3209
U 750 Sul-Po-Mag	3064	3352
UT Mix. (Urea & SA)	3240	3133
T 1130 (SA)	3148	3165
LSD (P=0.05)	322	
CV %	6	

Overall, no significant yield differences were found due to application of different fertilizer mixtures with or without Mg. Further, no significant differences were observed between the application of N at 240 and 360 kg ha^{-1} yr^{-1}.

TABLE 31 - *Effect of application of potassium and/or magnesium from kieserite and Sul-Po-Mag on soil Mg at 0-15cm depth*

Treatments	*N Level (kg ha^{-1} yr^{-1})*	*Soil Mg (mg kg^{-1}) 0-15 cm*
U 709 (Urea)	240	15.7
U 709 + Kieserite	240	17.7
U 750 Sul-Po-Mag	240	13.3
UT Mix. (Urea & SA)	240	17.3
T 1130 (SA)	240	32.7
U 709 (Urea)	360	31.3
U 709 + Kieserite	360	44.0
U 750 Sul-Po-Mag	360	21.0
UT Mix. (Urea & SA)	360	26.0
T 1130 (SA)	360	14.3
LSD (P=0.05)	NS	
CV %	65	

Although Mg enriched NPK mixtures were applied in this trial, so far no greater differences in soil Mg levels were observed. This experiment is in progress.

S.M.Dissanayake and L.S.K.Hettiarachchi

3. Project D/AGCH - *Divisional Activities*

3.1. Characterisation of soils in the tea growing areas of Sri Lanka

This project was commenced in early July 1995 in colaboration 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) is drafted and yet to be finalized, in order to carry out the work program with newer modifications effectively.

In addition, in the process of land use planning for development of marginal tea lands in the mid - country, under the contract research project funded by CARP, soil survey was commenced in November 1996 in order to prepare detailed soil distribution maps through GIS software and to incorporate soil information into land use planning. The operations in this project have been carried out in collaboration with Environment and Forest Conservation Division of the Mahaweli Authority in Kandy.

3.2. Demonstration fertilizer trials (TRI/TSHDA Interaction)

Some pre-treatment data in relation to soil and plant nutrient status, obtained from sites selected in 18 tea small holders' sites, are presented in Table 32.

TABLE 32 - *Some pre - treatment data in relation to soil and plant nutrient status from tea smallholders' lands*

	Soil pH (0-15cm) Block		*Plant (Mature Leaf) Block*							
Location	*T 1130*	*U 709*	*T 1130*				*U 709*			
			N%	*P%*	*K%*	*Mg%*	*N%*	*P%*	*K%*	*Mg%*
Boralanda	4.20	4.90	3.64	0.17	1.14	0.14	3.72	0.18	1.21	0.17
Pitamaruwa	4.70	4.70	4.03	0.12	1.05	0.16	3.89	0.11	0.98	0.14
Kandagolla	4.70	4.80	3.93	0.20	1.08	0.17	3.81	0.23	1.14	0.20
Balangoda	3.50	3.50	3.44	0.13	0.97	0.15	3.52	0.15	1.00	0.14
Kalawana	3.70	3.65	4.06	0.11	0.80	0.11	3.92	0.09	0.90	0.11
Deraniyagala	3.80	3.90	3.92	0.10	0.95	0.10	3.85	0.09	1.00	0.13
Ingiriya	4.55	4.50	3.22	0.08	0.50	0.20	3.57	0.12	0.75	0.24
Badureliya	3.40	4.00	3.64	0.14	1.01	0.14	3.43	0.12	0.90	0.13
Rikilagaskada	4.30	4.00	3.71	0.09	0.60	0.80	3.92	0.11	0.50	0.14
Kadugannawa	4.10	4.10	3.59	0.14	1.11	0.08	3.67	0.14	1.16	0.16
Rangama	4.20	4.30	3.35	0.13	1.10	0.19	3.35	0.12	1.01	0.15
Hiniduma	3.70	3.60	4.06	0.19	0.75	0.11	4.13	0.18	0.80	0.11
Elpitiya	4.10	4.40	3.29	0.05	1.00	0.16	3.50	0.06	1.05	0.15
Akuressa	3.80	3.80	3.29	0.20	0.80	0.11	3.22	0.10	0.90	0.19
Urubokka	4.10	4.20	3.85	0.15	1.00	0.09	3.92	0.09	0.85	0.09
Deniyaya	3.60	3.80	3.50	0.21	1.05	0.14	3.71	0.18	0.75	0.14
Tispane	4.30	4.30	3.27	0.18	1.21	0.18	3.51	0.19	1.23	0.20
Norton Bridge	4.50	4.60	3.27	0.11	1.10	0.21	3.19	0.12	1.01	0.21

The field operations such as fertilizer applications etc. are in progress, in collaboration with the respective advisory and extension staff members of TRI substations.

3.3. High Forest Estate Problem, clone TRI 2025 - Die back of shoots

The details of the problem were given in the *Annual Report for* 1994.

Soils were collected from affected and unaffected patches and soil water extracts (0-15 and 15-30 cm depths) were obtained as per the proposals made at the High Forest task force. Two clonal cuttings were dipped (TRI 2025 and CY 9) in order to examine whether there is any effect in relation to general tea growth, but no significant effects were observed.

From the same patches, different types of rock samples were also collected, and analysed for heavy metal concentrations to find out any toxicity involved in the problem, Here again, no significant amounts were found. Studies 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 soon.

S.Ananthacumaraswamy and L.S.K.Hettiarachchi

4. Project C/ANAL - Central Analytical Services

The number of fertilizer, soil and leaf samples analysed for advisory purposes during 1995 are given below:

Element	*Fertilizer*	*Soil*	*Leaf*	*Total*
Nitrogen	455	123	152	730
Phosphorus	228	495	336	1059
Potassium	371	462	338	1171
Magnesium	294	511	359	1164
Calcium		34	30	64
Zinc	8	52	275	335
CEC		56		56
Sulphur		406	231	637
Moisture	21	4		25
Mesh Size	236			236
Aluminium		45	44	89
Manganese		45	44	89
pH		2287	2287	
Carbon		1748		1748
Total	1613	6268	1809	9690

G.P.Gunaratne, S.Ananthacumaraswamy, R.G.A.Wijayawardhana, W.M.S.Wijethunge, H.A.P.Warnasiri and S.M.Dissanayake

5. Meetings Seminars Workshops

Dr G. D. Wimaladasa addressed or attended the following

Attended a general meeting of the Planters Association, Kandy branch at Kandy Club on 6th February and addressed the participants on Fertilizer Use.

Addressed the Superintendents of the Badulla district on 'Recent Advance in the Fertilizer use in Tea at a a seminar held at the Haldumulla Club, Haputale, held on 13th February.

Addressed the Tea Smallholders on 'Fertilizer Use in a seminar organised by the Lions Club, Nawalapitiya branch at Nawalapitiya/Kotmale club on 8th March.

Attended a workshop conducted by NIBM on 'Management by objective' (MBO), at the NIBM Office in Colombo from 25th to 29th March.

Attended the RSC IV meeting held at Hantane sub-station on 29th March.

Addressed the Assistant Superintendents of Kahawatte Plantations Ltd, on Fertilizer use in Tea at a seminar held at Nawalapitiya on 12th June.

Dr. L. S. K. Hettiarachchi addressed or attended the following:

Attended the 1st meeting of the sub-committee on Chemical contaminants in Made Tea, held at the SLTB Auditorium, on 18th March.

Attended the 9th meeting of the Working Group on Fertilizer held at Sri Lanka Standards Institution, Colombo, on 2nd April.

Attended the 2nd meeting of the sub-committee on Chemical Contaminants in Made Tea, held at SLTB Auditorium in Colombo, on 21 st June.

Attended the discussion held at the TRI Board Room with the senior officials of the Kotagala Plantations Ltd in relation to 'Fertilizer and pruning Aspects, on 4th October.

Addressed the members of the RSC VII meeting on Integrated Nutrient, Management towards Higher Tea Crop Productivity, held at Hotel Reef in Hikkaduwa, Galle on 25th October.

Attended the Annual Congress of the Post Graduate Institute of Agriculture held at PGRC Auditorium in Peradeniya on 21st November.

Attended a meeting organised by the senior officials of SLTB in relation to Analytical Laboratory Activities held in Colombo, on 27 th November.

Addressed the participants at a seminar organised by the Lanka Phosphate Ltd. for the promotion of ERP in plantation crop sector, held at the Tangerine Beach Hotel, Kalutara on 29th November on "Present recommendations on the use of ERP in Tea and their significance."

Addressed the members of the RSC I (Nuwara Eliya region) meeting on Nutrient Management in pruning held at the TRI Auditorium, Talawakele, on 5th December.

Attended a public seminar organized by NARESA for the presentation of salient points of 'International Conferences attended by the Scientists of Sri Lanka and their Significance, held at NARESA Auditorium in Colombo, on7th December.

Dr G.D.Wimaladasa, L.S.K. Hettiarachchi, Mr G. P. Gunaratne and Mrs S. Ananthacumaraswamy delivered lectures and conducted practicals in the TRI for NIPM Planter trainees on 29th May.

Mrs S. Ananthacumaraswamy attended or Addressed the following:

Mrs. S. Ananthacumaraswamy, Mrs. A. K. Withana, Messrs. G. P. Gunaratne and W. M. S. Wijethunge participated in a Workshop conducted by the General Research Committee and SLAAS on 'Scientific Writing at SLAAS Auditorium, in Colombo on 24th May and 19th June.

Addressed the Superintendents, Assistant Superintendents and Field Officers of the Bogawanthalawa Plantations Ltd on "Fertilizer Use in Tea" at the Kotiyagala Estate Club on 7th November.

Addressed the Superintendents, Assistant Superintendents and Field Officers of the Bogawanthalawa Plantations Ltd on "Fertilizer Use Tea" at Champion Estate on 21st November.

Dr L.S.K. Hettiarachchi and Mrs. S. Ananthacumaraswamy, attended a seminar conducted by NIBM on Survey Methodology at the NIBM Office, in Colombo from 18th to 19th July.

Dr L.S.K. Hettiarachchi and Mrs. S. Ananthacumaraswamy attended a seminar organized by the Agrapatana Plantations Ltd on 'Participatory Research', held atTRI Auditorium on 16th September.

Mrs S. Ananthacumaraswamy attended a seminar organized by the Pussellawa Plantations Ltd, held at Helbodde Estate on 26th November. Mr. Ananthacumaraswamy addressed the participants on "Soil, Leaf and Fertilizer Sampling Procedures'.

6. Visitors

A group of 80 students from Faculty of Agriculture, University of Peradeniya visited the division on 21st March.

Dr R.L de Silva, an Agric Consultant to Plantation Management Companies (PMC), and a group of PMC officials visited SPND to discuss fertilizer related aspects with Dr L.S.K.Hettiarachchi on 21st March.

Dr S.Somasiri and Mr R.Thilakasekera, attached to ENDEV Project at the Mahaweli Authority, Polgolla, visited SPND laboratory to discuss soil related studies at TRI, on 26-27th March.

Four Superintendents from Uda Pussellawa Plantations Ltd visited SPND laboratory on soil, plant and fertilizer related aspects with Dr L.S.K. Hettiarachchi on 15th May.

Drs Tee Boon Goh and Bob Eliers from Canadian Soil Science Society, and Dr R.B.Mapa, Messrs A.Senerath and A.R.Dassanayake from Soil Science Society of Sri Lanka visited SPND in order to discuss recent developments in relation to soil characterisation work in tea growing areas, with Dr L.S.K. Hettiarachchi, on 13th and 14th August.

Mr Pseng Muthavey from Cambodia visited SPND along with Mr S.M.M. Iqbal from RRI, in order to familiarise fertilizer aspects in relation to tea, on 23rd August.

The executives from Norwood and Wanarajah group, in Bogawanthalawa Plantations Ltd visited SPND, in order to discuss fertilizer related aspects and to see laboratory work, on 04th December 1996.

7. Advisory Circulars

An integrated package of nutrient management, consisting of ground fertilizer applications, foliar nutrient feeds and dolomitic limestone applications at various growth stages of young tea plants was introduced to improve overall health of bush and thereby crop production, as an advisory circular (Serial No. 1/96. Circular No. F 9).

8. Publications

HETTIARACHCHI, L.S.K., BALASINGHAM, A., ANANTHACUMARASWAMY, S., GUNARATNE, G.P. and WARNASIRI, H.A.P. (1996).

Mineral composition in relation to leaf maturity from 2000, 3000 and 4000 clonal series: Leaf analysis as a guide in tea crop nutrition. *Sri Lanka Journal of Tea Science*. **64**, In press.

HETTIARACHCHI, L.S.K. and WIMALADASA, G.D. (1996). Particle size of dolomitic limestone. *TRI update*, Tea Research Institute of Sri Lanka. **1**(2), 3.

TECHNOLOGY DIVISION

Head - M. T. Ziyad Mohamed

1. General

Dr M.T. Ziyad Mohamed was appointed as Deputy Director Research (Technology) w.e.f. 1st August.

Ms Marion Gehrke from the University of Hohenheim, Germany, spent a month in the division commencing 20th March to test two moisture meters to measure the moisture content in the withered leaf.

Mr K. Raveendran was recruited as the Chemical Engineer to the division w.e.f. 3rd July.

Mr P.A.N. Punyasiri was granted two years no pay leave w.e.f. 7th July.

Mr S.Koneswaramoorthy spent 3-4 months at the Royal Institute of Technology(KTH), Stockholm, Sweden from July to continue his post-graduate studies.

Ms B.W.S Kariyawasam was transferred to the Biochemistry Division w.e.f. 4th September.

Dr M.T. Ziyad Mohamed visited Kenya from 6th October to 16th November to study Tea Processing Technology. This visit was funded by Agricultural Research Project(ARP). He also spent 2 weeks at the Tea Research Foundation of Kenya during which period he had the opportunity of working with the Environmentally Controlled Miniature(ECM) manufacturing system.

Dr M.T. Ziyad Mohamed continued to serve as a member of the CTC Technical Committee. He was also appointed as a member of the panel of the Professional Examination in Tea Manufacture and Factory Practices by the Chairman, National Institute of Plantation Management.

2. Project B/CPCO - *Continuous process*

No progress was made due to lack of staff. The staff member involved in this project is also working on the solar energy project at St. Joachim Estate, Ratnapura.

S. Koneswaramoorthy and L. Jayasinghe

3. Project B/EDRY - *Reduction of the cost of tea drying*

3.1. Performance of stepwise FBD 3 compared with FBD 4

More replicates were carried out to check the performance of the stepwise FBD-3 drier against the standard FBD-4 drier. This time the trials were carried out, keeping the 1st, 2nd and 3rd weir heights at 3", 3" and 4" respectively. The results

revealed that the output was low and also the efficiency at those settings (Table 1). It was suggested setting the 1st weir height at 4" and changing the 2nd weir from 4" to 6" and the 3rd weir from 4" to 8" and testing the output and the firewood consumption along with the drying curve. The humidity of each section was measured using mettler thermo-couple unit.

TABLE 1 - *Moisture content of tea in different sections and the relative humidity in each section of the drier*

W/dhool		Sections					(after cooling)MT	
		1st		2nd		3rd		
	M%	M%	RH%	M%	RH%	M%	RH%	M%
(1)	54.7	37.5	-	12.0	-	3.5	-	3.4
(2)	49.7	35.6	74.9	18.1	50.1	6.1	13.4	6.5
(3)	56.3	36.1	67.0	14.2	60.0	3.0	11.8	3.6

Note: The table represents the average values of eight replicates.

The results indicate that there is no pattern in the reduction in humidity from the 1st to the 3rd section. The moisture contents of the samples drawn from all sections were analyzed. Comparing humidity values and the moisture levels of each sample in each section, it can be pointed out that the humidity level of a particular section is directly proportional to the moisture content of the sample. The moisture content in each section is dependent on the initial moisture content of the fermented dhool, feeding rate as well as the inlet and exhaust temperatures of the drier. This work is in progress.

W.S. Botheju, L. Jayasinghe, S.H.P. Waduge and M.T. Ziyad Mohamed

3.2. Trials with 'Economizers'

"Economizer" units were installed and since the drier connected to this economizer was not used for sometime due to heavy crop, the trials could not be carried out.

3.3. Solar Tea Drying Project

The objective of this project is to test the feasibility of using solar energy for withering and drying. As an initial step two prototype solar flat bed collectors were designed, fabricated and their performance tested at St Joachim Estate. The initial results showed that the air could be heated from about 32 to 92^{0}C using solar energy. It was reported that to produce 1 kg of tea, as much as 22 MJ of thermal energy is spent.

The approach was to preheat the air which enters the heat exchanger to around 50 - 60^{0}C using solar energy and to raise the temperatures to operational limits (95^{0}C) using firewood. The technology using solar energy is well established. However the economic feasibility of using such a system will be looked into.

The results of the comparison of the efficiencies of the collectors under different conditions are presented in Table 2, 3 and 4.

TABLE 2 - *Comparison of outlet temperatures(^{0}C) with same air flow for the corrugated absorber plate GI vs Aluminium.*

	Day 1			Day 2			Day 3		
Time	Ambi-ent	Tout (GI)	Tout (AL)	Ambi-ent	Tout (GI)	Tout (AL)	Ambi-ent	Tout (GI)	Tout (AL)
9.00	27	42	42	29	50	51	27	52	50
10.00	28	52	54	30	58	57	30	62	61
11.00	31	60	63	33	63	62	31	65	64
12.00	33	60	65	35	69	68	30	71	70
13.00	33	72	71	37	65	67	31	74	73
14.00	31	65	64	37	66	67	33	75	75
15.00	33	52	54	33	47	48	30	58	55
16.00	33	45	44	35	46	45	32	54	52
17.00	31	40	42	34	43	42	31	45	45
18.00	30	35	34	32	39	39	30	40	40

TABLE 3 - *Comparison of outlet temperatures(^{0}C) with same air flow when the air is flowing above(A) and under(U) the absorber plate*

Day 1		Day 2		Day 3		Day 4		Day 5	
U	A	U	A	U	A	U	A	U	A
61	52	67	61	45	40	45	40	64	60
62	53	79	72	60	56	61	60	62	52
64	55	83	74	61	52	66	65	55	45
83	73	81	70	83	72	75	72	57	46
86	75	92	79	85	74	80	78	53	43
64	58	94	82	88	76	84	83	48	40
76	70	94	82	88	76	84	83	48	40
73	67	93	80	71	62	83	79	45	40

TABLE 4 - *Comparison of outlet temperatures(^{0}C) with same air flow when the air is flowing under(U) and under and above(U&A) the absorber plate*

	Day 1			Day 2			Day 3		
Time	Ambi ent	Tout (U)	Tout (U&A)	Ambi ent	Tout (U)	Tout (U&A)	Ambi ent	Tout (U)	Tout (U&A)
9.00	29	44	44	26	42	42	27	39	39
10.00	30	55	53	31	54	52	31	48	47
11.00	33	66	63	34	67	65	29	42	41
12.00	34	69	65	32	55	50	30	48	46
13.00	33	67	63	35	52	49	32	60	57
14.00	35	75	70	32	54	50	33	62	59
15.00	33	58	57	31	47	45	30	50	48
16.00	33	44	43	32	49	46	27	45	45
17.00	33	44	43	30	40	40	26	36	36
18.00	27	34	34	26	32	32	25	30	30

From the results(by comparing the efficiencies of the collectors) obtained under the above conditions it was concluded that the efficiency of the collector is higher when the air flow is under the absorber plate.

The results of comparison of outlet temperatures for different gap settings of absorber plates and glazing are presented in Table 5 and 6.

TABLE 5 - *Comparison of outlet temperatures(^{0}C) with same air flow for gap setting 1" and 0.5" between the absorber plate and glazing*

	Day 1			Day 2			Day 3		
Time	Ambi-ent	Tout (1")	Tout (0.5")	Ambi-ent	Tout (1")	Tout (0.5")	Ambi-ent	Tout (1")	Tout (0.5")
9.00	29	44	44	29	45	45	27	42	42
10.00	30	54	52	31	54	52	30	53	53
11.00	32	60	59	32	58	56	32	59	57
12.00	33	65	64	33	67	65	32	66	63
13.00	32	63	63	35	69	67	34	69	67
14.00	35	60	60	30	64	62	34	69	67
15.00	34	55	55	32	56	53	32	59	57
16.00	32	50	50	32	50	50	31	52	49
17.00	30	34	34	31	41	41	30	41	41
18.00	30	34	34	31	36	36	29	36	36

TABLE 6 - *Comparison of outlet temperatures(^{0}C) with same air flow for gap setting 1" and 2" between absorber plate and the glazing.*

Day 1		Day 2	
Gap 1"	Gap 2"	Gap 1"	Gap 2"
35	33	64	62
47	43	48	47
45	44	43	42
52	49	46	45
55	53	42	40
59	57	37	35
60	58	35	34
55	53	42	40

From the above results it was concluded that the efficiency of the collector is comparable when the gap between the absorber plate and glazing is 2".

The design of the collector was finalized as follows:

Material of the outer frame	- Zinc Alum
Absorber plate	- GI corrugated sheet (gauge 24) coated with black paint
Glazing	- 3mm glass
Gap between absorber plate and the glazing	- 2"
Air flow	-50 cfm through the duct and (between the absorber plate and plain sheet of aluminum(gauge 28)

Current status

Fabrication of all 200 absorber plates and frames of about 100 solar collectors already completed. The structure to fix the solar collector has been decided in consultation with Dr Kulasinghe, Consultant of this project. It was decided to use rectangular and square ducting instead of circular ducting. Cross sections of each ducting with corresponding air flow are being finalized in consultation with Prof Peterson, of KTH. The first 100 completed frames will be transported to Ratnapura and glass glazing will be fixed there and installed on prestressed concrete pillars and columns. This work is in progress.

S. Koneswaramoorthy and M.T. Ziyad Mohamed

3.4. Dehumidified air technique for withering

Feasibility of using silica gel for dehumidifying air was tested. Moisture absorption capacity of silica gel was tested at the divisional laboratory. A known

weight(100g) of silica gel was spread on four trays and placed on a table and air was blown over it by using an exhaust fan at a velocity similar to that of the withering trough air flow for a period of one hour. The weight of the silica gel was measured every 10 min. The results are presented in Table 7.

TABLE 7 - *Final weights of the silica gel at different time intervals*

Time(min)	Tray number			
	1	2	3	4
10	103.93	104.95	104.86	106.00
20	106.51	108.88	108.77	110.39
30	108.51	112.05	112.07	114.00
40	110.07	114.74	114.91	117.11
50	111.59	116.92	117.11	119.34
60	113.27	119.32	119.68	121.91
* After 2 days	125.36	128.42	138.90	138.90

* Note: Without switching on the fan but just placing the trays on the table.

These measurements show that the silica gel has the potential of absorbing moisture at the desired rate over a period of one hour and it can absorb moisture up to 25 - 38 % of its own weight. This work is in progress.

K. Reveendran, L. Jayasinghe and M.T. Ziyad Mohamed

3.5. Gasifiers

Repairs to both gasifiers were carried out by the mechanic attached to the division. The BECE-KARA gasifier was used for electricity generation on and off specially during the days of power crisis.

Due to poor design the NERD gasifier could not be operated during 1996. The problems encountered were brought to the notice of NERD engineers, but they could not repair it and put it in order.

M.T. Ziyad Mohamed, G.L.C. Galahitiyawa, P.B. Chandradasa and M.B. de Silva

4. Project B/GRNT - *Green tea/Brick tea*

This project was suspended.

W.S. Botheju and V. Wickremasinghe.

5. Project B/PSLG - *Production of small leaf grades*

5.1. Particle size distribution - Variation of Grade Mix, dry leaf and liqouring characteristics in CTC production with usage (or wear and tear) of CTC cutters

Two replicates were carried out during the period under review. Analysis of the samples showed an increase in BP1 percentage, a decrease in PD percentage and somewhat uniform pattern for PF1 with wastage of rollers up to 50 hours as observed in previous trials. It was difficult to analyze the amount of flaky particles due to some uneven firing in the miniature FBD used in this study.

M.T. Ziyad Mohamed, W.S. Botheju, L. Jayasinghe and V. Wickramasinghe

5.2. Monitoring CTC manufacture

CTC manufacture in several mid-country factories were monitored during the period under review. Since the machinery used were quite old, purchase of new machines for most of the SLSPC factories were recommended by the division.

M.T. Ziyad Mohamed, W.S. Botheju and L. Jayasinghe

6. Project D/TECH - *Divisional Activities*

6.1. Testing the suitability of using nylon bag to transport green leaf

Four square type nylon bags received from a manufacturing company were tested for their suitability in green leaf transportation. To test this, leaf from Lamilliere division(2.5 km away from the factory) and from the dam side(1 km away from the factory) at St. Coombs Estate were transported by tractor using these nylon bags. Coir bags were used as control in this experiment. Once the leaf arrived at the factory, known amounts of flush samples were drawn from each bag and the number of good leaves and damaged leaves were counted and the percentage of damaged leaf(counting method) calculated. The weight of good and damaged leaf were determined separately and the percentage damaged leaf was calculated similarly on the basis of weight(weighing method). The leaf standard was determined simultaneously by counting(Table 8) and weighing(Table 9) methods.

TABLE 8 - *Percentage of damaged leaf determined by counting method*

Lamiliere Division

Date	Damaged leaf(%)		Leaf standard(%)		Weight(kg)	
	N-bag	C-bag	N-bag	C-bag	N-bag	C-bag
25.10.96	16	18	71	76	16	16
28.10.96	17	27	78	69	16	16
06.11.96	25	17	67	74	16	16
15.11.96	33	32	63	60	16	16
20.11.96	23	39	70	57	15	20
21.11.96	41	33	55	62	21	21
22.11.96	36	24	54	67	20	16
02.12.96	35	37	58	51	21	21

Dam side St. Coombs Estate

Date	Damaged leaf(%) N-bag	C-bag	Leaf standard(%) N-bag	C-bag	Weight(kg) N-bag	C-bag
25.10.96	14	18	79	75	16	16
28.10.96	17	20	79	75	16	16
30 10.96	13	11	82	82	16	16
15.11.96	27	27	67	67	16	16
20.11.96	42	40	50	50	16	16
22.11.96	27	33	67	62	20	21

TABLE 9 - *Percentage of damaged leaf determined by weighing method*

Lamilliere Division

Date	Damaged leaf(%) N-bag	C-bag	Leaf standard(%) N-bag	C-bag	Weight(kg) N-bag	C-bag
25.10.96	22	28	65	65	16	16
28.10.96	24	26	65	69	16	16
06.11.96	23	19	69	70	16	16
15.11.96	42	36	51	56	16	16
20.11.96	34	41	59	53	15	20
21.11.96	46	47	48	47	21	21
22.11.96	40	27	49	69	20	16
02.12.96	43	55	51	43	21	21

Dam side St. Coombs Estate

Date	Damaged leaf(%) N-bag	C-bag	Leaf standard(%) N-bag	C-bag	Weight(kg) N-bag	C-bag
25.10.96	19	24	69	68	16	16
28.10.96	25	30	71	63	16	16
30 10.96	24	16	71	78	16	16
06.11.96	47	36	41	44	16	16
15.11.96	39	36	54	55	16	16
20.11.96	47	53	42	36	16	16
22.11.96	29	33	65	59	20	21

Note: N - Nylon C - Coir

The results revealed that there was no significant difference in leaf damage when these two types of bags were used and the leaf weight was between 16 - 20 kg and transported over a long distance. When the leaf standard was poor, both nylon and coir bags showed higher percentage of damaged leaf. During bright, sunny days the temperature build up inside the nylon bags were slightly higher than the

coir bags. The same type of bags will be tested in the low-country where the leaf is transported over long distances.

W.S. Botheju, S.H. Priyanthi, L. Jayasinghe and N. Nisantha

6.2. FBD-4 Drying curve at different exhaust temperatures

Samples of dhool were drawn every 4 min from each section of the FBD 4 drier to determine the moisture content. Exhaust temperatures were noted when these samples were drawn. Drying curves were plotted with moisture percentage versus length of the drier. Results are presented in Table 10.

By adjusting the feed rate and maintaining the exhaust temperature around 89-93^{0}C the respective drying curve was found to be similar to the normal drying curve obtained using the ECP drier. Few more replicates will be carried out to confirm this fact.

TABLE 10 - *Moisture content(%) of dhool in different sections of FBD-4 at different inlet(I) and tea temperature/weir end(W)*

	Day 1	T(^{0}C)		Day 2	T(^{0}C)		Day 3	T(^{0}C)		Day 4	T(^{0}C)	
W/dhool		56.6			58.7			54.6			57.9	
Section		I	W		I	W		I	W		I	W
1st	17.9	130	95	44.2	117	100	47.2	130	106	42.5	127	100
	13.2			37.5			46.3			36.9		
	8.6			30.2			43.0			33.0		
2nd	3.0	130	110	16.1	118	90	24.2	128	86	14.2	128	93
	2.7			14.5			14.6			11.0		
	2.9			9.2			10.0			6.5		
3rd	4.6	130	110	5.8	120	95	5.8	-	-	2.9	128	90
	4.3			5.5			4.4			2.7		
	4.1			4.7			3.4			2.6		
4th	6.4	130	95	3.7	122	100	2.9	129	103	3.7	128	100
	4.9			4.6			2.9			3.3		

Note: I = Inlet temperature
W = Weir end temperature

W.S. Botheju, S.H. Priyanthi and L. Jayasinghe

6.3. Testing new moisture meter to measure the moisture content in withered leaf

This is a collaborative project with the Post Harvest Technology Department, University of Hohenheim, Germany. Attempts were made to measure moisture percentage of withered leaf using two techniques viz. electromagnetic(IMKO meter) and conductivity. Two meters brought from Germany were used in this project.

Withered leaf samples taken at different time intervals were tested as whole leaf and cut leaf using CTC rollers. The meter working on the conductivity principle was not suitable due to leaf juice wringing out when the sample is inserted and pressed. The IMKO meter measures the time taken for the electromagnetic waves to travel through the leaves. This time depends on the moisture content in the leaves. The results obtained in each trial are presented below(Table 11 and 12).

TABLE 11 - *IMKO meter reading (MR) at constant volume from withered leaves obtained from St.Coombs factory*

Whole leaf						Cut leaves					
						Two cuts				Four cuts	
50g		70g		100g		70g				100g	
MR	M%	MR	M%	MR	M%	MR	M%			MR	M%
25.9	69.0	32.5	65.1	66.4	65.1	29.1	58.7			55.5	50.7
26.2	68.8	31.7	64.9	59.8	57.3	27.8	58.7			56.6	46.8
27.4	68.1	31.7	63.5	52.8	56.1	27.4	57.5			56.6	49.8
25.6	67.2	33.1	63.5	52.4	55.3	26.5	56.3			57.0	54.9
25.8	66.4	31.7	62.8	53.9	54.8	26.6	56.3			57.0	52.3

TABLE 12 - *IMKO meter reading(MR) in vol% in different weights - withering was done at laboratory*

Whole leaf				Cut leaves/two cuts					
50g		80g		60g		80g		90g	
MR	M%	MR	M%	MR	M%	MR	M%	MR	M%
19.6	49.3	32.1	50.3	19.0	47.7	33.1	49.4	51.8	37.0
21.2	52.0	33.2	52.0	21.5	52.0	31.3	51.8	51.8	40.6
20.6	55.3	34.2	55.6	20.9	52.8	35.2	56.1	55.5	42.5
22.7	55.5	35.5	57.8	21.1	55.0	37.7	57.8	55.9	41.4
22.5	57.1	35.7	60.0	20.6	55.0	37.5	57.8	57.8	46.7

The results obtained were not reproducible when used for whole leaf or cut leaves since the meter was not calibrated for green leaf. Based on the results obtained the meter will be calibrated and tested again.

M. Gehrke, W.S. Botheju, S.H. Priyanthi, L. Jayasinghe and M.T.Z. Mohamed

6.4. Use of paper sacks for packaging of large leafy grades

Five types of paper sacks were compared with chests for its suitability to pack leafy grade teas. Three grades were used namely OPA, OP1 and BOP1 for this purpose. Initial results showed that whether the teas were packed in chests or sacks made no difference. However since more breakage is expected at the ware house, it was decided to transport these samples to one of the ware houses in Colombo, expose to usual handling and then analyze the breakage.

Preliminary results indicated that container paper sacks could be used to pack OP1 and BOP1 but not OPA grade teas. Types of sacks used were Safe-T-Open top, Safe-T-Side valve, J & C - Open top, J & C - Side valve and Container sacks.

B.W.S. Kariyawasam, and M. T Ziyad Mohamed

6.5. Outturn (MT/GL) study at St. Joachim Estate.

This study was carried out at St. Joachim Estate, Ratnapura using estate leaves and bought leaf obtained from smallholders. There is controversy with regard to net outturn(made tea/ green leaf) achievable from different standards of leaf with different moisture contents. The price of green leaf is determined based on this outturn. The objective of this study is to develop a program in which the net outturn could be predicted by feeding the information on leaf standard and moisture content under commercial conditions. Five replicates were completed under commercial scale and two replicates under miniature scale during the year 1996. The results are tabulated below(Table 13).

TABLE 13 - *Outturns obtained from the leaf manufactured on a commercial and miniature scale at St. Joachim Estate, Ratnapura.*

	Large Scale				Miniature		
Replicate No.	1	2	3	4	5	6	7
M% of green leaf	77.56	79.9	76.8	77.8	74.6	77.5	79.1
Dry matter content(%)	22.44	20.10	23.20	22.20	25.40	22.50	20.90
Plucking standard(%)	70.27	71.65	71.83	72.55	71.4	76.0	72.0
M% of made tea	3.15	3.89	4.10	3.97	3.72	4.8	4.3
Wt. of green leaf(kg)	988	940	847	890	854	20.4	20.6
Wt. of made tea(kg) (M% corrected to 3%)	224.76	190.58	197.20	199.14	211.76	4.57	4.27
Gross outturn(MT/GL)	22.75	20.27	23.28	22.38	24.80	22.38	20.75
M% of refuse tea	9.1	7.5	7.0	8.0	7.4	9.5	9.4
Wt. of refuse tea(kg) (M% corrected to 5%)	9.78	7.41	10.29	10.38	9.86	0.29	0.3
Refuse tea(%)	4.28	4.13	5.13	5.24	4.84	6.01	6.62
MC% of graded tea(GT)	5.35	6.61	5.10	5.48	5.22	7.46	7.29
Wt. of graded tea(kg) (M% corrected to 5%)	219.03	171.98	190.41	187.60	193.77	4.48	4.18
Net outturn(GT/GL)	22.17	18.30	22.48	21.0	22.69	21.95	20.30

This experiment is in progress.

G.L.C. Galahitiyawa, B.W.S. Kariyawasam and M.T. Ziyad Mohamed

6.6. Study of the water holding capacity of coir bags used for green leaf transportation

An experiment was carried out to determine the maximum water holding capacity of different types of coir bags used for green leaf transportation. The trials were carried out using new and used bags. Each bag was soaked with water and weighed after about 10 min. It was found that the bigger (coir thickness is comparatively higher) type of used bags could hold a maximum of 2.2 kg water. Smaller bags (used or new) with almost same dimensions made out of thinner coir, hold about 0.8 kg(Table 14).

TABLE 14 - *Water holding capacity of used and new bags*

	Size (cmxcm)	Wet weight (kg)	Dry weight (kg)	Water holding capacity(kg)
Used bags	92x74	1.65	3.69	2.04
(thicker)	92x74	1.65	3.79	2.14
	92x74	1.82	3.77	1.95
Used bags	89x70	0.48	1.20	0.72
(lighter)	89x70	0.48	1.08	0.60
	89x70	0.50	1.27	0.77
New bags	72x62	0.45	1.20	0.75
(lighter)	72x62	0.45	1.27	0.82
	72x62	0.46	1.22	0.76

This study is in progress.

G.L.C. Galahitiyawa, P.B. Chandradasa and M.T. Ziyad Mohamed

6.7. Monitoring the standard of leaf at St. Coombs Factory

Since the standard of leaf contributes to the quality of teas produced, it is important that a minimum standard of 65% (good leaf) is brought to the factory. A study was commenced to monitor the leaf coming into St. Coombs factory for at least two days a week. The leaf harvested from St. Coombs Estate including Lamiliere division and that from Diyanillakelle Estate (bought leaf) were taken to monitor the standard of leaf coming into St. Coombs Factory.

Leaf from each section were spread on the troughs and samples drawn. The respective samples were bulked and about 250 g from each sample taken to monitor the leaf standard. This leaf was then divided as standard leaf and substandard leaf as follows:

Standard leaf	Substandard leaf
Bud itself	Bud + three or more leaves
Bud + one leaf	and leaf with hard stem
Bud + two leaves	Coarse banji and coarse Bud + three
leaves(if 3rd is tender)	single leaves
Tender single leaf	Any damaged leaves
Tender banji	

The acceptable standard of leaf should be about 65% good leaf for good manufacture.

The following equation was used to calculate the percentage of leaf standard

$$\text{Standard of leaf} = \frac{\text{Standard leaf}}{(\text{Standard leaf} + \text{Substandard leaf})} \times 100$$

The results are given in Table 15.

TABLE 15 - *Standard of leaf brought to St. Coombs Factory from three different places*

Date	St.Coombs		Lamiliere		* Diyanillakelle	
	Count(%)	Wt.(%)	Count(%)	Wt.(%)	Count(%)	Wt.(%)
12.08.96	24	34			35	32
16.08.96	59	59			65	57
29.08.96	60	62	76	69	41	46
04.09.96	76	77	80	77	56	52
17.09.96	72	74	70	64	80	65
30.09.96	88	70	79	76	91	83
07.10.96	88	83	94	86	94	89
14.10.96	95	93	89	89	93	90
28.10.96	84	74	83	82	85	84
13.11.96	78	70	70	69	84	82
19.11.96	71	70	63	61	70	69
26.11.96	56	54	72	68	84	81
05.12.96	69	65	72	75	77	78
09.12.96	60	55	58	53	73	71

* Bought leaf received from Diyanillakele Estate

6.8. Evenness in drying - FBD-4

Attempts were made to investigate whether the moisture contents of different size tea particles at the drier mouth are the same. Several samples were drawn from the FBD-4 drier at St. Coombs factory and particle size distribution analysis was carried out. The moisture contents of duplicate samples of different particle sizes and the bulked sample were determined. The results revealed that there was no significant difference in the moisture content between the different particle sizes and the bulked sample(Table 16).

TABLE 16 - *Moisture contents of samples drawn from drier mouth and moisture contents of similar samples after distribution*

Dryer	Moisture contents of the samples				
	Drier mouth	F1	F2	F3	F4
FBD	3.7	4.5	4.2	4.1	4.0
ECP	2.2	2.6	2.6	2.55	2.55

Here F1, F2, F3 and F4 denote the fractions of tea particles in 4 different sieve size ranges.

FI- Over No. 14 and 16, F2- Over No. 22, F3- Over No. 25, 30 and 36, F4- Over No. 44 and 60

6.9. Documentation of ISO 9000 for St. Coombs Factory

Action was initiated during the last quarter of the year to obtain ISO 9002 certification for tea processing at St Coombs Factory. Preparation of ISO 9000 manuals is in progress with the help of Mr Gamini Jayasiri, Consultant, Gihan Talgodapitiya Associates, Productivity Development Consultants. The 'Work Instruction' manual has already been prepared. Preparation of 'Quality System Manual' and the 'Quality Procedure Manual' are in progress.

K. Raveendran and M.T. Ziyad Mohamed

7. Seminars/Meetings/Lectures

Dr M.T.Z. Mohamed, Technologist attended or addressed the following:

AgMMA Sectoral Committee meeting in Colombo on 12th January.

A seminar on 'Future needs of agricultural education' at Hector Kobbakaduwa Agrarian Research and Training Institute on 20th January.

Tea Sector Review meeting in Colombo on 22nd January.

RSC Low-country seminar in Galle on 26th January.

31st "National Farm Mechanization" Committee meeting in Colombo on 16th February.

Inform-CARP meeting in Colombo on 14th March.

Meeting on "Chemical Contaminants in made tea" at SLTB in Colombo on 15th March.

RSC Mid-country seminar on 29th March at TRI, Hantana.

AgMMA Sectoral Committee meeting in Colombo on 19th April.

Addressed a seminar on 'Processing of quality tea during flavour season' held at Bandarawela on 5th July.

Addressed a seminar on 'Energy needs of tea industry' at IFS, Kandy on 22nd July.

Advisory Officers forum at Ratnapura on 6th August.

A training course on 'Effective Writing Skills' at the British Council, Colombo from 9th-10th August.

Meeting on "A new type of withering machine" at TSHDA Head Office in Colombo on 17th September.

Seminar at Walahanduwa on 20th September.

Mr W.S. Botheju attended a meeting on "Quality, Standards and Grades of tea produced and exported by Sri Lanka" at the Plantation Ministry in Colombo on 6th December.

He conducted a lecture on "Technology of Tea Manufacture" for undergraduate students of the Faculty of Agriculture, University of Peradeniya on 30th November.

8. Training Programs/Paper presentations

Dr M.T.Z. Mohamed, served as a resource person for factory officer training programs in 4 batches on "Tea Manufacture" at NIPM, Bogawantalawa. (from 6th to 9th January; 20th to 24th April; 14th and from 16th-18th July; 22nd and from 24th-25th September)

9. Visitors

The number of visitors during the year to the Technology Division was 11.

10. Advisory Reports

64 advisory visits to factories were made by the members of the Technology Division on various aspects of tea manufacture and factory development. The number of samples received from estates for the determination of the moisture content percentage was 1676. These were reported with advice for correction of defects wherever, necessary.

STATISTICS UNIT

1. General

The Statistics Unit continued to assist the research divisions in the statistical analysis of experimental data.

Ms N. Senaratne served as Assistant Co-ordinator for information for Agricultural Research Managers (INFORM). She has completed Parts I & II of the Australian Computer Society examinations.

2. Statistical Analysis and Design

(a) Routine statistical analyses were carried out on data obtained mainly from randomized complete block, incomplete block, randomized block, covariance, general linear model, split, dsplit, factorial, one way, lattice designs. Simple regression and correlation analysis and paired and unpaired tests also were done. For most of the analyses, SAS and Instat were used.The following table gives the designs and number of analyses done by the division.

Experimental design		Number of analysis
1.	RCBD	297
2.	RBD	12
3.	Factorial	02
4.	Split	15
5.	Dsplit	03
6.	Covariance analysis	12
7.	Simple Correlation / Regression	27
8.	CRD	17
9.	Incomplete	24

(b) An analysis of the TRI budget for 1996 was undertaken using Excel. It identified the break-up among the various research and administration divisions, separately on the revenue and capital accounts.

AGRICULTURAL ECONOMICS UNIT

Officer -in -Charge - J.A.A.M.Jayakody

1. General

Mr G. Ganewatte, Research Assistant returned on 1st September after completing the course work for his MSc programme at PGIA. Mr D.P.B. Herath was granted study leave to follow a PhD programme in Agricultural Economics at Guelph University and left for Canada in October.

Mr D.S.A. Rajakaruna, NDT trainee from the NAB, completed his 4 month training programme in February. The graduate trainee attached to the AEU, Mr R.Paskerathevan, continued his training programme till the end of August and was then transferred to the Plant Breeding Division. Mr W. Dayantha, NDT trainee from the NAB, completed a 4-month training programme in June and subsequently, he served as casual Technical Assistant in the Unit for three months.

2. Divisional Activities:

2.1 . Interaction with the other Research Disciplines

A continuing dialogue took place with the research divisions with a view to asses the cost-effectiveness of the recommendations.

Economic inputs were provided for two Experiment & Extension Forum sessions held in 1996 in relation to the effect of plucking standard on quality/ profitability, energy saving in tea factories, subsoil irrigation in young tea and shear/ mechanical plucking.

2.2. Research prioritisation.

The TRI research prioritisation *via* CADMAR approach was co-ordinated by AEU; This approach incorporates 25 thrusts and 83 accompanying projects, covering most aspects of the problems/constraints of the tea sector, for which costing has been completed and benefit calculation is to be done before prioritisation.

J.A.A.M. Jayakody

2.3. Economic Studies

The following studies were completed during the year 1996.

2.3.1. Economics of plucking

A formula was developed for the precise calculation of plucking costs in terms of plucker intake and norms, while providing measures to cope up with under norm/rush crop and linking plucking policy to quality and price.

2.3.2. Labour Planning

Labour demand for plucking, other field operations, manufacturing and overheads besides capital development activities for micro-level application were estimated, based on estate size and worker out-turn.

2.3.3. Mechanical Harvesting

Preliminary analysis was done to estimate the benefits associated with mechanical plucking using the model NV 60 H. The result showed the net benefits compared to the alternative of temporary abandonment of fields due to shortage of pluckers. Further studies are planned for the refinement of these findings.

2.3.4. Impact of Power Crisis on Tea Manufacture

The impact of power failure on tea manufacture cut was studied, culminating in Government extending the subsidy for purchasing generators.

2.3.5. Productivity Indices

Two sets of indices were developed for assessing estate performance and for inter-estate comparison; one index is based on worker output while the other incorporates material component as well.

2.3.6. Ranking of Estates

Using nine interrelated criteria, an Estate Ranking Index (ERI) was developed for use at Government and corporate level for evaluating estate level performance.

2.3.7. Financial Returns of Replanting

An updated study on financial returns of replanting was undertaken, separately for estates and the smallholding sector which now points to its viability.

P Sivaram and G. Ganewatte

2.3.8. Feasibility of Infilling

The possibility of direct "block" infilling involving the use of compost was examined, with a view to reducing the capital cost and expediting soil rehabilitation. Preliminary results show the higher NPV and a shorter pay back period of the investment.

B. Sivaram

2.4. Development Planning

2.4.1. CTC Conversion

The AEU was represented on the Committee set up to study the CTC conversion and the report was submitted in early 1996.

2.4.2. Mid-country Tea Rehabilitation

The AEU was represented at the Inter-Ministerial Committee now functioning on Mid-country Rehabilitation. Assistance is being rendered in its deliberations and in drawing up the report.

B. Sivaram and J.A.A.M. Jayakody

2.5. GIS applications for Tea Estate Planning

2.5.1. Development of a Tea Information System

A collaborative project to study the potential use of GIS for Land Use Planning in tea estates was continued between the Tea Research Institute and the Environment and Forest Conservation Division of the Mahaweli Development Authority. A land suitability classification for forestry in five selected estates of the Kelani Velley Plantations in Nuwara Eliya was completed.

2.4.2. Development of Marginal Tea Land

A project funded by CARP for developing marginal tea land with multiple objectives in the mid-country was continued.

J.A.A.M. Jayakody, and R.M.S.S. Rajapakse

2.5. Tea Small holder Studies

2.5.1. GIS application for smallholder sector

A GIS application on tea smallholder sector to study the desirability of this technology being used in the smallholder sector is being continued.

J.A.A.M. Jayakody and A. Somaratne

2.5.2. Cost of green leaf production in smallholder sector

Study on the cost of production of green leaf in the small holder sector is being continued. A revised questionnaire have been drawn up in consultation with the TSHDA for this purpose. Arrangements have been made to collect monthly data from 18 smallholdings in the different elevational regions where TRI/TSHDA fertilizer trials are also established.

2.6. Performance Evaluation of Tea Estates

2.6.1. Performance of Tea Estates in 1995

Comprehensive survey covering 83 estates representing good, average and poor units, were undertaken based on 1995 performance to estimate the performance.

2.6.2. Financial Appraisal of Tea Estates

Two surveys for the period of 1995 and first half of the 1996 were conducted to estimate the cost of production, yield, profitability and related parameters in estate sector.

2.6.3. TRI Estates

Regular monitoring of performance of TRI estates and comparisons with neighbouring estates was continued.

2.7. Miscellaneous Activities

Assistance was rendered in preparing National Tea Research Plan and Agenda for 2005 under proposed ARP Phase II

3. Publications and Presentations

3.1. Labour Economics in Tea

Monograph covering almost all aspects of labour planning in tea plantations was published.

3.2. Development Planning in Tea

"Tea Bulletin" of June 1995, brought out in October 1996, was fully devoted to a reproduction of four papers presented by AEU on "Development Planning in Tea"

3.3. TRI Update

AEU contributed to the first two issues brought out during the year on statistics in the tea sector. An article on "Geographic Information System(s) -GIS- for Land Use Planning in Tea Estates" was published in the 3rd issue.

3.4. "Tea and Coffee Trade Journal"

AEU contributed two articles during the year, one highlighting TRI achievements and future approaches and the other on role of estate sector in the emerging privatised regime.

3.5. Seminar and Meetings

Following meetings and seminars were attended by the divisional staff.

i) Presentation on "GIS for Tea Plantations" by Mrs. A. Jayakody at RSC meeting, Galle in January.

ii) Presentation on "Economics of Length of Pruning Cycle" by Mrs A. Jayakody at RSC meeting, Kandy in March

iii) Presentation on "Privatisation, Productivity and Labour Welfare" by Mr. B. Sivaram at PH&SWT Colombo Seminar in June.

iv) Mrs A. Jayakody served as a Lecturer in NIPM training programme held at the Institute in June.

v) Presentation on "Worker Motivation" by Mr B. Sivaram at the seminar organised by PSWT in Ratnapura in July.

vi) Presentation at RSC Kandy on "Economics of Replanting" and "GIS in Tea Industry" by Ms. A. Jayakody in July.

vii) Presentation at RSC UVA on "Labour Productivity Concepts" by Mr. B.Sivaram in July.

viii) Presentation at RSC UVA on "Land Use Planning" by Ms. A.Jayakody in July.

ix) Mr. B. Sivaram addressed the seminar organised by Agrapathana Plantations Ltd. in September at TRI Auditorium.

x) Presentation at RSC, Galle, on "Resource Planning" by Mr. Sivaram in October.

xii) Presentation at RSC, Kandy on "Economics of Plucking" by Mr. B.Sivaram in November.

xii) Presentation at RSC, Nuwara Eliya on "Economics of Pruning" by Mrs. A. Jayakody in November.

xiii) Mrs A. Jayakody served as a Lecturer in NIPM training programme held at the Institute in December.

ST. COOMBS/LAMILIERE ESTATE

Acting Superintendent - M. W. Newman

1. General

Mr I D Gooneratne, the consultant was overlooking the property upto 31st May on which date he relinquished his service as consultant.

Mr M. W. Newman, Superintendent of Watawala Plantation Ltd., is overlooking the property since 1st June, 96.

Mr M.R.G.Perera, Assistant Field Officer, passed away on 16th July, '96.

2. Hectarage Statement

The revenue extents of St. Coombs and Lamiliere were 97.70 ha and 48.50 ha respectively totalling 146.20 ha.

3. Crop (made tea kg)

The production on St. Coombs/Lamiliere Estate in 1996 compared to the previous year is as follows.

	1996		*1995*	
	Crop	*Yield*	*Crop*	*Yield*
St.Coombs	183,395	1877	209,006	2150
Lamiliere	78,767	1624	83,524	1705
Total	262,162	1793	292,530	2001
Bought leaf	113,432		107,783	
Grand Total	375,594	1793	400,313	2001

4. Tea Prices

St. Coombs recorded an all time highest price of Rs. 300/- per kilo for BOP grade in March, apart from topping the Western market on several occasions. the working of St. Coombs/Lamiliere resulted in a profit of Rs. 5,194,465/02 which is equivalent to Rs. 35,578/52 per ha. (Table 1)

5. Nursery

A total of Rs. 24,800 plants of the TRI 3000 and 4000 series clones were raised in the nursery for planting and infilling. No shoots were sold during the year.

6. Labour

Labour on St. Coombs and Lamiliere has been quiet and the health of the labour was satisfactory.

7. Replanting

An extent of 2.00 ha of rehabilitated area in Field No. 13 of St Coombs was planted with clones of the TRI 3000 and 4000 series. Plant growth was satisfactory and shade trees have been planted.

8. Cultural Operations

Field No. 1

Seedling tea	-	Nil
VP tea	-	6.50 ha
Planting year	-	1953, 1959, 1993
Last pruned	-	August 1994
Yield per ha 1995	-	2366 kg
Yield per ha 1996	-	2791 kg
Shade	-	Dadaps and *Grevillea*

Field No. 2

Seedling tea	-	Nil
VP tea	-	2.60 ha
Clones	-	TRI 2143, 2142, 2025, DT 1 & DT 95
Last pruned	-	August 1996
Planting year	-	1964
Yield per ha 1995	-	2117 kg
Yield per ha 1996	-	1091 kg
Shade	-	Dadaps and *Grevillea*

Field No. 3

Seedling tea	-	0.40 ha
VP tea	-	13.30 ha
Clones	-	TRI 2027, 2043, 2025 & WT 26
Planting year	-	1965, 1966, 1967, 1968
Last pruned	-	July 1993
Yield per ha 1995	-	3239 kg
Yield per ha 1996	-	2878 kg
Shade	-	Dadaps *Grevillea and calliandra*

Field No. 4

Seedling tea	-	Nil
VP tea	-	9.10 ha
Clones	-	TRI 62/9, 2025, 3016, DN, N 2 and CY 9
Planting year	-	1978, 1981
Last pruned	-	October, 1995
Yield per ha 1995	-	1618 kg
Yield per ha 1996	-	1862 kg
Shade		Dadaps and *Grevillea*

Field No. 5

Seedling tea	-	Nil
VP tea	-	7.40 ha
Clones	-	TRI 2142, 2023, 2025, TC 9, DT 95 & N 2
Planting year	-	1970
Last pruned	-	May 1996
Yield per ha 1995	-	3049 kg
Yield per ha 1996	-	999 kg
Shade	-	Dadaps and *Grevillea*

Field No. 6

Seedling tea	-	Nil
VP tea	-	5.90 ha
Clones	-	TRI 2025, DN & N 2
Planting year	-	1985, 1986
Last pruned	-	July 1992
Yield per ha 1995	-	2067 kg
Yield per ha 1996	-	1619 kg
Shade	-	*Grevillea*

Field No. 7

Seedling tea	-	Nil
VP tea	-	4.70 ha
Clones	-	TRI 2024, 2025, 62/9, DT 1, DT 95
Planting year	-	1962, 1964
Last pruned	-	April 1995
Yield per ha 1995	-	939 kg
Yield per ha 1996	-	2213 kg
Shade		Dadaps and *Grevillea*

Field No. 8

Seedling tea	-	Nil
VP tea	-	5.20 ha
Clones	-	TRI 2024, 2025 & DT 1
Planting year	-	1962, 1994
Last pruned	-	June 1989
Yield per ha 1995	-	2525 kg
Yield per ha 1996	-	1932 kg
Shade	-	*Grevillea*

Field No. 9

Seedling tea	-	4.80 ha
VP tea	-	3.00 ha
Clones	-	TRI 3000 & TRI 2025
Planting year	-	SL 1935, VP 1986
Yield per ha 1995	-	1400 kg
Yield per ha 1996	-	1472 kg
Shade	-	Dadaps and *Grevillea*

Field No. 10

Seedling tea	-	1.00 ha
VP Tea	-	1.50 ha
Clones	-	Salt area
Last pruned	-	July, 1992
Planting year	-	SL 1935; VP 1991 - 1993
Yield per ha 1995	-	3971 kg
Yield per ha 1996	-	2730 kg
Shade	-	*Grevillea* and *Calliandra*

Field No. 11

Seedling tea	-	4.00 ha
VP tea	-	2.00 ha
Clones	-	TRI 2025, 62/9 & N 2
Planting Year	-	SL 1935; VP 1988
Last pruned	-	July 1993
Yield per ha 1995	-	2596 kg
Yield per ha 1992	-	1676 kg
Shade	-	Dadaps and *Grevillea*

Field No. 12

Seedling tea	-	9.60 ha
VP tea	-	1.20 ha
Clones	-	TRI 2025 & K 145
Planting year	-	SL 1935; VP 1985
Last pruned	-	June 1994
Yield per ha 1995	-	1475 kg
Yield per ha 1996	-	1128 kg
Shade	-	*Grevillea* and *Calliandra*

Field No. 13

Seedling tea	-	9.10 ha
VP tea	-	1.30 ha
Clones	-	TRI 2025, 7/27 & DN
Planting year	-	SL 1935; VP 1986
Last pruned	-	July, 1992
Yield per ha 1995	-	1854 kg
Yield per ha 1996	-	1379 kg
Shade	-	*Grevillea* and *Calliandra*

Field No. 14

Seedling tea	-	1.00 ha
VP tea	-	5.10 ha
Clones	-	TRI 777, 2024 & N 2
Planting year	-	1961
Last pruned	-	June, 1994
Yield per ha 1995	-	2654 kg
Yield per ha 1996	-	2247 kg
Shade		*Grevillea* and *Calliandra*

9. Yield data - St.Coombs

The monthly yield of St.Coombs Estate for 1996 in comparison with the yields obtained from 1992 to 1996 is given in Table 2 while the monthly yield of each field is given in Table 3.

TABLE 2 - *Monthly yield (kg ha-1), rainfall and average N applied from 1992 to 1992 - St.Coombs Estate*

Month	*1992*	*1993*	*1994*	*1995*	*1996*
January	192	109	172	206	148
February	76	57	153	168	102
March	34	90	140	136	74
April	24	178	199	184	93
May	259	125	199	276	424
June	212	236	146	172	105
July	80	119	112	119	150
August	133	92	105	190	140
September	73	155	163	132	93
October	108	146	173	205	164
November	136	192	164	184	198
December	156	196	170	178	186
	1483	1695	1896	2150	1877
Total rainfall					
(mm)	2455.2	2918.7	2356.1	2291.9	2199.2
No. of wet days	190	220	220	188	210
Average N					
(kg ha^{-1} yr^{-1})	215	222	220	234	258

10. REPORT ON LAMILIERE DIVISION

11. Cultural Operations

Field No. 4 A

VP tea	-	5.10 ha
Clones	-	TRI 2025
Planting year	-	1984
Last pruned	-	June, 1996
Yield per ha 1995	-	2293 kg
Yield per ha 1996	-	988 kg
Shade	-	*Grevillea* and Dadaps

Field No. 4 B

VP tea	-	1.90 ha
Clones	-	TRI 2025
Planting year	-	1986
Yield per ha 1995	-	2393 kg
Yield per ha 1996	-	2241 kg
Shade	-	*Grevillea* and Dadaps

TABLE 3 - *Monthly yield (kg Midtea ha-1) of fields with fertilizer mixture used and amounts of N applied - St Coombs (1996)*

Field No	Extent (ha))	Total (kg ha^{-1})	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
01	6.5	300	252	129	105	78	645	228	195	162	148	182	383	284	2791
02	2.6	180	207	85	108	60	273	90	119	56	20	11	29	23	1091
03A	6.7	320	299	164	116	91	753	84	246	187	138	1=218	178	205	2679
03B	7.0	320	173	136	65	157	884	160	226	235	127	291	332	283	3069
04	9.1	200	46	75	67	158	182	171	174	179	106	223	239	241	2426
05	7.4	180	159	101	68	105	357	29	10	11	06	17	47	89	999
06A	3.9	260	177	100	66	60	267	121	91	168	121	223	147	176	1717
06B	2.0	260	190	86	111	101	372	64	124	96	85	49	146	93	1517
07	4.7	240	153	117	102	53	599	137	211	154	161	133	228	165	2213
08	5.2	320	115	92	93	144	485	85	144	141	95	162	189	187	1932
09	7.8	180	06	05	04	20	178	72	166	182	105	243	268	223	1472
10	1.0	260	299	189	160	172	707	234	300	201	235	326	406	407	3636
10B	1.5	260	39	36	26	12	137	16	101	190	08	18	30	22	635
11A	2.0	300	284	170	165	143	454	99	165	178	137	131	289	417	2632
11B	4.0	300	71	41	31	98	189	78	75	91	56	132	228	105	1195
12A	1.2	260	372	289	112	127	980	279	471	467	281	251	159	258	4046
12B	8.6	260	52	47	16	38	76	31	49	60	34	104	105	151	763
13	10.4	260	159	103	75	48	342	83	92	93	55	122	116	91	1379
14	6.1	300	157	165	93	149	613	91	233	152	82	168	161	183	2247
	97.7		148	102	74	93	424	105	150	140	93	164	198	186	1877

TABLE 1 - *Working account of St. Coombs/Lamiliere for the year 1996 compared to previous years*

Year	Total crop (kg made tea)	Bought leaf (kg)	Yield (kg made tea	Nett Sale Average (%)	Cost of production (Rs/kg) Estimated	Actual	Gross Profit+ Loss-(Rs)	Actual Profit+ Loss-(Rs)
1992	198,461	79,414	1,404	82.75	70.95	84.21	-336,760.00	-336,760.00
1993	246,267	102,211	1,696	87.02	74.36	88.43	-463,497.40	-463,497.40
1994	267,687	91,434	1,845	89.60	84.36	85.01	1,828,191.13	1,828,191.13
1995	292,530	107,765	2,001	93.52	83.03	82.56	2,965,830.76	2,965,830.76
1996	262,162	113,432	1,793	106.52	83.09	92.69	5,194,465.02	5,194,465.02

12. The monthly yield for 1996 in comparison with the yields obtained from 1992 to 1996 is given in Table 4 while the monthly yield of each field is given in Table 5.

12. Yield data - Lamiliere

TABLE 4 - *Monthly yield (kg ha^{-1}) and average N applied from 1992 to 1996 - Lamiliere Division*

Month	*1992*	*1993*	*1994*	*1995*	*1996*
January	170	105	167	184	120
February	72	86	129	161	98
March	37	111	149	114	63
April	27	202	143	171	153
May	240	174	172	196	287
June	168	189	134	146	113
July	97	108	107	60	118
August	145	79	112	134	123
September	93	158	192	93	82
October	105	125	115	161	133
November	128	185	156	141	176
December	187	176	161	144	158
	1469	1698	1737	1705	1624
Average N (kg ha^{-1}yr^{-1})	214	222	220	217	215

ST.JOACHIM ESTATE

1. General

Mr L.A.Seevaratnam retired w e f 31st March,1996. He was away from the estate from 31st December,1996 on his annual leave. Mr S. Wimaladharma, Officer-in-charge, TRI Low Country Station was appointed by the T.R.I. to overlook St.Joachim Estate until the appointment of a Superintendent. Mr S. G. Ekanayake assumed duties as Asst. Superintendent on 2-5-1996.

Mr I. D. Gunaratne, Consultant/Estate Management and Extension Services paid monthly visits and inspected field and factory operations during the 1st quarter of the year. M/s Bartleet and Co.,Ltd. and M/s De Silva Abeywardena and Peiris continued as Brokers for St.Joachim during 1996.

The factory continued to function without a Head Factory Officer. A dispute in this connection is pending before the Labour Tribunal at Ratnapura. During 1996 Mr D. J. W. Ranawaka did not work on the estate as he was mobilised for Army Voluntary Services.

2. Hectarage as at 31st December, 1996

	ha	
Mature V.P. tea	50.73	
Land under rehabilitation	37.42	
Estate Nursery	1.59	
Abandoned tea	4.96	
Crop diversified-Timber	3.34	
Land under Rubber	12.30	
Land under Paddy	8.74	119.08
Other lands		
Acquisition by Government, buildings,roads,ravines and jungle		22.90
Total extent		141.98

3. Crop (made tea, kg)

The production on St.Joachim Estate in 1996 compared to the previous year was as follows:-

Year	*Esate crop*	*Bought crop*
1995	55,643	887,732
1996	63,330	1,024,941

The production on the estate showed an increase of 7,687 kg in comparison to the previous year.This represents an increase of 14%.

TABLE 3 - *Monthly yield (kg Made tea ha^{-1}) of fields with fertilizer mixture used and amounts of N applied Lamiliere Div.(1996)*

Field No	Extent (ha))	Total (kg ha^{-1})	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
04	5.1	180	134	112	60	113	394	91	-	-	-	-	51	33	988
04B	1.9	200	184	121	71	146	666	81	213	123	95	147	206	185	2241
05	2.0	180	76	34	22	41	91	36	49	67	40	59	80	94	689
06	2.0	180	18	29	05	24	153	45	55	89	63	93	87	103	767
06B	3.0	240	31	60	10	22	72	40	66	54	71	74	105	92	697
07	4.5	200	156	104	84	233	299	142	183	168	102	186	230	231	2117
08A	5.0	200	141	84	120	180	224	173	149	203	140	200	204	237	2055
08B	4.0	200	85	46	44	128	232	62	-	-	-	07	43	44	691
09A	4.0	200	116	103	82	136	298	114	147	130	100	134	214	07	1284
09B	4.0	200	108	117	76	211	311	152	158	110	90	136	229	154	1867
10	6.6	260	173	109	56	138	402	110	182	207	107	200	288	176	2248
11	6.4	260	102	151	57	252	220	162	137	181	106	194	204	247	2013
	48.5		120	98	63	153	187	113	118	133	82	133	176	158	1624

3.1. Bought Leaf

The bought leaf manufactured at St.Joachim Factory showed an increase of 207,209kg in comparison to last year. This represents an increase of 23%.This increase is mainly due to favourable weather conditions that prevailed throughout the year and better prices paid for bought leaf in comparison to other factories in the area.

4. Prices

All teas produced at St.Joachim Factory were sold at the Colombo Auctions in the Main Low Grown catalogue. Messrs Bartleet and Co. Ltd. and Messrs De Silva,Abeywardena & Peiris sold our tea in equal proportions.

The tea produced during the year was sold at a Nett Sale Average price of Rs.115/41.The Nett Low Grown Average for the year was Rs.114/35,thus the factory Nett Sale Average is 1/06 above Low Grown Average.The average price paid for bought leaf during the year under review was Rs.17/31.9 per kg as against an average of Rs.11/64.9 paid in the previous year.The working of St.Joachim Estate resulted in a profit of Rs.18,431,737/00.

(Table 1)

5. Nursery

The supply of planting materials to Smallholders in the district continued this year too.Sale of planting materials as compared to the previous year was as follows:

Year	*Shoots supplied*	*Income (Rs.)*	*Plants supplied*	*Income (Rs.)*
1995	1,200	1,200	7,500	15,283
1996	-	-	8,750	26,250

TABLE 1- ***WORKING ACCOUNT OF ST. JOACHIM ESTATE FOR THE YEAR 1996 COMPARED TO PREVIOUS YEARS***

Year	Total crop sold(made tea kg)	Yield/ha (made -loss (Rs/kg)	Nett Sale Average	Cost of Production(Rs/kg) Estimated	Actual Rs.	+Profit tea kg) Rs.
1990	*819,715 56,165	1101	67/54	51/39.75	63/53.20	+3,728,043/=
1991	*726,162 75,190	1162	55/96	65/17.16	60/09.21	-2,653,503/=
1992	*338,205 31,463	693	70/00	64/10.00	72/60.08	-2,999,959/=
1993	*690,355 55,775	1014	74/70	71/65.59	72/37.69	+1,734,553/=
1994	*865,691 57,487	1045	69/49	66/13.84	69/53.08	-35,914/=
1995	*887,732 55,643	1097	78/89	68/80.25	75/88.38	+2,827,076/=
1996	*1,094,941 63,330	1248	113/81	87/06.38	102/30.88	+18,431,737/=

* Bought crop

1996 Production - 2,228,965 kg of made tea unsold as at 31/12/96

6. Cultural

Field No. 1

V.P. tea	...	5.85 ha
Clones	...	T.R.I. 2023,2025,2026,2027,S106
Last pruned	...	July,1996
Yield per hectare 1995	...	497 kg
Yield per hectare 1996	...	372 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Routine upkeep of the tea was done during the year and 7,175 V. P. plants of T.R.I. 2025 and 2027 were used in infilling vacancies under Mana grass.

Field No.1A

V. P. tea	...	1.20 ha
Clones	...	T.R.I. 2025,2027,S/106 & KEN
Last Pruned	...	May 1995
Yield per hectare 1995	...	1,109 kg
Yield per hectare 1996	...	2,124 kg
Shade	...	*Albizia and Gliricidia*

Planting of Mana grass was undertaken in vacant patches

Field No.2

V.P tea	...	4.12 ha
Clones	...	T.R.I. 2025,2026,2027 & S106
Yield per hectare 1995	...	402 kg
Yield per hectare 1996	...	562 kg
Shade	...	*Albizia and Gliricidia*

This area is under the supervision of the T.R.I. and is used for clonal proving trials.

Field No.2A

V.P.tea	....	0.93 ha
Clones	...	T.R.I.2025,S106
Last pruned	...	June 1995
Yield per hectare 1995	...	1,403 kg
Yield per hectare 1996	...	2,988
Shade	...	*Albizia and Gliricidia*

Intercropping area, planted with coconut in tea

Field No. 2F

V.P. tea	...	6.78 ha
Clones	...	T.R.I. 2025,2026,2027 & S106
Last pruned	...	May 1996
Yield per hectare 1995	...	1,262 kg
Yield per hectare 1996	...	788 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Routine 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	...	June 1994
Yield per hectare 1995	...	1,316 kg
Yield per hectare 1996	...	1,452 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Routine upkeep of the tea was done during the year

Field No.3 Rubber Area

The rubber in this area was tapped and the latex was collected by Zion (Pvt) Ltd.,Nugadanda Estate,Ingiriya.Routine maintenance was carried out during the year.

Field No.10 Rubber Area

This field too was tapped and the latex was collected by Zion(Pvt) Ltd.,Nugadanda Estate,Ingiriya.Routine maintenance was done during the year.

Field No.10 Rubber Area (part)

Planted in 1990 on an extent of 3.6 ha. Normal upkeep was undertaken.

Field No. 4

V.P. tea	...	5.85 ha
Clones	...	T.R.I. 2023
Last pruned	...	June 1994
Yield per hectare 1995	...	1,015 kg
Yield per hectare 1996	...	1,030 kg
Shade	...	*Albizia and Gliricidia*

Planting Mana grass was undertaken in vacant patches.

Field No. 5

V.P.tea	...	8.20 ha
Clones	...	T.R.I. 2023,2025
Last pruned	...	May 1995
Yield per hectare 1995	...	703 kg
Yield per hectare 1996	...	771 kg
Shade	...	*Albizia and Gliricidia*

Routine upkeep was done during the year and 17,805 V.P.plants of T.R.I. 2026 and 2027 were used in infilling.

Field No.6

V.P. tea	...	1.50 ha
Clones	...	T.R.I. 2025, 2026 & 2027
Last pruned	...	June 1995
Yield per hectare 1995	...	1,740 kg
Yield per hectare 1996	...	2,943 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Routine maintenance of grass under rehabilitation was undertaken.

Field No.8B

V.P.tea	...	4.30 ha

Excluded from the tea in bearing hectarage and shown under abandoned area.

Field No.8A

V.P.tea	...	6.00 ha
Clones	...	T.R.I.2025,2026,2027, KEN,S106 & 3063
Last pruned	...	May 1994
Yield per hectare 1996	...	2,396 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Field No.8C

V.P. tea	...	1.90 ha
Clones	...	T.R.I.2025,2027,KEN,S106 & 3063
Last pruned	...	June 1995
Yield per hectare 1996	...	2,540 kg
Shade	...	*Albizia and Gliricidia*
Experiments	...	Nil

Routine upkeep of the tea was done during the year. The following New Clearing work was undertaken during the year.

Field No.1 - 4.25 ha - Tea and Rubber Interplanting

Interplanting tea and rubber in this area was not undertaken this year. Upkeep of Mana,lopping and weeding were done during the year.

Field No.8B & 8D - 4.85 ha - Upkeep of Mana grass

Upkeep of Mana,lopping and weeding were done during the year.

Field No.1 - 4.80 ha - Upkeep of Mana grass

Upkeep of Mana, lopping and weeding were done during the year

Field No.6 - Oil Palm 7.28 - Upkeep of Mana grass

Upkeep of Mana, lopping and weeding were undertaken during the year **Intercropping Experiment - 1.20 ha** Fertilising and routine upkeep of tea and rubber were undertaken during the year.

Field No.5 - 5.60 ha Upkeep of Mana grass

Routine upkeep of Mana, weeding and lopping were undertaken.

Field No.4-4.14 ha -Upkeep of Mana grass

Routine upkeep of Mana, weeding and lopping were undertaken.

7. Factory

Routine upkeep of factory buildings and machinery was done during the year.

8. Buildings

All buildings on the estate were well maintained during the year.

9. Labour

Health condition of the population was satisfactory.There were no strikes or major disputes.The estate was unaffected by any form of violance or disturbances during the year.

The monthly yield of St.Joachim Estate for 1996 in comparison with the yields obtained from 1991 to 1995 is given in Table 2 while 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 1990 to 1995 - St.Joachim Estate.*

Month	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
January	97	89	71	102	94	82
February	74	24	34	94	68	86
March	82	05	52	99	77	83
April	106	12	90	109	96	90
May	144	60	82	66	97	96
June	115	44	96	88	99	75
July	82	61	108	66	102	119
August	113	82	79	79	101	112
September	79	68	88	75	101	108
October	105	70	98	87	89	125
November	98	85	106	89	104	126
December	97	93	110	91	69	146
	1162	693	1014	1045	1097	1248
Total rainfall (mm)	3740.9	3993.7	4589.3	3679.0	4216.2	3655.0
No.of wet days	203	185	226	217	208	188
Average N (kg^{-1} ha^{-1} yr^{-1})	121	160	154	133	165	119

TABLE 3

Monthly yield(Kg ha-1) of fields with fertilizer mixture used and amounts of N applied of St.Joachim Estate

Fld No.	Exte. (ha)	Tot al N	Ferti mix. used	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	5.85	130	U/235	55	59	40	54	66	17	-	03	12	23	17	26	372
1A	1.20	150	U/235	158	48	141	180	148	96	244	215	206	272	200	216	2124
2	4.12	TRI	Ex.block	20	44	34	28	36	37	45	46	72	65	46	97	570
2A	0.93	150	U/235	163	127	175	202	227	209	270	407	274	257	267	410	2988
2F	6.78	130	U/235	79	110	110	72	45	14	-	18	37	88	108	107	788
3	8.40	150	U/235	94	101	92	102	94	98	154	123	132	131	166	165	1452
4	5.85	150	U/235	57	52	60	55	80	65	104	113	88	133	93	130	1030
5	8.20	150	U/235	51	66	58	80	67	43	55	78	66	65	59	83	771
6	1.50	150	U/235	183	131	193	221	242	221	350	278	278	302	234	310	2943
8A	6.00	150	U/235	130	126	105	150	178	148	296	258	212	234	268	291	2396
8C	1.90	150	U/235	158	136	135	108	205	190	374	206	261	268	257	242	2540
		50.73		82	86	83	90	96	75	119	112	108	125	126	146	1248

ADVISORY AND EXTENSION SERVICES - TALAWAKELE

Officer-in-Charge - C C Rajasingham

1. General

Mr V.S.Sidhakaran went on study leave in January to follow a MSc course at the University of Peradeniya.

Mr B.A.D.Samansiri, Advisory Officer left for the Phillipines on 1st June to persue a course of post-graduate studies at UPLP College, Phillipines.

Mr J.C.K.Rajasinghe, Actg OIC and Advisory Officer, TRI Advisory and Extension Centre, Deniyaya was transferred to this Division as Advisory Officer, w e f 1st July.

Mr P.Rajamanthri was appointed as Clerk/Typist to this Division w e f 1st August.

2. Advisory and Extension Services

494	Letters were written on technical matters
99	Advisory visits were made to plantations
06	Advisory visits were made to tea smallholdings
50	Seminars/Field days were conducted on plucking for plantation field staff and selected labour
03	Skill training programmes on nursery management were conducted for field staff and nursery labour
01	Group visit of Superintendents to the TRI Laboratories was conducted.
06	Lectures were delivered to Agricultural Diploma students.
01	Exhibition stall in public exhibitions were installed and manned by the Advisory staff.
11	Soil samples were tested for pH
2961	persons visited the Division
601	from estates
184	Smallholders
1077	school students
748	University/Diploma students
27	Foreigners
324	Others

3. TRI/TSHDA interaction on adaptive fertilizer trials

Messrs J.C.K.Rajasinghe and C.C.Rajasingham provided technical support to the smallholders of the experimental trials at Norton and Tyspane.

They also demonstrated the salient aspects of pruning and plucking to the farmers living around the experimental site.

4. Regional Scientific Committee - I

110 Superintendents and Assistant Superintendents attended the RSC seminar on pruning organized by the division in association with the RSC on 05th December.

5. TSHDA/TRI Workshop

Three programmes on nursery management and one on replanting and mature tea upkeep were conducted by Messers J.C.K.Rajasinghe and C.C.Rajasingham for the Tyspane/Ambagamuwa Tea smallholders at the TRI.

6. NIPM training programmes for CRI/RRI Extension Officers

Mr J.C.K.Rajasinghe co-ordinated several programmes conducted during the following period for the above officers:

1) 18th to 23rd November - six days

2) 16th to 20th December - five days

LOW-COUNTRY STATION RESEARCH, ADVISORY AND EXTENSION CENTRE RATNAPURA

Officer-in-Charge - S. Wimaladharma

1. General

Mr D.W.Bartholomeusz, Administrative Officer was transferred to the Head Office w.e.f. 1st August. Mr N.I. Giddawage assumed duties as Administrative Officer w.e.f. 1st August.

The staff strength as at 31st December was 32.

Ms S.M. Samarasinghe, Experimental Officer, Entomology Unit continued her research work for her M.Phil degree.

Mr S.L.D. Amarathunge, Extension Officer of the Advisory Unit continued his post-graduate studies on Environmental Science leading to the MSc degree.

Mr S. L. D. Amarathunge was temporarily transferred to TRI Advisory and Extension Centre, Diyadawa, Deniyaya w.e.f. October to function as the acting Officer-in-Charge.

Mr H.J.M.De Silva, Extension Officer, TRI Mid - country Research, Advisory and Extension Centre, Hantane was temporarily transferred to the Advisory Unit at Ratnapura.

2. Advisory and Extension Services

210	Advisory letters were written
80	Advisory visits were done (19 for the estate sector, 27 for the smallholders and 34 other extension visits)
09	Nursery skills training programmes were conducted. (04 estate sector; 3 for the smallholders; 02 for other agencies)
02	Skill training programme on plucking for the estate sector
14	Field demonstrations/Field days were conducted (3 on soil conservation; 3 on pruning/weed management; 6 on pests & diseses; fertilizer use and others)
12	Awareness programmes on tea cultivation (11 smallholders and 1 for Sirasa Radio)
06	Seminars on leaf quality and transport for the smallholders.
17	Seminars on tea cultivation were conducted for the estate sector and smallholders
03	Educational programmes for NIPM and others
01	TSHDA/TRI Interaction/Regional discussion
16	Visits on Adaptive Research Trials on fertilizer and pruning

03 Training programmes were conducted for Agricultural Diploma studies

02 Seminars/Workshops were attended by Mr S.Wimaladharma, Senior Advisory Officer (Watershed Management Workshop, Colombo; Regional Scientific Committee Seminar, Nuwara Eliya Region)

01 Mahapola Exibition at Pelmadulla

154 Soil samples were tested for pH

64 Estate Management personnel visited the station

48 Smallholders visited to seek advice.

640 Students visited the station

88 Other visitors sought advice on general matters relating to tea

2.1 Publications distributed

374 Advisory leaflet sets
25 Advisory Circulars
52 Monographs/ Hand books
17 Field Guide Books

3. Research Activities

The following research activities are being conducted at this station.

Agronomy Division

D/AGRY

B/INCR

Technology Division

D/TECH

Entomology Division

B/TERM

Plant Breeding Division

B/CLON

Research activities were in progress and their progress reports have been forwarded to the respective Heads of Divisions and the information is included in their divisional/project reports.

4. Buildings and Utility Services

Work on the proposed extensions to the Low-country Station have been initiated and a sketch plan was prepared.

5. Problems encountered in the Low-country districts

The growers visited this station during the period under review on Stem and Branch Canker, yield decline, Red Borer damage and nursery failures.

Incidences of multiple bud formation and deformity in fields recovering from pruning and mature tea is on the increase and this was mainly due to execessive use of glyphosate for weed control. Several incidents of death of tea were reported. Three awareness programmes were conducted for the benefit of the growers in the affected areas.

MID - COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE - KANDY

Officer-in-Charge - P.B.Ekanayake

1. General

Mr R.M.Chandrasekara, Experimental Officer retired from the services of the Institute with effect from 22nd June.

Messrs W.A.M.Dharmasena, U.B.Herath and Ms B.Sureshkumar, Experimental Officers were transferred from Talawakele to the Entomology Unit in February.

Mr W.M.S.Wijetunga, Experimental Officer was transferred from Talawakele to the Soils and Plant Nutrition Unit in March.

Mr K.Palathanthirige, Works Supervisor was transferred from Ratnapura in November.

Ms B.K.S. Herath, Accounts Clerk was transferred from Talawakele in December.

Mr B.M.Gunadasa, Guest House Keeper was transferred to Passara in May.

We record with deep regret the death of Mr W.A.M.Dharmasena, after a brief illness on 10th October.

2. Advisory and Extension Services

237 Letters were written to estates and smallholders

102 Advisory visits were made during the year

171 Local and foreign visitors and 301 smallholders visited the Centre

654 Soil samples were tested for pH

5 Field days/seminars/demonstrations were held for smallholders in Oonugaloya, Doragala, Moragalla, Wattappola and Handiyadeniya.

6 Seminars were conducted for the Assistant Superintendents and field staff of Madulkelle, Melfort, Geragama, Alakolla, Rangala and Hatale estates.

2 Seminars were held for the TSHDA at Hantane Auditorium one each for Tea Inspectors of Kandy region and for all Regional Managers, Assistant Regional Managers and Tea Inspectors.

2 RSC Seminars were held at Hantane Auditorium organised by the RSC IV, Mid - Country.

3. Hectarage as at 31st December, 1996

	ha
Seedling tea	3.60
VP tea	7.00
Mother bush	3.00
Tea nursery	0.20
Under mana grass	0.40
Fruit trees	0.40
Coconut	0.81
Forestry	1.21
Marshy land	0.61
Buildings, gardens,paths & roads	5.77
TOTAL	23.00

4. Crop

Green leaf harvested (kg)

Month	*Harvested*	*Sold*	*Rate paid/kg Rs. cts*	*Total Rs. cts*
January	3961	3948	10.29	44572.92
February	3013	3009	11.12	33460.08
March	4340	4333	13.32	57715.56
April	4475	4461	13.12	57748.92
May	4730	4700	11.89	55883.00
June	1686	1683	10.60	17839.80
July	4763	4755	10.12	51449.10
August	3105	3099	12.09	37466.91
September	5252	5194	13.06	67833.64
October	4368	4325	13.99	60506.75
November	5367	5359	12.33	66076.47
December	4602	4595	11.58	53210.10
Total		49,461		603,758.83

5. Income

No. of cuttings sold		4,72,8750
Income from sale of cuttings	Rs.	94,575.00
No. of VP plants sold		98,758
Income from sale of plants	Rs.	286,398.20
Amount(kg) of crop harvested		49,461
Income from green leaf sold	Rs.	603,758.25
Guest House occupation charges	Rs.	21,300.00
Electricity charges	Rs.	1,700.74
Soil testing (pH) charges	Rs.	19,620.00
Miscellaneous	Rs.	15,001.64
Total Income	Rs.	1,042,353.83

6. Special Scientific Visitors

1. Dr G Wadasinghe, Senior Lecturer, Faculty of Agriculture in February
2. Dr N Ratnaweera, Director, NIPM in March
3. Mr P.G.Joseph, Energy Conservation Fund in June
4. Dr K Hirimburegama, University of Colombo in June
5. Mr K.V.S.Premakumar, Export Agriculture Research Station in July
6. Mr Nick Jones, Zeneca Agrochemicals, UK in August
7. Mr Piyal Marasinghe, Herbal Farm, Haldummulla in September

DENIYAYA ADVISORY AND EXTENSION CENTRE - DIYADAWA

Officer-in-charge - M. K. S. L. D. Amarathunga

1. General

Mr J.C.K.Rajasinghe was transferred to the Head Office w.e.f. 30th June.

Mr J.A.S.K.V.Jayasinghe assumed duties as Actg. OIC w.e.f. 1st July. He left for India for a training programme leading to a diploma on 30th October.

Mr M.K.S.L.D.Amarathunga assumed duties as Actg. OIC w.e.f. 28th October. He continued his MSc course on Environmental Science at the University of Colombo.

Dr R.L.de Silva, Consultant, Maturata Plantations Ltd visited the Centre.

2. Advisory and Extension Services

53 Letters were written on Advisory matters
52 Advisory visits were made
907 Visitors including smallholders visited the station
2 Field days (for smallholders) were conducted
18 Training programmes (13- smallholders, 1-Gami Sumithuro, 1-Labourers & field staff, 2-Change agent members, 1-Samurdhi Niyamakas)
14 Seminars (1-Labourers & field staff, 13- smallholders)
34 Video films show programmes
154 Soil samples were tested for pH

3. Hectarage as at 31st December, 1996

	ha
Tea	6.41
coconut	0.13
Grafting Experiment	0.04
Buildings	1.44
Gautemala area	0.70
Nursery	0.70
Encroachment	1.12
Others	2.73
	13.27

4. Crop

Green leaf harvested (kg) - 1996

Month	Harvested	Rate paid/kg Rs.cts	Total Income Rs.cts.
January	1604	15/61.7	25,049.67
February	1789	16/79.6	-
	57	17/73.3	31,058.82
March	1851	17/09.9	31,650.25
April	1379	16/87.6	23,272.00
May	793	17/73.3	14,062.27
June	894	16/94.3	15,147.04
July	1028	18/90.8	19,437.43
August	1217	17/86.4	21,740.49
September	1299	19/31.5	25,090.19
October	1946	19/40.9	37,769.91
November	2116	16/59.5	35,115.02
December	2294	16/31.1	37,417.43
Total	18267		316,810.52

5. Income

No.of cuttings sold		61,400
Income from sale of cutting	Rs.	12,280.00
No. of plants sold		45,425
Income from sale of plants (with loading charges)	Rs.	152,586.25
Amount (kg) of crop harvested		18,267
Income from sale of crop	Rs.	316,810.52
Average price fetched per kg green leaf	Rs.	17.29
Miscellaneous income	Rs.	30,245.00
Total Income	Rs.	511,921.77

6. Experiments

6.1. LVP 43- Since April, the 4000 series clonal cuttings have been issued to estates and smallholders. The clonal plots have been tipped and arrangements have been made to record the yield data for another pruning cycle commencing from January, 1997.

6.2. Earthworm Experiment - Anningkanda

This experiment is being conducted under the supervision of the Agronomy Unit at Hantane.

6.3. Shear plucking - Kiruwanaganga

This experiment was commenced at Kiruwanaganga Estate this year and it will be conducted under the supervision of the Agronomy Unit at Ratnapura.

6.4. Demonstration fertilizer trials - Pasgoda & Deniyaya

These two demonstration fertilizer trials are being carried out in collaboration with TSHDA, Matara region from the May/June pruning season; plucking records are being maintained from November.

6.5. Aislaby Selections

This experiment has been terminated.

7. Special Meetings/ Seminars

One Advisory Officers' meeting was held at the Deniyaya substation on 29th November.

The Actg. OIC participated in a workshop on Sustainable Development Greening on National Accounts' organized by the German Cultural Institute and LIFE organization of Colombo at Taj Samudra Hotel on 13th and 14th December.

UVA ADVISORY AND EXTENSION CENTRE PASSARA

Officer-in-charge - M.B.A.Perera

1. Advisory and Extension Services

279	Advisory letters were written
60	Advisory visits were made to Estates
25	Seminars/Field days were held for Estates/Smallholders
02	Regional seminars were held in collaboration with Uva RSC
138	Visitors including Planters/Smallholders visited the Centre
494	Soil samples were tested for pH
304	Soil samples were analyzed for their organic carbon content

2. Hectarage as at 31st December 1996 (approx.)

		ha.
Mature tea (in plucking)	-	5.30
Mother bushes	-	1.15
Under rehabilitation	-	0.50
Buildings/Roads	-	0.50
Forest/Scrub/Grass area	-	6.85
Total	-	14.30

3. Crop

Green leaf harvested (kg) - 1996

Month	Harvested	Sold	Rate paid/Kg Rs.cts	Total Income Rs.cts
January	3426	3482	10.28	35,794.96
February	3031	3028	11.42	34,579.76
March	4115	4110	12.74	52,361.40
April	4400	4406	13.61	58,965.66
May	5852	5844	12.25	71,589.00
June	3403	3403	10.55	35,901.65
July	3232	3226	9.81	31,647.06
August	3257	3243	11.18	36,256.74
September	3730	3733	14.01	52,299.33
October	5647	5623	15.05	84,626.15
November	4300	4295	11.09	47,631.55
December	3485	3494	11.39	39,796.66
Total	47,938	47,887	-	581,449.92

The crop of 47,938 kg green leaf is the highest recorded at the Centre. However this includes the crop harvested from 0.5 ha. of seedling tea area purchased from Gonakelle Estate. The total yield obtained (including seedling area) was 1996 kg MT/ha. The estimated yield for the year was 1455 kg MT/ha.

4. Income

No of VP cuttings sold		80,150
Income from sale of VP cuttings	Rs.	20,037.50
No. of VP plants sold		410
Income from sale of VP plants	Rs.	1,435.00
Amount (kg) of crop harvested		47,887
Income from green leaf sold	Rs.	581,449.92
Average price fetched per kg green leaf	Rs.	11.95
Soil analytical charges	Rs.	48,260.00
Other income (Guest house occupation, sale of publications, etc.)	Rs.	29,755.00
Total Income	Rs.	680,937.42

The nursery was maintained only to raise limited number of TRI 3000/4000 series clonal plants. These plants were issued to clonal trials in plantations and selected smallholdings. Those plants which remained in the nursery were sold to smallholders.

5. Labour Force

No. on permanent check roll	- 24
Out -turn (Women)	- 77%
Out -turn (Men)	- 73%

6. Field Trials

6.1. Clonal observation trials UVP 8 and UVP 9 are in progress at the centre. These trials are monitored by the Plant Propagation & Breeding Division, TRI.

6.2. An observation trial on the use of shears for harvesting tea is being carried out at the Centre.

6.3. A field trial is in progress to assess the effect of foliar application of different potash salts to mitigate drought. This trial is being carried out by the Soils & Plant Nutrition Division, TRI.

6.4. Demonstration trials on the use of fertilizer mixtures T- 1130 Vs. U-709 for mature tea under smallholder cultivation conditions are being carried out in three different locations in the region in selected properties. These trials are conducted by the Soils & Plant Nutrition Division in collaboration with the TSHDA.

7. Special Uva problems

The NE monsoon which is the only effective rainy season for the Uva failed during the year hindering common field operations done during the monsoon such as replanting and infilling.

SOUTHERN PROVINCE ADVISORY AND EXTENSION CENTRE - TALGAMPOLA

Officer-in-charge - K.D.Dahanayake

1. Advisory and Extension Services

115 Advisory letters were written
92 Advisory visits were made including visits to smallholders
431 Visitors visited the centre.
23 Training programmes were held for Superintendents, Asst. Superintendents, Field staff and smallholders'.
33 Seminars/ field days were held.
24 Soil samples were tested for pH

2. Hectarage as at 31st December, 1996

Not given

3. Crop

Green leaf harvested (kg) - 1996

Month	Harvested	Sold	Rate paid/kg Rs. cts.	Total income Rs. cts.
January	7675	7675	16/62.9	127,627.57
February	8053	8053	16/82.7	135,507.83
March	5817	5817	18/63.3	108,388.16
April	7117	7117	17/96.1	127,828.44
May	4473	4473	18/89.5	84,517.33
June	4631	4631	19/25.1	89,151.38
July	6400	6400	20/11.9	128,761.60
August	5532	5532	19/12.6	105,805.03
September	6140	6140	20/31.4	124,727.96
October	8161	8161	20/00.5	163,260.81
November	7790	7790	17/88	139,285.20
December	9246	9246	17/51.6	161,952.93
	81035	81035		1,496,814.24

4. Income

No. of cuttings sold		75,125
Income from sale of cuttings	Rs.	15,025.00
No. of VP plants sold		50,250
Income from sale of VP plants	Rs.	150,750.00
Miscellaneous income	Rs.	15,728.41
Amount (kg) of crop harvested		81,035
Income from green leaf sold	Rs.	1,496,814.24
Total Income	Rs.	1,678,317.65

5. Labour Force

Number on check-roll	- 62
Out-turn (average)	- 50

6. Experiments

01. Chopping prunings
02. Shear plucking observation block
03. Hedge planting observation block
04. 4000 series clonal observation block
05. Bud grafting experiment
06. *Calliandra* block
07. Intercropping coffee, pepper, planted in existing tea
08. 200 plants of cinnamon in boundaries (intercropping)
09. Biclonal experiment
10. Plant growth regulator trial
11. Multi cuttings Vs single - cuttings observation block

METEOROLOGICAL OBSERVATIONS - 1996

TRI - St Coombs, Talawakele (Lat. 6 °55¹ N, Long. 80° 40¹E, 1382 m amsl)

Month	*Mean Temperature (°C)*		*Soil at 20cm depth*		*Relative Humidity (%)*		*Wind travelled (miles)*	*Mean Sunshine (h day⁻¹)*	*Total Rainfall (mm)*	*Wet Days*	*Total Evaporation (mm)*
	Min. Dry.	*Max. Dry.*	*08.30h*	*15.30h*	*08.30hrs*	*15.30h*					
January	11.7	24.1	20.8	21.4	91.9	91.2	2459.75	5.7	46.1	8	83.64
February	12.5	25.3	20.9	21.6	90.9	88.4	2568.75	5.9	20.6	5	89.81
March	10.2	27.4	22.5	22.9	87.7	86.2	2345.86	8.8	30.8	4	131.93
April	14.3	25.5	22.2	22.8	94.8	95.3	1664.10	5.2	310.7	22	69.01
May	15.5	25.0	23.1	23.8	95.1	93.8	2100.27	5.4	248.1	16	71.00
June	15.2	23.1	21.2	21.7	94.8	93.6	3156.54	4.2	228.9	16	63.30
July	15.9	20.9	20.2	20.5	97.7	96.6	4048.23	1.2	420.1	29	42.90
August	15.7	21.7	20.5	20.7	97.8	93.4	2617.52	2.1	311.9	28	42.50
September	15.7	21.7	20.6	20.9	98.1	97.1	2455.57	0.9	342.4	29	33.11
October	13.1	23.5	20.8	21.4	96.1	90.6	2225.4	4.5	191.2	16	53.06
November	13	24.6	21.3	21.9	90.6	92.7	1920.35	6.1	172.1	16	66.20
December	11.3	24.1	20.7	21.3	94.3	85.4	1841.52	6.3	45.2	13	72.10

MID-COUNTRY RESEARCH, ADVISORY AND EXTENSION STATION - KANDY (ELEVATION 762 AMSL)

Month	*Mean temperature ^{0}C*		*Relative Humidity*		*Total sunshine*	*Total wind*	*Total rain-*	*Total evap.*
	Min.dry	*Max. dry*	*0830*	*% 1530h*	*hr-^{1}/day*	*(km)*	*fall(mm)*	*(mm)*
January	18.4	26.3	78	82	6.3	4929	48.6	82.2
February	18.1	25.6	70	74	7.4	4365	99.4	80.6
March	19.6	30.4	71	73	8.5	2303	48.7	124.0
April	19.7	27.9	80	83	5.9	1387	272.5	122.1
May	20.8	28.4	70	74	8.7	3092	16.0	129.6
June	20.2	28.4	78	84	5.3	3273	165.0	83.4
July	20.5	25.0	86	89	3.3	4996	142.5	66.9
August	20.5	25.9	88	92	5.1	3742	126.0	68.2
September	20.4	25.2	85	89	2.4	3361	203.9	47.1
October	20.4	26.4	80	87	5.3	2367	311.0	54.3
November	19.2	26.8	82	86	6.1	1451	403.1	62.7
December	18.4	26.1	89	85	5.1	1469	150.4	52.7

LOW COUNTRY STATION, RESEARCH, ADVISORY & EXTENSION CENTRE, RATNAPURA.
(LAT 6 41'N LONG 80°E - 40°E, 29m amsl)

Month	*Mean Temperature (°C)*			*Relative Humidity (%)*		*Total Rainfall (mm)*	*Difference from 30 yrs*	*Wet days*	*Difference from 30 yrs*	*Evaporation (mm/dd)*
	Mix. Dry.	*Min. Dry.*	*9.00h*	*16.00h*	*Mean Sunshine (h day^{-1})*					
January	33.5	22.9	85	60	4.8	89.7	-21.4	8	-1	2.95
February	33.9	22.2	88	60	5.0	141.0	+4.0	11	+2	2.98
March	35.0	22.2	83	71	6.3	153.5	-58.7	9	-5	5.09
April	33.6	22.9	86	80	4.2	381.3	+42.4	21	+1	3.04
May	34.0	23.8	81	68	6.5	58.5	-417.4	6	-14	4.07
June	31.6	24.5	83	77	3.0	693.4	+281.2	19	-2	2.81
July	30.9	24.3	84	80	2.3	345.5	+52.7	24	+4	3.01
August	31.2	23.9	84	79	3.5	235.4	+68.7	16	-4	3.08
September	30.4	23.6	89	86	1.6	744.7	+323.3	29	+9	3.25
October	32.1	23.2	85	77	4.4	382.2	+54.6	16	-5	2.82
November	32.2	23.2	85	70	5.1	204.5	-166.9	16	-2	2.99
December	32.3	22.8	86	66	5.0	180.8	-54.5	12	-2	3.20
Total	-	-	-	-	-	3610.5	-	187	-	-
Mean	32.6	23.3	85	73	4.3	-	-	-	-	3.27

DENIYAYA ADVISORY AND EXTENSION CENTRE - DIYADAWA
(Elevation 250 m amsl)

Month	*Mean Temperature (^{0}C)*		*Soil at 30 cm*		*Relative Humidity (%)*		*Mean*	*Total*	*Total*
	Min Dry	*Max Dry*	*0830 h*	*1530 h*	*0830 h*	*1530 h*	*Sunshine (h day^{-1})*	*wind km*	*Rainfall (mm)*
January	19.33	29.02	26.64	26.72	81.38	81.48	5.68	704	101.8
February	20.95	30.99	26.81	27.10	83.59	81.25	5.47	654	266.6
March	21.20	33.01	27.80	29.18	87.03	83.80	8.21	846	305.7
April	20.45	28.35	27.91	28.41	80.96	72.63	4.30	830	462.7
May	24.57	31.91	26.45	29.28	89.60	76.91	- *	1458	83.2
June	23.43	30.12	27.53	28.16	78.30	75.26	-	1868	347.0
July	23.71	29.57	23.73	27.16	83.0	75.45	-	2609	290.6
August	24.21	30.14	26.34	27.17	79.12	73.00	-	2764	237.9
September	23.11	29.58	26.73	26.86	84.0	73.92	-	1733	612.8
October	22.91	30.51	26.90	27.08	80.96	73.74	-	1613	382.0
November	21.43	31.09	28.97	27.17	77.30	74.16	-	885	209.9
December	20.7	30.8	27.07	27.12	63.0	50.0	-	761	240.4
Total	-	-	-	-	-	-	-	16725	3540.6
Mean	22.17	30.42	26.91	27.62	80.69	74.30		5.1	

* Sunshine recorder had been stolen on 30th April '96

UVA ADVISORY AND EXTENSION CENTRE - PASSARA

(LAT. 6°56¹ N, LONG. 18°07¹ E, 1120 M AMSL)

Month	*Mean temperature °C*		*Relative Humidity*		*Mean sunshine*	*Total Wind*	*Total Rainfall*	*Total evap.*
	Min.dry	*Max. dry*	*0830*	*% 1530h*	*hr./day-¹*	*(km)*	*mm)*	*(mm)*
January	15.1	22.1	92	92	4.7	2071	222.5	68.08
February	15.3	24.3	92	92	4.8	1911	171.1	75.27
March	15.7	26.5	85	78	6.9	1262	31.0	97.72
April	16.6	26.3	89	87	4.2	769	419.5	42.25
May	19.8	28.2	90	88	6.8	341	160.5	84.56
June	18.5	25.6	91	80	3.8	1666	92.5	63.06
July	17.9	26.6	89	89	3.9	1463	28.0	91.95
August	16.2	27.1	87	86	5.4	785	116.5	66.28
September	17.7	27.5	90	91	3.3	908	309.1	59.87
October	16.7	26.2	89	86	4.3	409	193.5	56.88
November	16.3	26.2	89	92	4.6	697	254.9	38.69
December	15.6	25.5	95	96	3.3	853	177.2	31.88
Total						13135	2176.3	776.49
Mean	16.8	26.0	90	88	4.7			

SOUTHERN PROVINCE EXTENSION CENTRE, TALGAMPOLA - KOTTAWA
(Elevation 30 m amsl)

Month	*Mean Temperature (^{0}C)*		*Relative Humidity % 0830*	*Mean Sunshine h day^{-1}*	*Total Rainfall (mm)*	*Rainfall difference (from 20 yrs)*	*Wet days*	*Difference from 20 yrs*
	Max Dry	*Min Dry*						
January	-	-	-	6.0	98.3	-12.0	09	-
February	-	-	-	5.0	138.4	+43.3	07	-
March	-	-	-	-	54.1	-88.8	04	-
April	-	-	-	3.4	99.6	-181.8	06	-
May	-	-	-	-	153.9	-220.5	09	-
June	29.8	-	91	3.4	333.0	+33.3	24	-
July	29.4	-	86	3.1	202.5	+17.4	20	-
August	29.7	-	90	5.5	92.1	-118.6	16	-
September	29.1	-	90	2.7	554.2	+303.1	26	-
October	29.9	-	88	5.4	223.0	-140.1	16	-
November	30.4	21.8	86	5.8	184.0	-152.3	15	-
December	30.6	21.4	85	5.1	118.1	- 62.3	16	-
Total					2251.2		168	