ISSN 1012 – 3954

ANNUAL REPORT 1995

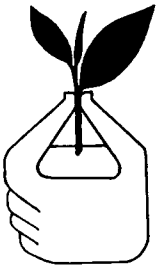
TEA RESEARCH INSTITUTE OF SRI LANKA

THE TEA RESEARCH INSTITUTE

OF

SRI LANKA

ANNUAL REPORT
FOR THE YEAR
1995



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ST. COOMBS, TALAWAKELE, SRI LANKA
1996

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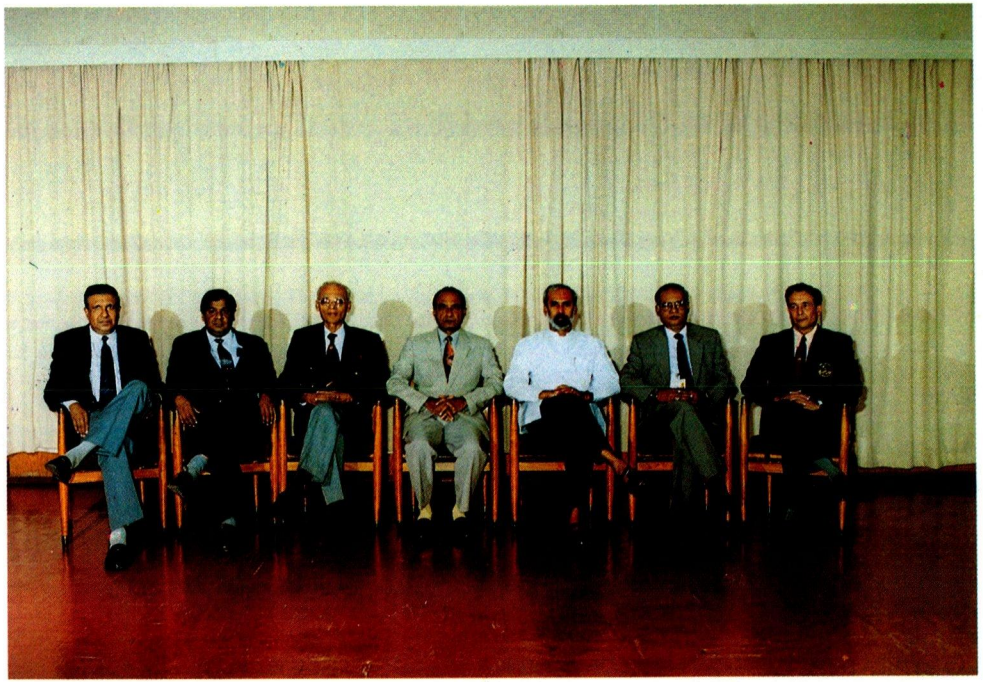
TEA RESEARCH BOARD



PRESENT : Mr I. L. A. Fernando (Member), Mr Sepala Ilangakoon (Member), Dr Anura Ekanayake (Member), Mr G. V. Tissera (Member), Mr S. Wirasinghe (Member), Dr S. D. I. E. Gunawardena (Chairman), Mr E. Kanendran (Member)

ABSENT : Mr Rohana Illangaratne (Member), Prof. H. P. M. Gunasena (Member), Mr J. P. M. Y. Ratnayake (Member), Mr V. Puthirasigamoney (Member), Mr Sivam Loganathan (Member)

REPORT OF THE DIRECTOR - 1995

STAFF APPOINTMENTS

Directorate

Dr M. T. Z. Mohamed, Technologist, was appointed as the Actg Deputy Director (Research) w. e. f. 22nd February.

Heads of Divisions/OIC's of Divisions/Substations/Units

Mr J. C. K. Rajasinghe, Advisory Officer assumed duties as Actg Officer-in-Charge, Deniyaya substation, w. e. f. 1st February.

Dr I. S. B. Abeysinghe was appointed as Actg. Head Biochemistry Division w.e.f. 20th February.

Mr V. Shanmugarajah, Research Officer, Plant Propagation and Plant Breeding Division was appointed as the Actg Officer-in-Charge w. e. f. 1st March.

Mr D. W. Vithana, was transferred from the Deniyaya substation to the Low-country station, Ratnapura w. e. f. 17th April.

Mr S. Wimaladharma was appointed as Officer-in-Charge, Low-country station, Ratnapura w.e.f. 1st August.

Promotions

Mr. S. Wimaladharma Advisory Officer was promoted to Senior Advisory Officer w.e.f. 1st January.

Mr V. Wickremasinghe, Technical Assistant, Technology Division was promoted as Experimental Officer w. e. f. 15th January.

Drs I. S. B. Abeysinghe and A. C. Liyanage, Research Assistants, Biochemistry Division were promoted to Grade 1 cadre of the Institute's service w. e. f. 25th June and 5th August 1993, respectively.

Dr (Ms) L. D. Amarasinghe and Mr K. Thirugnanasuntheran, Research Officers, Entomology Division, were promoted to Senior Research Officer Grade 1 w. e. f. 29th October 1993.

Mr W. M. S. Wijethunge, Technical Assistant, Soils and Plant Nutrition Division was promoted as Experimental Officer, w. e. f. 1st October.

Resignations and Retirements

Directorate

Dr (Ms) N. C. Gnanapragasam, Deputy Director (Research) resigned from the services of the Institute w. e. f. 3rd April.

Staff

Mr A. R. M. Hassim, Actg O I C, Plant Propagation and Plant Breeding Division, retired from the services of the Institute w. e. f. 28th February.

Mr W. C. A de Silva, Consultant, Process Technology resigned from the services of the Institute w. e. f. 28th February.

Mr D. Gunasekera, Superintendent, St. Coombs Estate retired from the services of the Institute from 2nd November.

Transfers

Mr J. H. N. Piyasundera, Technical Assistant, Plant Propagation and Plant Breeding Division was transferred to the Plant Breeding Unit at the Low-country station, Ratnapura w. e. f. 16th February.

Messrs E. R. Perera and A. K. Prematunge, Experimental Officers, Entomology Division were transferred to the Termite Research Unit at TRI Low-country station, Ratnapura w. e. f. 1st February and 1st March, respectively.

Mr D. D. Liyanage, Experimental Officer, Entomology Division was transferred to the Head Office from the TRI Southern Province Advisory and Extension Centre, Kottawa w. e. f. 23rd April.

Mr G. Ganewatte, Research Assistant, Agricultural Economics Unit was transferred to the Head Office w. e. f. 15th May.

Ms J. A. A. M. Jayakody, OIC, Agricultural Economics Unit, Hantane sub-station was transferred to the Head Office w. e. f. 15th May.

Mr D. K. Nawaratna, Actg Officer-in-charge TRI Low-country station, Ratnapura was transferred to the Head Office as acting Head of the Advisory and Extension Division w.e.f. 1st August.

Ms B. W. S. Kariyawasam, Research Assistant, Technology Unit, Low-country station, Ratnapura was transferred to the Head Office w. e. f. 4th September.

Overseas visits

Directorate

Dr S. D. I. E. Gunawardena, Chairman, Tea Research Board visited China to attend the 'International Tea Quality Human Health Symposium' held from 7 – 10 November.

Staff

Dr N. L. Herath, Head, Biochemistry Division was on sabbatical leave for a period of one year w. e. f. 1st March.

Mr A. Balasuriya, Research Officer, Plant Pathology Division, reported back to work in September after spending a year at the Imperial College of Science, Technology and Medicine in the UK.

STAFF TRAINING PROGRAMMES

Post-graduate degree

Mr A. M. T. Amarakoon, Research Assistant, Biochemistry Division, continued his PhD research project at the Department of Biochemistry of the Faculty of Medicine, University of Peradeniya and the Biochemistry Division, TRI.

Mrs K. Amarakoon, Research Assistant, Plant Propagation and Plant Breeding Division returned to the Island on 6th January to commence the project component of her PhD programme.

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

Mr T. S. Gunasekera, Research Assistant, Plant Pathology Division, proceeded to UK in March to continue his post-graduate training.

Mr K. Mohotti, Research Assistant, Entomology Division, continued his post-graduate studies in UK.

Mrs J. Mohotti, Research Assistant, Plant Physiology Division continued her post-graduate studies at the University of Reading, UK.

Mrs S. Nagahaulla, Research Officer, Entomology Division, commenced her post-graduate training leading to a PhD, in July at the University of New England, Armidale, Australia.

Ms S. M. Samarasinghe, Experimental Officer, Entomology Division, resumed work at the Termite Research Unit at the Low-country station on 5th October after completing the course component of the M Phil programme undertaken at the PGIA, Peradeniya.

Mr G. Ganewatte, Research Assistant, Agricultural Economics Unit was granted one year leave to follow a MSc programme in Agricultural Economics at the PGIA from October.

RESEARCH PROGRAMMES

CROP PRODUCTION

Agronomy

An intercropping trial to study the effect of tea and rubber each planted at closer and wider spacings was commenced at St. Joachim Estate, Ratnapura.

With a view to enhance productivity per unit area of tea land a series of fruit crops have been planted in a seedling tea field in the mid-country. It is envisaged that the fruit trees would provide an additional source of income.

The study involving several methods of harvesting showed that it was detrimental to the tea bush to continuously machine or shear pluck. However, the reduction in yield was less under a mixed plucking system.

The series of experiments conducted to improve the fertility of soil by growing cover crops, use of mulches and culturing of earthworms proceeded satisfactorily. Among several cover crops tested, the leguminous species *Arachis pintoii* obtained from CIAT, Colombia proved most promising with its prostrate growth habit and ease of propagation from nodal cuttings. A significant feature of this cover crop is that it does not compete with tea during periods of moisture stress and it does not straggle the tea by encircling it. Indications are that it would prove to be a versatile cover crop for degraded tea lands.

Earthworm casts which are a rich source of nutrients proved beneficial to the growth of young tea.

Physiological Research

Studies on resting of tea without plucking for varying periods prior to pruning showed that root starch level was enhanced even in clonal bushes that have been rested (two months duration). The yield loss during the period of resting and gain in yield, if any, after pruning are being monitored.

The effect of spraying antitranspirants for drought mitigation is being evaluated in the field.

Soils and Plant Nutrition

The studies conducted on ground applications of increasing levels of phosphorus did not show any differences in yield. A lack of response may probably be an indication of inherently high soil phosphorus levels in Sri Lanka tea soils.

Foliar application of phosphorous as triple superphospate or as diammonium phosphate at increasing levels did not have any marked effect on yield.

The studies conducted at different locations to monitor the effect of increasing applications of potassium, magnesium and of dolomite of different particle sizes continued.

CROP IMPROVEMENT

Plant Breeding Division

While evaluation of clonal progenies are being conducted in the low- and up-country under the Phase I (monitoring of growth and yield of selections in nearby TRI stations) and Phase II (Regional adaptability tests conducted in various agro-climatic zones) programmes, evaluation of the 3000 and 4000 series clones are being conducted in the low- and up-country as well as in the Uva region under the Phase III (monitoring under estate conditions) programme. There has been a greater demand for the 3000 and 4000 series clones and every effort has been made to supply cuttings of these series to estates and smallholdings in all elevational categories for the purpose of establishing nucleus mother bush plots and for evaluation trials.

CROP PROTECTION

Entomology

The Nematology Division was amalgamated with the Entomology Division w.e.f. 14th July and the combined division was named as the Entomology Division.

Screening of newly released clones against the different species of nematodes that cause damage to tea is an ongoing programme. A study is underway to screen the TRI 4000 series clones against the root-lesion nematode, *Pratylenchus loosi.*

Several concentrations of a new formulation of neem extract, "Neemzal F1" were evaluated with neem seed oil cake and other nematicides in order to evaluate its efficiency in controlling *Pratylenchus loosi* in young tea.

Several plant species that are associated with tea or found in close proximity to tea fields and which were earlier proved to be immune to nematodes causing damage to tea were screened to check for the presence of any inherent nematicidal properties that could be exploited to advantage.

Studies have been initiated to evaluate the efficiency of different soil amendments in reducing the damage caused to tea by the root-lesion nematode, *P. loosi.*

A number of insecticides are being screened against the shot-hole borer beetle in a trial that includes two times of pruning.

A series of studies were initiated to test micro-insecticides and systemic insecticides on the up-country live-wood termite. However, as these were not promising, a study is underway to test a systemic insecticide and two entomopathogenic fungi on the live-wood termite. The entomopathogenic fungus *Metarhizium anisopliae* proved excellent in killing termites in the laboratory.

Several clones are being screened for their tolerance to the low-country live-wood termite in collaboration with the Division of Plant Breeding.

Plant Pathology

An intensified study on the incidence of *Hypoxylon* wood rot was carried out. The survey on wood rot carried out at Diyagama East Estate indicated that the intensity of the disease increased by approximately 20% in a year.

Anatomical studies of wood tissues of several clones have shown that those clones susceptible to *Hypoxylon* wood rot have higher total cell counts with consequent higher fibre cell counts which attract this fungus causing the characteristic 'soft rot decay'.

The study on the effect of systemic fungicides on the control of *Phomopsis* canker showed that clones with better callusing properties respond better to systemic fungicides at low levels of infection.

PROCESS TECHNOLOGY

Biochemistry

Biochemical studies on the control of the Shot-hole borer beetle of tea is continuing in collaboration with the University of Peradeniya. Investigations are ongoing to determine the relationship of the degree of susceptibility of tea clones with the saponin content of tea stems, presence of beetle attractants/repellents in susceptible/resistant clones and the influence of polysaccharides of the fungus on beetle or larval growth, etc. These studies have indicated that the beetle did not require sterols to complete its life cycle which implied that there was no relationship between saponin levels and resistance of tea clones to borer attack.

Studies on the two enzymes, polyphenol oxidase and peroxidase, have resulted in defining their range of activity in terms of temperature and pH ranges.

Foliar sprays of phosphorus showed that desirable quality characteristics were enhanced when sprayed at 4%. Clonal differences were noted.

Manufacturing Technology

Investigations on the feasibility of harnessing solar energy for tea drying are in progress.

The study to identify clones suitable for CTC manufacture showed that quality clones have high value for total colour which produced very bright CTC teas compared to other clones. This investigation indicated that quality clones produce quality CTC tea unlike succulent clones which invariably do not produce such teas.

Monitoring of CTC manufacture revealed that the MaCloy 2 stage drier was more efficient than the conventional TRI–CCC fluid bed drier probably due to increased bed area.

Economics Unit

With a view to imparting more cost effectiveness in the Institute's research trials and recommendations, the Economics Unit continued to interact closely with the research divisions and the Advisory and Extension Division. Concurrently the Unit undertook a number of macro-level studies for improving the viability of the tea industry, both in the estate and smallholder sectors. Several of the seminars organised by the TRI also received inputs from the Staff of the Unit.

Analytical Service

The Staff of the Entomology Division carried out nematode estimation on 2310 root/soil/nursery plant samples for advisory and research purposes and 118 reports have been issued.

The Soils and Plant Nutrition Division analysed a total of 4804 soil, 792 leaf and 1448 fertilizer samples during the period under review as part of their continuing programme of analytical service to the industry.

The Plant Breeding Division supplied cuttings of promising 3000 and 4000 series clones to estates and smallholdings for the purpose of establishment of mother bushes and evaluation trials.

Publications

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

Audio Visual Programmes

Three programmes were produced during the year under review.

Extension Service

The Extension Service continued to provide advice to all estates, private plantations and 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 253 field days, seminars, demonstrations and training programmes for the benefit of plantation executives, field staff and tea smallholders. A total of 333 advisory visits were undertaken. The Senior Scientific staff of the various research disciplines were actively involved 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 1995, amounted to Rs. 83.61 million. The total income received by the Institute inclusive of the income from its commercial activities amounted to a total sum of Rs. 97.91 million. The total recurrent expenditure for the year under review amounted to Rs. 71.14 million resulting in an income over expenditure of Rs. 26.77 million.

The total capital expenditure incurred during the year amounted to Rs. 7.66 million.

TRI ESTATES

St. Coombs Estate

During the year under review, St. Coombs produced 292,530 kg made tea of which 107,765 kg was from bought leaf. The average yield was 2001 kg per ha. The nett sale average during the year was Rs. 93.52 at estate level while the average revenue cost of production was Rs. 82.56. The total profit realized by the estate was Rs. 2,965,830.

St. Coombs topped the western market on several occasions at the weekly auctions and ended the year with a sale average of Rs. 240 per kg for BOP which was an all time record.

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 55,643 kg made tea while 887,732 kg was from bought leaf purchased from the smallholders. The nett sale average realized during the year was Rs. 78.89 while the cost of production was Rs. 75.88.

The profit realized by the estate was Rs. 6,251,986 during the year. The average price paid for green leaf during the year was Rs. 11.65 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 which amounts to about 94% of the tea manufactured at the factory.

DIRECTOR

TEA RESEARCH BOARD OF SRI LANKA
REPORT FOR THE YEAR 1995

Administration Report

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 investigation 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, extension and advisory programmes of its main centre at Talawakele and 5 substations located in the different tea growing districts.

1.4. Members of the Tea Research Board as at 31st December, 1995

1.	Dr S. D. I. E. Gunawardena	–	Chairman, TRB
2.	Mr Rohana Illangaratne	–	Member
3.	Mr E. Kanendran	–	Member
4.	Dr Anura Ekanayake	–	Member
5.	Mr W. L. A. H. Fernando	–	Member
6.	Prof H. P. M. Gunasena	–	Member
7.	Mr G. V. Tissera	–	Member
8.	Mr J. P. M. Y. Ratnayake	–	Member
9.	Mr Sepala Ilangakoon	–	Member
10.	Mr V. Puthirasigamoney	–	Member
11.	Mr Sivam Loganathan	–	Member
12.	Mr S. Wirasinghe	–	Member
13.	Mr I. L. A. Fernando	–	Member

Secretary to the Board : Mr C. C. Mawilmada

1.5. Senior Management Staff as at 31st December, 1995.

1.	Director	–	Post vacant
2.	Deputy Director (Research)	–	Post vacant, Actg. Dr M. T. Z. Mohamed
3.	Deputy Director (Administration)	–	Mr C. C. Mawilmada
4.	Senior Accountant	–	Mr L. A. Senanayake

1.6. Heads of Divisions, Administrative, Scientific & Research Staff – Grades I & II as at 31.12.1995

Administration:

1.	Mr C. C. Mawilmada	– Deputy Director (Administration)
2.	Vacant	– Administrative Officer

Finance Division:

1.	Mr L. A. Senanayake	– Senior Accountant
2.	Mr G. A. K. P. de Silva	– Accountant – I
3.	Vacant	– Post of Accountant – II

Library:

1.	Mrs R. W. M. W. K. Illanganthilake	–	Librarian/Gr. II

Publications & Publicity Officer:

1. Mrs F. Y. M. Maharoof – Publications Officer

Scientific Staff Grade I & II

1.	Vacant	– Post of Head/Advisory & Extension
2.	Mr C. C. Rajasingham	– Actg. O.I.C./Advisory Officer
3.	Mr B. A. D. Samansiri	– Advisory Officer

Plant Physiology Division:

1.	Vacant	– Post of Head of Division
2.	Dr A. Anandacumaraswamy	– Actg. Head/Snr. Research Officer
3.	Mrs A. J. Mohotti	– Research Assistant

Agronomy Division:

1.	Dr A. Kathiravetpillai	– Head of Division
2.	Mrs M. S. D. L. de Silva	– Research Officer
3.	Mrs J. Balasooriya	– Research Assistant

Biochemistry Division:

1.	Vacant	– Post of Head of Division
2.	Dr I. S. B. Abeysinghe	– Actg. Head/Snr. Research Officer
3.	Dr A. C. Liyanage	– Snr. Research Officer
4.	Mrs J. Jayasundera	– Research Officer
5.	Mr A. M. T. Amarakoon	– Research Assistant

Entomology Division:

1.	Vacant	– Post of Head of Division
2.	Mrs S. I. Vitharana	– Actg. Head/Snr. Research Officer
3.	Dr (Ms) L. D. Amarasinghe	– Snr. Research Officer
4.	Mr K. Thirugnanasundaran	– Snr. Research Officer
5.	Mrs K. U. S. M. Nagahaulla	– Research Officer
6.	Mr K. M. Keerthi	– Research Assistant
7.	Mr W. A. M. Dharmasena	– Experimental Officer – 01

Plant Pathology Division:

1.	Vacant	– Post of Head of Division
2.	Mr A. Balasooriya	– Actg. O. I. C./Research Assistant
3.	Mrs R. M. D. T. Pallemulla	– Research Officer
4.	Mr T. S. Gunasekera	– Research Assistant

Agricultural Economics Unit:

1.	Vacant	– Agriculture Economist
2.	Mrs J. A. A. M. Jayakody	– Actg. O.I.C./Research Officer
3.	Mr D. P. B. Herath	– Research Assistant
4.	Mr G. Ganewatte	– Research Assistant

Plant Propagation & Breeding:

1.	Vacant	– Post of Head of Division
2.	Mr V. Shanmugarajah	– Actg. O.I.C./Research Officer
3.	Mrs M. T. K. Gunasekera	– Research Officer

Soils & Plant Nutrition Division:

1.	Dr G. D. Wimaladasa	– Head/Snr. Research Officer
2.	Dr L. S. K. Hettiarachchi	– Snr. Research Officer
3.	Mrs S. Anandacoomaraswamy	– Research Officer
4.	Mr A. K. N. Zoyza	– Research Assistant

Technology Division:

1.	Dr M. T. Z. Mohamed	– Head/Technology/Actg. DDR
2.	Mr P. A. N. Punyasiri	– Research Officer
3.	Mr W. S. Botheju	– Research Officer
4.	Mrs B. W. S. Kariyawasam	– Research Officer

Statistics Unit:

1.	Vacant	– Post of Head of Division

Advisory and Extension Centres

a) TRI Uva Station – Passara

1.	Mr M. B. A. Perera	– Advisory Officer/OIC

b) TRI Low-Country Station – Ratnapura

1.	Mr S. Wimaladharma	– OIC/Snr. Advisory Officer
2.	Dr M. A. Wijeratne	– Snr. Research Officer
3.	Mr D. W. Bartholomeusz	– Administrative Officer
4.	Mr M. S. Koneswaramoorthy	– Mechanical Engineer
5.	Mr G. L. C. Galahitiyawa	– Research Officer
6.	Mr K. G. Premathilaka	– Research Assistant
7.	Ms S. M. Samarasingha	– Experimental Officer III – 01

c) TRI Mid-Country Station – Hantane

1.	Mr P. B. Ekanayake	– Snr. Research Officer/OIC
2.	Mr S. T. Yatawatte	– Advisory Officer
3.	Mrs S. K. Liyanage	– Research Assistant
4.	Mr T. M. Sarathchandra	– Experimental Officers III – 02
5.	Mr P. D. Upali	

d) TRI – Substation – Deniyaya

1.	Mr J. C. K. Rajasinghe	– Advisory Officer /OIC

e) TRI Substation – Kottawa

1.	Mr K. D. Dahanayake	– Advisory Officer/OIC
2.	Mr D. D. Liyanage	– Experimental Officer

1.7. The vacant position of Deputy Director (Administration) was filled in 1995.

1.8. Action has been initiated to fill the other existing vacancies including the post of Director and two other posts of Deputy Directors (Research).

1.9. Draft of the Manual of Administrative Procedure of Tea Research Institute has been completed.

1.10. Action has been initiated to implement the recommendations of the Committee appointed to Review the Activities of the Tea Research Institute of Sri Lanka. This Committee was appointed by the Hon Minister of Plantation Industries in 1993.

1.11. The Chairman appointed a Transport Committee to look into the maintenance of the Institute's vehicles. Action has been initiated to implement the recommendations of this committee.

1.12. The Tea Research Board held 09 meetings during the year 1995. The three Consultative Committees of the Tea Research Board on Research, Estates and Advisory Services and Administration and Finance held 3, 3 and 7 meetings, respectively.

1.13. Maintenance Divisions – Engineering, Electrical and Water Supply of the TRI continued to maintain a high standard in the maintenance of buildings, electrical installations and in the supply of water to the staff quarters within the TRI Campus, during the year.

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

1.15. Action has been initiated in consultation with the Attorney General's Department, to pursue legal action against officers who had not completed their obligatory periods of service after completion of post-graduate studies, both foreign and local.

REPORT OF THE FINANCE DIVISION

SOURCE AND APPLICATION OF FUNDS – 1995

Source of Funds		**Rs.**	**Rs.**
Surplus for the Year		26,774,834	
Adjustments in respect of items not involving the movement of funds			
Add:–	Provision for Gratuity	3,076,647	
	Depreciation	9,670,221	
		39,521,702	
Less: Prior Year Adjustments		(622,991)	
Funds generated from operations			38,898,711
Other Sources			
Grants and Reserves			3,715,542
			42,614,253
Application of Funds			
Purchase of Fixed Assets		8,976,632	
Decrease in Capital Work-in-Progress		(246,946)	8,729,686
			33,884,567

Increase in Working Capital as analysed below

Effect on Working Capital	**Increase/(Decrease)**
Stocks	1,758,154
Debtors	16,753,119
Deposits and Pre-Payments	(936,662)
Loans and Advances	1,311,970
Short Term Investments (7 Day Call Deposits)	20,500,000
Cash and Bank Balances	695,699
Suspense	52,704
Creditors and Provisions	(6,250,417)
	33,884,567

(Annex. XIII)

TEA RESEARCH BOARD

INCOME FROM PLANTATIONS AND OTHER COMMERCIAL ACTIVITIES FOR THE PERIOD 1ST JANUARY TO 31ST DECEMBER 1995

1994 Rs.		1995 Rs. Cts.	1995 Rs. Cts.
	Plantations		
1,828,191	St. Coombs Estate	2,965,830.76	
(902,345)	St. Joachim Estate	6,251,986.06	9,217,816.82
	Sale of Clonal Cuttings		
85,902	TRI Hantane	137,530.00	
19,032	TRI Kottawa	19,429.00	
33,000	TRI Passara	27,246.00	
41,558	TRI Deniyaya	33,850.20	218,055.20
	Sale of Green Leaf		
37,544	TRI Talawakele	196,005.78	
361,714	TRI Hantane	444,216.91	
755,561	TRI Kottawa	1,049,613.82	
402,849	TRI Passara	407,719.68	
176,854	TRI Deniyaya	214,984.86	2,312,541.05
	Commercial Nurseries		
102,824	TRI Hantane	135,321.22	
(28,476)	TRI Kottawa	5,420.48	
(53,583)	TRI Passara	2,233.08	
(62,574)	TRI Deniyaya	(156,729.58)	(13,754.80)
2,798,051			11.734,658.27
	Miscellaneous		
586,719	ARP Reimbursements		387,854.22
72,316	Sale of Publications		46,462.35
363,796	Interest and Rentals		451,885.45
860,640	Analytical Service		635,080.00
275,971	Miscellaneous		415,845.98
6,049	Disposal of Fixed Assets		55,212.14
2,165,491			1,992,340.14

N. B:– Negative figures are shown within brackets

TEA RESEARCH BOARD
CONSOLIDATED BALANCE SHEET AS AT 31ST DECEMBER – 1995

1994 Rs.			Tea Research Institute 1995 Rs.	St. Coombs Estate 1995 Rs.	St. Joachim Estate 1995 Rs.	Total 1995 Rs.
	FIXED ASSETS					
218,934,886	Property, Plant, Equipment, etc.		227,911,517.94			227,911,517.94
(113,306,138)	Less: Accumulated Depreciation	(Anx. I)	(122,976,359.39)			(122,976,359.39)
105,628,748			104,935,158.55			104,935,158.55
10,755,940	Capital Work-in-Progress	(Anx. II)	10,508,994.36			10,508,994.36
1,504,670	Purchase Consideration-Lamiliere Estate		1,504,670.00			1,504,670.00
117,889,358			116,948,822.91			116,948,822.91
	CURRENT ASSETS					
7,909,960	Stocks	(Anx. III)	7,338,038.26	1,488,546.28	841,529.59	9,668,114.13
24,363,096	Debtors	(Anx. IV)	39,575,608.37	1,410,322.78	130,284.16	41,116,215.31
8,682,409	Deposits and Pre-Payments	(Anx. V)	7,317,264.49	254,446.07	174,036.43	7,745,746.99
7,323,692	Loans and Advances	(Anx. VI)	6,803,726.74	983,909.44	848,026.75	8,635,662.93
5,300	Other Current Assets		5,300.00	–	–	5,300.00
500,000	Short Term Investments		21,000,000.00	–	–	21,000,000.00
5,105,576	Cash and Bank Balances	(Anx. VII)	5,164,890.13	118,648.30	517,736.43	5,801,274.86
53,890,033			87,204,827.99	4,255,872.87	2,511,613.36	93,972,314.22
149,286	Suspense	(Anx. VIII)	150,285.48	51,704.47	–	201,989.95
234,720	Identified Losses	(Anx. IX)	234,720.01	–	–	234,720.01
19,150	Excess & Shortages	(Anx. IX)	19,150.41	–	–	19,150.41
54,293,189			87,608,983.89	4,307,577.34	2,511,613.36	94,428,174.59
	CURRENT LIABILITIES					
(13,626,134)	Creditors and Provisions	(Anx. X)	(7,317,919.47)	(5,359,419.23)	(7,199,212.71)	(19,876,551.41)
40,667,055	Net Current Assets		80,291,064.42	(1,051,841.89)	(4,687,599.35)	74,551,623.18
158,556,413	TOTAL ASSETS LESS CURRENT LIABILITIES		197,239,887.33	(1,051,841.89)	(4,687,599.35)	191,500,446.09
	REPRESENTED BY					
32,862,965	Grants and Reserves	(Anx. XI)	36,578,507.24			36,578,507.24
117,011,338	Tea Research Fund	(Anx. XII)	143,163,181.93			143,163,181.93
–	A/C Current St. Coombs Estate		3,318,718.09	(3,318,718.09)		–
–	A/C Current St. Joachim Estate		5,786,471.07		(5,786,471.07)	–
754,670	Long Term Liabilities–Land Reform Commission		754,670.00			754,670.00
7,927,440	Provision for Gratuity		7,638,339.00	2,266,876.20	1,098,871.72	11,004,086.92
158,556,413			197,239,887.33	(1,051,841.89)	(4,687,599.35)	191,500,446.09

Note:– Negative figures are shown within brackets

TEA RESEARCH BOARD
TEA RESEARCH INSTITUTE
OPERATING ACCOUNT FOR THE PERIOD 01ST JANUARY TO 31ST DECEMBER, 1995

1994 Rs.		INCOME		1995 Rs. Cts.
82,150,000	3.1	Cess		83,616,461.03
2,798,051	3.2	Income from Plantations and Other Commercial Activities	(Annex XIII)	11,734,658.27
474,791	3.3	Interest on Investments		571,509.92
2,165,491	3.4	Miscellaneous	(Annex XIII)	1,992,340.14
87,588,333				**97,914,969.36**
		Expenditure		
26,505,266	4.1	Personnel Emoluments		24,932,922.06
2,510,198	4.2	Travelling		2,385,110.28
6,909,487	4.3	Supplies and Requisites		6,248,425.26
7,728,552	4.4	Repairs and Maintenance of Capital Assets		7,274,155.92
8,054,133	4.4	Depreciation of Fixed Assets		8,163,216.49
12,870,114	4.5	Transportation, Communication, Utility and Other Services		12,201,985.19
671	4.5	Losses and Write-offs	(Annex XIV)	14,199.11
876,567	4.7	Contributions, Grants and Subsidies		916,392.13
2,944,994	4.8	Pensions and Retirement Benefits		2,508,135.58
1,289,351	4.8	Gratuity Provision		834,991.50
677,004	4.10	Media, Advertising, Publicity and Gifts		311,215.82
3,264,842	4.11	Cultivation and Field Trials		3,064,401.91
3,678,921	4.12	Miscellaneous	(Annex XV)	2,248,983.20
77,310,100				71,140,134.45
10,278,233		Operating Income over Expenditure		26,774,834.91
(48,200)		Less: Prior year Adjustments		(622,990.79)
10,230,033		Net Operating Income transferred to Tea Research Fund		26,151,844.12

Note:

1. Prior year Adjustments

(i)	Arrears of Overtime – 1981 to 1987	330,366.40
(ii)	Arrears of Acting Allowance	89,862.70
(iii)	Defence Levy on imports 1992 to 1994	202,761.69
	Total	622,990.79

2. Cess receivable from Sri Lanka Tea Board to end of December 1995 – Rs. 17.116 million.

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 maximise income and conserve soil through optimal land utilisation*

Project Leader – P. B. Ekanayake

1.1. Effect of intercropping tea and rubber on productivity

1.1.1. *Kuruwita*

The pruned plots (Tea+Rubber, non rehabilitated) were brought into plucking. Recovery from pruning was poor. Plucking continued in the other Tea + Rubber rehabilitated plots. Yield records revealed that there was a significant reduction in tea yield in intercropped plots compared to the control (tea only). Unpruned, rehabilitated plots showed that the yield reduction in intercropped plots was about 40–50% compared to the control. Among pruned plots, there was a significant yield reduction in intercropped plots where rubber was planted at closer spacings (2.4x8.0 m or 8'x27') compared to those with wider spacings of rubber (2.4x12.0 m or 8'x40'). The same trend was observed in rehabilitated unpruned plots, but the differences were not significant. The yield of tea recorded during the year is presented in Table 1.

TABLE 1 – *The effect of intercropping tea and rubber on yield of tea*

Treatment	*Yield (F. wt g/bush)*
Rehabilitated	
Tea only	1658 (100)
Tea + Rubber (2.4 x 8.0 m)	718 (42)
Tea + Rubber (2.4 x 12.0 m)	1010 (61)
LSD (P=0.05)	400
CV% = 20	
Non rehabilitated	
Tea + Rubber (2.4 x 8.0 m)	512 (100)
Tea + Rubber (2.4 x 12.0 m)	856 (60)
LSD (P=0.05)	256
CV% = 16	

The reduction in tea yield in intercropped plots may be attributed to the shading effect of rubber canopies.

The experiment is in progress.

1.1.2. *St. Joachim Estate, Ratnapura*

Tea was brought into bearing in October. About 20% of branches were removed from the rubber trees in one half of the intercropped plots in November. Growth assessments showed that rubber girthing (at a height of 1.06 m or 42") was high in intercropped plots (2.4 x 12.0 m) compared to monocultured plots (3.7 x 5.5 m). However, girthing of tea was superior in monocultured plots compared to the intercropped plots (Table 2).

TABLE 2 – *Effect of tea and rubber intercropping on girthing of plants*

	Girth (cm)	
Treatment	*Rubber*	*Tea*
Rubber alone	37.8	–
Tea + Rubber	41.6	2.82
Tea alone	–	3.19
LSD (P=0.05)	2.95 (CV%=3)	0.34 (CV%=10)

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

Tea was pruned in June and tipped in November. Rubber tapping commenced in December.

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

About 2 acres of land was planted with tea (TRI 2027) and rubber (RRI 121). There were 4 treatments viz. Tea only, Rubber only (2.4 x 8.0 m), Tea+Rubber (2.4 x 12.0 m) and Tea+Rubber (18 x 2.4 x 2.4 m) randomized in 4 plots. Each plot was divided into two sections for planting tea at 1.2 x 0.6 m and 0.9 x 0.6 m spacings.

Planting was done in July.

These experiments are in progress.

M. A. Wijeratna and C. Gunasekara

1.2. Effect of intercropping seedling tea with coffee and pepper

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

Growth of coffee plants are satisfactory; however there had been some casualties of pepper which had been again infilled.

This experiment is in progress.

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

The effect of intercropping seedling tea with fruit tree species is being studied as an observation trial.

Treatments:
Avocado
Mango
Citrus
Vanilla
Pomegranate (Delum)
Wood-apple
Rambutan
Guava

Delum, Naran, Avacado, Guava and Rambutan were planted during November. All cultural practices are being done on a regular basis.

This trial is in progress.

A. P. D. A. Jayasekara

1.3. Sloping Agricultural Land Technology

1.3.1. *St. Coombs Estate, Observation trial*

This trial continued to show improvements in soil fertility and a marginal increase in crop yield. The yield and biomass production during the year are presented in Tables 3 and 4 respectively.

TABLE 3 – *Effect of SALT hedgerows on yield of tea*

Treatment	*Yield (made tea kg ha^{-1})*
Control	1714(100)
Vetiver/*Calliandra*	1821(106)
Calliandra/Vetiver	1788(104)
Vetiver/Elderberry	1755(102)
Elderberry/Vetiver	1875(109)

TABLE 4 – *Biomass production of hedgerow species*

Species	*Biomass production (Dry wt. kg ha^{-1})*
Vetiver	737
Calliandra	3040
Teckoma	1135
Elderberry	1752
Eupatorium	801

U. P. Abeysekara

1.3.2. *Hantane substation, SALT demonstration hedgerows*

Four loppings were done during the year. *Calliandra, Cassia* and *Flemingia* had given higher biomass production than the other species. The biomass production during the year is presented in Table 5.

TABLE 5 – *Biomass production of different hedgerow species*

Species	*Biomass production (kg ha^{-1})*
Calliandra calothyrsus	8118
Flemingia congesta	5042
Cassia spectabilis	4506
Teckoma stans	774
Adathoda vasica	602
Desmodium rensonii	424

The biomass production of *Calliandra* was very high compared to the other species tested while *Teckoma, Adathoda* and *Desmodium* gave low biomass production. There were more casualties with *Desmodium.*

This demonstration trial is in progress.

A. P. D. A. Jayasekara

1.3.3. *Low–country station, Ratnapura*

Hedgerows were lopped regularly according to the growth of different plant species and the loppings kept *in situ.*

These observations are in progress.

MONO – DISCIPLINARY RESEARCH PROJECTS AND DIVISIONAL ACTIVITIES

AGRONOMY DIVISION

Head – A. Kathiravetpillai

1. General

Mr S. K. Senadheera retired from the service of the Institute on 18.07.1995.

Mr L. C. Yapa, Experimental Officer was transferred to the TRI substation, Passara with effect from 17 April.

Mrs P. Premathunga, Technical Assistant was transferred from the Head Office, to the Agronomy unit, Low-country Station, Ratnapura on 01 March.

Mr D. W. Vithana, Experimental Officer was transferred from the TRI substation, Deniyaya, to the Agronomy unit, Low-country Station, Ratnapura on 17 April.

2. Project B/PLUK – *Harvesting Practices*

Project Leader – M. A. Wijeratna

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

Plucking continued with the machine, shears and manually. Yield recorded during the year is given in Table 1. Compared to hand plucking, continuous machine and shearing gave about 50% and 35% reduction in yield respectively. However, the reduction in yield is less under mixed plucking system (20-30%). Mechanically harvested plots had plucking tables about 6–8 cm lower than those plucked manually.

TABLE 1 – *Effect of methods of plucking on yield of tea*

Treatments	*Yield (made tea kg ha^{-1})*
Manual plucking	4379
Machine plucking	2106
Shear plucking	2845
Machine during cropping season + Manual	3609
Shear during cropping season + Manual	3101
Machine + Manual alternatively	2985
Shear + Manual alternatively	3368
LSD (P=0.05)	917
CV% = 16	

2.2. Effect of clones and frequencies of plucking on yield, St. Joachim Estate, Ratnapura

Plucking continued at different intervals. The yield during the year is presented in Table 2. A yield increase of about 20% was seen with shorter plucking rounds (4 day) compared to extended rounds (6–8 days). The clone S 106 has given significantly higher yield than the other clones viz. TRI 2025 and TRI 2027.

TABLE 2 – *Effect of clone and frequencies of plucking on yield of tea*

Treatment	*Yield (made tea kg ha^{-1})*
Clone	
TRI 2025	3614
TRI 2027	3035
S 106	4710
LSD (P=0.05)	616
Frequency of plucking	
4 days	4359
6 days	3478
8 days	3523
LSD (P=0.05)	616
CV% = 16	

3. Project B/PRUN – *Pruning practices*

Project Leader – M. A. Wijeratne

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

A trial commenced to study the effect of different heights of pruning with and without lungs and of plucking in and tipping on yield of tea.

The treatments were 3 x 2 x 2 with 4 replicates.

Treatments:

3 pruning heights 45, 55 and 65 cm (18", 22" and 26")
2 (with and without lungs)
2 (plucking-in and tipping)

The pruning treatments were imposed on 26.06.95 and a bud count of bushes was done after 20 and 30 days of pruning (Table 3).

TABLE 3 – *Effect of height of pruning, retention of lungs and method of tipping on number of buds per plant*

Height of prune (cm)	*Date of commencement of plucking*	*20 days*		*30 days*	
		with lungs	*without lungs*	*with lungs*	*without lungs*
45	09.10.95	20	12	40	27
55	21.09.95	67	76	112	127
65	06.09.95	118	119	171	165
LSD (P=0.05)		24.4		29.3	
CV(%)		48.2		37.4	

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 treatments are shade (Dadap) vs no shade, replicated. The clone used is TRI 2025 with 36 plots. Yield records are being maintained.

4.2. Performance of different provenances of Calliandra, Up-country – (1994)

The assessments of the height and girth of the provenances planted at St. Coombs, Dessford and Park are given below:

	St. Coombs		*Dessford*		*Park*	
Planted on	*05.10.94*		*07.10.94*		*01.12.95*	
Assessment on	*22.02.95*		*09.01.95*		*07.10.95*	
No. of plants	*305*		*233*		*184*	
	Height (cm)	*Girth (cm)*	*Height (cm)*	*Girth (cm)*	*Height (cm)*	*Girth (cm)*
10/91/95	69.0	8.3	87.4	6.72	–	–
10/91/01	76.0	7.8	50.1	5.46	173	14.74
10/91/02	111	7.7	102.7	5.46	–	–
10/91/04	94.0	7.8	79.9	4.46	140	9.42
10/91/09	110	8.2	82.9	7.85	117	10.12
10/91/07	106.0	7.0	161.7	6.36	202	15.05
10/91/06	132.0	10.1	63.8	2.9	115	9.24
10/91/05	110.0	4.5	92.6	4.45	153	10.31
10/91/19	97.0	6.7	77.4	5.52	–	–
10/91/18	–	59.8	7.27	–	–	–
10/91/20	51.0	4.3	58.1	4.36	49	6.13
10/91/16	110.0	7.4	61	5.36	80	7.89
10/91/17	114.0	5.3	33.3	4.41	–	–
10/91	54.0	6.6	–	–	–	–
9/91/01	114.0	7.5	38.3	4.15	–	–
9/91/02	102.0	6.6	87.4	5.46	105	4.75

9/91/11	96.0	8.0	88.3	7.68	112	5.15
9/91/07	120.0	7.7	73.7	5.08	110	6.88
9/91/18	61.0	2.4	70.0	5.37	123	7.01
9/91/19	110.0	8.0	86.4	7.36	131	9.05
9/91/20	75.0	5.7	77.2	7.10	168	12.95
9/91/13	89.0	6.1	98.3	6.8	189	10.28
9/91/06	131.0	8.0	61.5	7.38	158	138
9/91/12	–	–	63.4	7.08	–	–
33/93/15	123.0	7.0	79.5	5.62	138	11.75
33/93/21	115.0	8.3	52.2	4.91	93	1.95
33/93/03	72.0	8.8	53.8	3.47	–	–
33/93/08	59.0	3.2	79.3	4.58	146	9.02
33/93/02	–	–	23.2	3.32	–	–
33/93/11	56.0	4.1	65.8	3.69	130	11.47
33/93/20	41.0	6.4	59.0	5.25	129	8.05
33/93/10	75.0	4.2	66.4	5.76	212	16.12
33/93/22	110	8.1	67.4	3.25	124	13.73
33/93/04	102.0	7.4	47.1	4.02	–	–
33/93/01	78.0	8.1	62.7	5.03	154.5	13.11
33/93/06	–	–	–	–	186	10.84

A. R. Amarasekera

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 forking and soil reconditioning after pruning on yield of mature tea*

5.1.1.1. *St. Coombs Estate, Talawakele – (1990)*

This experiment is in the fifth year of the current cycle. The yield for the fifth year is presented in Table 4.

TABLE 4 – *Effect of forking and soil reconditioning after pruning on yield of mature tea*

		Yield (made tea kg ha^{-1})
T_1	Control	2596
T_2	Guatemala grass	2693
T_3	Mana grass	2503
T_4	Forking (end and mid-cycle)	2747
T_5	Forking (end cycle)	2562
T_6	Guinea (B) grass	2491
T_7	*Eragrostis*	2621
LSD (P=0.05)		NS
CV(%) = 12		

There were no significant differences among treatments.

5.1.1.2. *Giragama Estate, Pilimathalawa – (1990)*

This experiment is in the fifth year of the current cycle. The yield for the fifth year is presented in Table 5.

TABLE 5 – *Effect of forking and soil reconditioning after pruning on yield of mature tea.*

		Yield (made tea kg ha^{-1})
T_1	Control	3936
T_2	Guatemala grass	3886
T_3	Mana grass	3809
T_4	Forking (end and mid cycle)	4344
T_5	Forking (end cycle)	3833
T_6	Guinea (B) grass	4074
T_7	*Eragrostis*	4226
LSD (P=0.05)		NS
CV(%)=9		

There were no significant differences among treatments.

5.1.2. *Effect of rehabilitation after pruning on recovery and yield of tea (K 145g). Observation Trial, Mattakele Estate, Talawakele – (1990)*

The yield for the fourth year of the current cycle is presented in Table 6.

TABLE 6 – *Yield of tea*

		Yield (made tea kg ha^{-1})
T_1	Rehabilitation	2304
T_2	Control (No rehabilitation)	2840

A. R. Amarasekera and U. P. Abeysekera

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

5.1.3.1. *St. Joachim Estate, Ratnapura – (1991)*

Tea was planted in 1993 after reconditioning the soil for a period of two years. Tea plants were given the second cut at a height of 45 cm and brought into bearing in September. No significant differences in growth was observed among treatments.

This experiment is in progress.

K. G. Prematilake and C. Gunasekera

5.1.4. *Effect of burying prunings on yield of tea (TRI 2025)*

5.1.4.1. *St. Coombs Estate, Talawakele – (1991)*

This experiment is in the fourth year of the current cycle. The yield for the fourth year is presented in Table 7.

TABLE 7 – *Effect of burying and retention of prunings on yield of tea*

Treatments	*Yield (made tea kg ha^{-1})*
T_1 Control (with normal fertilizer application)	4317
T_2 Burying of prunings (with normal fertilizer application)	4414
T_3 Burying of prunings only (with no fertilizer application)	4099
T_4 Burying of brush wood only	3864
T_5 Burying of brush wood only (with half of normal fertilizer application)	3447
T_6 Retention of prunings (with normal fertilizer application)	4148
T_7 Retention of prunings (with half of normal fertilizer application)	3425
T8 Retention of brush wood only	3417
LSD (P=0.05)	725
CV% = 12	

The effect of burying prunings was no longer seen. Burning of brush wood and retention of brush wood was inferior to burying of prunings.

A. Anandacoomaraswamy

5.2. Cover crops for tea lands

5.2.1. *St. Joachim Estate, Ratnapura – (1995)*

A new line of investigation commenced to study the feasibility of introducing cover crop spp. as a ground cover for vacant patches in mature tea lands. The following cover crops were planted after pruning to compare the effect of clean and estate weeding on growth of tea.

Wedeliya spp.
Arachis pintoii
Desmodium ovalifolium

A. P. D. A. Jayasekara

5.3. Effect of different mulching materials on growth and yield

5.3.1. *St. Coombs Estate – (1992)*

Tea (DT1) was brought into plucking in July 1994, 15 months after planting in the field. The yield for the period from July 1994 to June 1995 is presented in Table 8.

TABLE 8 – *Effect of different mulching materials on growth and yield of young tea*

Treatments	*Yield (kg ha^{-1})*
T_1 Refuse tea	1937
T_2 Mana grass	1825
T_3 Coir dust	1873
T_4 Saw dust	1830
T_5 Paddy husk	1879
T_6 *Pinus* needles	1875
T_7 Gautemala grass	1941
T_8 *Eragrostis*	1925
T_9 Control	1743
LSD (P=0.05)	256
CV% = 14	

There was no significant difference in yield probably due to well distributed rainfall.

A. Anandacoomaraswamy

5.3.2. *Galphele Estate, Panwila – (1993)*

The tea was brought into plucking in May. The growth assessments and yield from May to December is presented in Table 9.

TABLE 9 – *Effect of different mulching materials on growth and yield of young tea*

Treatments	*Girth (cm)*	*Yield (kg ha^{-1})*
Refuse tea	9.98 a	1237 a
Mana grass	9.98 a	1126 ab
Coir dust	9.21 a	973 bc
Saw dust	9.25 a	930 bcd
Paddy husk	9.19 a	879 ad
Control	7.64 b	743 d
LSD (P=0.05)	1.36	226
CV(%)	9.78	15.3

The results indicated that there is enhanced girthing in the plots with mulch compared to the control. There was significantly higher yield in the plots with refuse tea and in the plots with mana than in the other treatments.

This experiment is in progress.

A. P. D. A. Jayasekara

5.4. Frost control in tea

5.4.1. *St. Coombs Estate, Talawakele – (1993)*

5.4.2. *Court Lodge Estate, Kandapola – (1994)*

No frost was observed during the current year at both locations.

A. Anandacoomaraswamy

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 first cycle showed that there was no significant difference in yield between any of the treatments. However manual weeding every month and slash weeding resulted in higher yields (Table 10).

TABLE 10 – *Effect of different methods of weed management on yield*

Treatments	*No. of weeding rounds/year*	*Yield (kg ha^{-1})*
T_1 – Manual weeding at monthly interval	12	2345
T_2 – Manual weeding at 2 monthly interval	6	2098
T_3 – Manual weeding at 3 monthly interval	4	1977
T_4 – Chemical weeding with Paraquat (1.1 l ha^{-1})	6	2049
T_5 – Chemical weeding with Glyphosate (0.3%)	4	2049
T_6 – Chemical weeding with Sulphosate (0.3%)	4	2034
T_7 – Chemical weeding with Paraquat (1.1 l ha^{-1}) + 2, 4-D (1.5 kg ha^{-1})	5	2142
T_8 – Chemical weeding with Paraquat (1.1 l ha^{-1})+2, 4-D (1.5 kg ha^{-1})+Diuron (1.2 kg ha^{-1})	3	2108
T_9 – Slash weeding	5	2231

(CV% = 15.6)

This experiment is in progress.

A. P. D. A. Jayasekara

6.2. Efficacy of sulphosate compared to glyphosate – Observation trial, Hantane substation

a) Efficacy of sulphosate compared to glyphosate in the control of common weeds
b) Studies on rain-fastness of sulphosate compared to glyphosate

Levels of herbicides : 0.2%, 0.3%, 0.4%, 0.5%, 1.0% and 2.0%

The preliminary investigations indicated that sulphosate is comparable to glyphosate in controlling common weeds and also in rain-fastness. It is not superior to glyphosate. However, further experimentation is needed to arrive at a conclusion.

This experiment is terminated.

A. P. D. A. Jayasekara and S. N. Wijesekara

6.3. Management of problem weeds

6.3.1. *Control of Crassocephalum crepidioides (S: Hulantala, T: Thandampillu) and Erigeron sumatrensis (S: Sudana, T: Alawangupillu), St. Coombs Estate, Talawakele.*

a) Twelve factorial combinations of post-emergence herbicides viz. glyphosate (0.2%), 2,4-D (1.3 kg ha^{-1}), glufosinate ammonium (1 l ha^{-1}) and paraquat (1.1 l ha^{-1}) and 3 pre-emergent herbicides viz. Diuron (1.2 l ha^{-1}), Linuron (1 l ha^{-1}) and Oxyfluorfen (1.2 l ha^{-1}) were tested together with an unweeded control treatment in a pruned tea field. The objective of this trial was to evaluate the effect of herbicides on *Crassocephalum crepidiodes* and *Erigeron sumatrensis.*

Experimental Design : RCBD with 3 replicates.

The dry weight of the weeds were determined three months after herbicide application.

Treatments	*Dry weight (kg ha^{-1})*	
	Crassocephalum crepidiodes	*Erigeron sumatrensis*
Unweeded (control)	434	176
Post-emergent herbicides		
Glyphosate	239	17
2,4-D	243	12
Glufosinate ammonium	201	20
Paraquat	212	25
LSD (P=0.05)	NS	NS

Pre-emergent herbicides

Diuron	254	24
Linuron	231	20
Oxyfluorfen	175	11
LSD (P=0.05)	42.2	NS
CV (%)	22.31	42.50

The results showed that all the tested post-emergent herbicides as well as oxyfluorfen and linuron (pre-emergent herbicides) could be used for the control of *Crassocephalum crepidiodes* and *Erigeron sumatrensis.*

Orthogonal comparison of dry weights of weeds showed that all the post-emergent herbicides when combined with oxyfluorfen successfully controlled both *Crassocephalum crepidiodes* and *Erigeron sumatrensis* as shown below:

Contrast	Df	Dry weight (kg ha^{-1})	
		Crassocephalum	*Erigeron*
Cont. vs Herb.	1	*	*
Syst. vs Cont.	1	NS	**
Gly. vs 2,4-D	1	NS	NS
Gluf. vs Paraq.	1	NS	**
Oxy. vs Diu. & Lin.	1	*	*
Diu. vs Lin.	1	NS	NS
Inter. 1 (post vs pre)		*	**
Inter. 2 (Oxy. vs Diu. & Lin.)		NS	*

* refers to (P=0.05)

** refers to (P=0.01)

b) A confirmatory study has also been conducted to find the most susceptible growth stage/s of these species. In this study weeds were selected at the 2–4 leaf stage, 5–8 leaf stage, flower bud stage and maturity stage in patches of 6-7 plants. The same post-emergent herbicides were sprayed onto the weeds in demarcated patches. Colour changes were recorded at 2, 4, 6, 10, 18 days after herbicide application (Table 11).

TABLE 11 – *Response of C. crepidiodes to post-emergent herbicides applied at different growth stages*

Herbicide	*Growth*	*Response (DAH)*				
		2	4	6	10	18
Glyphosate	2–4 leaf stage	–	–	–	C	L
	5–8 leaf stage	–	–	C	L	L
	Flower bud stage	–	C	C	K	K
	Maturity	–	C	C	K	K
2,4-D	2–4 leaf stage	W	K	K	K	K
	5–8 leaf stage	W	K	K	K	K
	Flower bud stage	W	D	K	K	K
	Maturity	W	D	D	K	K
Glufosinate ammonium	2–4 leaf stage	S	K	K	K	K
	5–8 leaf stage	S	K	K	K	K
	Flower bud stage	S	L	L	K	K
	Maturity	S	L	L	K	K
Paraquat	2–4 leaf stage	S	L	K	K	K
	5–8 leaf stage	S	S	L	L	L
	Flower bud stage	S	S	S	L	L
	Maturity	S	S	S	L	L

DAH – Days after herbicide application

Responses of weeds

– : No response C : Chlorosis D : Dried leaves
S : Scorching of leaves L : Leaf fall K : Kill of plants

This study showed that the susceptibility varied with the growth stage of the two weeds. The most susceptible stage for both species was 5-8 leaf stage for glyphosate, 2,4-D and glufosinate ammonium and 2–4 leaf stage for paraquat.

6.3.2. *Control of Basella alba and Talinum paniculatum, Uva Highlands Estate, Bandarawela – (1994)*

Treatments

T_1 – 2% Glyphosate + Kaolin 2.5 kg ha^{-1}

T_2 – 2.5% Glyphosate

T_3 – 2.5% Glyphosate + Kaolin 2.5 kg ha^{-1}

T_4 – 4% Glyphosate

T_5 – Hedonal M–60 2 l ha^{-1}

T_6 – Hedonal M-40 3 l ha^{-1}

T_7 – Bi-Hedonal 2 l ha^{-1}

T_8 – Basta 3 l ha^{-1} + Diuron 1.2 kg ha^{-1}

Yams were collected from a 18 x 18 cm quadrat at 3, 5 and 10 weeks after imposition of the above herbicides and dried at 85°C. No significant difference in dry weights of rhizomes were seen.

Experimental Design : Incomplete block design
Plot area : 8 x 8 m^2

Treatments	*(Least Square mean) Dry weight of yams (g)*		
	3 weeks	*5 weeks*	*10 weeks*
T_1 – 2% Glyphosate + Kaolin 2.5 kg ha^{-1}	36.87	16.79	33.57
T_2 – 2.5% Glyphosate	26.06	24.96	45.50
T_3 – 2.5% Glyphosate + Kaolin 2.5 kg ha^{-1}	18.83	27.76	56.80
T_4 – 4% Glyphosate	25.96	25.96	45.90
T_5 – Hedonal M-60 2 l ha^{-1}	34.30	30.43	55.06
T_6 – Hedonal M-40 3 l ha^{-1}	29.86	23.76	60.56
T_7 – Bi-Hedonal 2 l ha^{-1}	32.23	33.96	61.93
T_8 – Basta 3 l ha^{-1} + Diuron 1.2 kg ha^{-1}	25.80	31.50	81.90
T_9 – Basta 3 l ha^{-1} + Diuron 2.4 kg ha^{-1}	31.60	28.86	54.66
T_{10} – Control	32.86	20.13	43.76

CV(%) = 28.98

This experiment should be repeated by spraying herbicide to the phloem after complete slashing of the species.

6.4. Screening of herbicides

6.4.1. *St. Coombs Estate, Talawakele*

The pre-emergent herbicides viz. Devrinol and Stomp were tested against Goal and Diuron and dry weights of weeds determined.

Treatments	*Weed dry weight (kg $plot^{-1}$)*
T_1 Diuron 1.2 kg ha^{-1}	15.36
T_2 Devrinol 3 kg ha^{-1}	20.03
T_3 Stomp 3 l ha^{-1}	17.86
T_4 Goal 1.2 l ha^{-1}	14.96
LSD (P=0.05)	8.35
CV% = 24.52	

The results indicate that there was no significant difference between treatments. This experiment should be repeated in the same location.

6.5. Residue studies of sulphosate

These studies were carried out in collaboration with CIC (Colombo) Ltd, at Galphele Estate, Panwila and at St. Coombs Estate, Talawakele. Residue levels of 0, 0.2, 0.4, 0.8 and 1.0% sulphosate were tested at 0, 3, 7 and 14 days after herbicide spraying. Miniature manufacture was employed and the processed samples were sent to ICI, UK by CIC (Colombo) Ltd.

The results of the residue analysis (St. Coombs trial only) indicated that the residue levels are below the MRL (Maximum Residue Levels) 1 week after the application for the levels tested i.e. 0.2 and 0.4% and 2 weeks after the application for the levels tested i.e. 0.8 and 1.0%.

Treatments

Rate of application of sulphosate	*Sampling interval (days)*	*PMG residue (mg kg^{-1})*
0.2%	0	0.19
0.2%	3	0.16
0.2%	7	<0.05
0.2%	14	<0.05
0.4%	0	0.84
0.4%	3	0.23
0.4%	7	<0.05
0.4%	14	<0.05
0.8%	0	0.21
0.8%	3	0.19
0.8%	7	0.07
0.8%	14	<0.05
1.0%	0	0.65
1.0%	3	0.13
1.0%	7	0.05
1.0%	14	<0.05

This experiment is terminated.

M. S. D. L. de Silva

7. Project D/AGRY – *Divisional Activities*

7.1. Earthworm culture

7.1.1. *Effect of selected herbicides on earthworm population, Galphele Estate, Panwila*

The following treatments were applied.

T_1 – Paraquat (1.1 l ha^{-1})
T_2 – 2,4-D (1.5 kg ha^{-1})
T_3 – Diuron (1.2 kg ha^{-1})
T_4 – Glyphosate (0.25%)
T_5 – Sulphosate (0.25%)
T_6 – Cocktail mixture : 2,4-D (1.5 kg ha^{-1}), Diuron (1.2 kg ha^{-1}) and paraquat (1.1 l ha^{-1})
T_7 – Control

Design : RCBD with 3 replicates

The plots were sampled for earthworms prior to application of treatments. Post-treatment sampling was done at 10, 20, 40, 80 and 120 days. The results are presented in Tables 12 and 13.

TABLE 12 –*Effect of herbicides on population of earthworms; difference over control plots in % (mean of 3 replicates with 6 samples)*

Treatment	*Days* 10	20	40	80	120
Paraquat	-26 b	-51 a	-57 a	-55 a	-8 a
2,4-D	-46 a	-72 c	-77 c	-54 c	-7 a
Diuron	-40 d	-84 a	-57 a	-61 d	-23 c
Glyphosate	-7 a	-63 b	-64 b	-49 b	-5 a
Sulphosate	-23 b	-52 a	-57 a	-55 a	-8 a
Cocktail	-31 c	-77 d	-57 a	-22 a	-14 b
CV%	-8.82	-1.99	-2.47	-3.11	-21.53

TABLE 13 – *Effect of herbicides on activity of earthworms (dry wt. of earthworm cast m^{-2}); difference over control plots in % (mean of 3 replicates with 6 samples)*

Treatment	*Days* 10 (g/m^{-2})	20 (g/m^{-2})	40 (g/m^{-2})	80 (g/m^{-2})	120 (g/m^{-2})
Paraquat	-36.93 c	-47.34 b	-66.17 c	-52.27 d	-5.41 a
2,4-D	-36.74 c	-47.21 b	-72.65 d	-27.54 b	-19.84 c
Diuron	-17.00 a	-37.19 a	-50.69 b	-25.21 b	-20.76 c
Glyphosate	-66.40 d	-51.54 c	-21.81 a	-13.28 a	-13.92 b
Sulphosate	-37.92 c	-48.09 b	-72.45 d	-26.11 b	-5.64 a
Cocktail	-31.39 b	-46.73 b	-52.38 b	-34.68 c	-15.52 b
CV%	-3.61	-1.78	-3.54	-5.14	-15.27

The population of earthworms started to increase gradually 40 days after application of herbicides. Except for glyphosate, the activity of earthworms increased 40 days after application of herbicides. In the case of glyphosate, activity increased 20 days after application.

The differences in earthworm activity seen between the herbicides may be explained by differences in physical and chemical properties of herbicides on reaching the soil.

7.1.2. *Effect of inoculation of earthworms on yield of tea, Galphele Estate, Panwila*

The following treatments were applied.

Treatments:

T_1 – 600 earthworms per plot (36 tea bushes) + T 750 fertilizer at the recommended rate

T_2 – T 750 fertilizer at the recommended rate

Design : Paired t test with 7 replicates.

Yield records were taken to compare the yield of the earthworm inoculated + fertilizer applied plots with only fertilizer applied plots. The results are presented in Table 14.

TABLE 14 – *Effect of inoculation of earthworms on yield of tea*

Treatments	*Mean yield (made tea kg ha^{-1})*	*t calculated*	*t Critical (Two tail)*
T_1 – 600 earthworms + T 750	577.4	0.1892	2.160
T_2 – T 750 fertilizer	572.4		

The results obtained over a 3 month period indicate that inoculation of earthworms had no effect on yield. This experiment is in progress.

7.1.3. *The role of earthworms in decomposing commonly used mulching materials, Galphele Estate, Panwila*

This experiment was carried out to investigate the influence of earthworms in breaking down mulching materials.

Treatments:

1. 200 g air dried Mana in nylon mesh bags with 7mm openings
2. 200 g air dried Gautemala in nylon bags with 7mm openings
3. 200 g air dried Mana in nylon mesh bags with 1mm openings
4. 200 g air dried Gautemala in nylon bags with 1mm openings

The loss in weight of mulching materials is to be determined to ascertain the decomposition rate. Population and activity of earthworms were measured before the bags were positioned in the field.

Population of earthworms (mean no. of earthworms m^{-2}) = 62
Activity of earthworms (Dry wt. of casts m^{-2}) = 223.9

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

Treatments:

T_1 – 75g casts per plant
T_2 – 150g casts per plant
T_3 – 250g casts per plant
T_4 – 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 (Tables 15 and 16).

TABLE 15 – *Effect of earthworm casts on growth of tea*

Treatments	*Increase in*		*No. of leaves*	*No. of roots*
	Plant height (cm)	*Girth (cm)*		
75 g casts	26.42	0.90 ab	33	23
150 g casts	22.97	1.01 ab	33	23
250 g casts	26.42	1.21 a	50	29
T200 fertilizer	18.4	0.74 b	53	28
CV%	39.39	25.46	34.82	15.79

TABLE 16 – *Effect of earthworm casts on dry weight of plant*

Treatments	*Dry wt. of leaves (g)*	*Dry wt. of main stem (g)*	*Dry wt. of side shoots (g)*	*Dry wt. of roots (g)*	*Total dry wt. (g)*
75 g casts	5.51 b	4.71 b	0.94 b	5.49	16.60 b
150 g casts	5.74 b	5.08 b	0.92 b	4.73	16.47 b
250 g casts	11.36 a	10.23 a	2.66 a	7.08	31.41 a
T200 fertilizer	7.34 b	4.40 b	0.86 b	5.56	18.48 b
CV%	33.03	36.2	51.51	54.49	25.36

7.1.5. *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:

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

2. Tea fertilizer at the recommended rate.

Design : Paired t test with 5 replicates.

The results of the first destructive assessment are presented in Table 17.

TABLE 17 – *Effect of inoculation of earthworms on growth of tea*

	Treatments			
	T_1	T_2	*t calculated*	*t critical Two tail*
Increase in plant height (cm)	23.78	9.04	1.324	2.447
Increase in girth (cm)	2.06	1.73	0.577	2.306
No. of leaves	32	41	0.75	2.306
No. of roots	22	23	0.10	2.306
Length of longest root (cm)	30.2	29.7	0.12	2.120
Dry wt. of main stem (g)	4.78	5.39	0.417	2.306
Dry wt. of leaves (g)	5.954	6.78	0.3004	2.306
Dry wt. of roots (g)	3.49	4.05	0.775	2.447
Total dry wt. (g)	17.24	17.33	1.26	2.306

There was no significant difference between the two treatments.

This experiment is in progress.

R. M. S. S. Rajapakse

7.2. *Calliandra* provenance trial, Hantane substation

Calliandra plants were lopped in December. The number of plants and the mean dry weight of loppings per plant is given in Table 18.

TABLE 18 – *No. of plants and biomass production of different provenances of Calliandra*

Provenance	*Initial No. of plants*	*No. of plants (%)*	*Mean dry weight of loppings (g plant^{-1})*
9/91	543	24.0	945.0
10/91	288	30.0	1265.0
33/93	74	47.0	652.0
34/93	515	41.5	1348.0

This trial is in progress.

A. P. D. A. Jayasekera

7.3. Effect of bud breaking agent (Dormex) on yield of tea

Trials were initiated at St. Coombs and Waltrim Estates, Talawakele and at Hantane and Galphele Estates, Kandy. The results of Hantane and Galphele are given below:

Treatments:

T_1 – Spray on day of pruning at 1%
T_2 – Spray on day of pruning at 2%
T_3 – Water spray on day of pruning
T_4 – Spray on 7th day after pruning at 1%
T_5 – Spray on 7th day after pruning at 2%
T_6 – Water spray on 7th day after pruning

The following records were maintained after spraying of Dormex.

1. Bud counts on pruned frames
2. Tipping weights
3. Yield records

(a) Hantane Estate – chemicals were sprayed during May. Bud counts and tipping weights are given in Table 19.

TABLE 19 – *Effect of Dormex on bud break and tipping weights of pruned tea*

Treatments	*1st bud count Mean*	*2nd bud count Mean*	*Tipping weights (kg ha^{-1}) Mean*
T_1	10	36	145
T_2	13	40	159
T_3	10	33	139
T_4	9	39	188
T_5	11	38	161
T_6	11	36	178

Plucking commenced during the end of the year.

(b) Galphele Estate, Panwila – chemicals were sprayed during August, Bud counts and tipping weights are given in Table 20.

TABLE 20 – *Effect of Dormex on bud break and tipping weights of pruned tea.*

Treatments	*Bud count Mean*	*Tipping weights (kg ha^{-1}) Mean*
T_1	61	3934
T_2	62	3812
T_3	55	3246
T_4	57	3734
T_5	53	3540
T_6	59	3285

Plucking started towards the end of the year.

These experiments are in progress.

A. P. D. A. Jayasekara and S. N. Wijesekara

7.4. Performance of tea planted with and without rehabilitation

7.4.1. *Field No. 12, Denmark Hill, Concordia Estate, Kandapola. Split-plot design with 5 clones – (1991)*

The yield for the 2nd year of the 1st cycle (July 94 – Aug. 95) is given in Table 21.

TABLE 21 – *Effect of planting tea with and without rehabilitation on yield*

Clones	*Yield (made tea, kg ha^{-1})*	
	Rehabilitated	*Direct Planted*
TRI 2025	975	792
TRI 2024	1240	779
NAY 3	1856	1338
DT 1	1584	1006
PK 2	1816	1297
LSD (P=0.05)	189.1	

A. R. Amerasekera and U. P. Abeysekera

8. Seminars/Conferences

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

Addressed the Regional Scientific Committee, on "Harvesting of tea" and "Weed Management in tea plantations" in a seminar held at the Low-country station, Ratnapura on 19th January.

Addressed the Asst. Superintendents and Field staff of Maskeliya Plantations Ltd. on "Plucking in relation to CTC manufacture" in a seminar held at Poonagala Estate, Bandarawela on 14th March.

Addressed the Regional Scientific Committee, on "Harvesting of tea" and "Intercropping tea and rubber" in a seminar held at Walahanduwa, Galle on 16th June.

Addressed the Regional Scientific Committee IV, Mid-country on "Intercropping in tea plantations" in a seminar held at the Auditorium, TRI, Hantane on 11th August.

Addressed the Regional Scientific Committee IV, Mid-country on "Weed management in tea plantations" in a seminar held at the Auditorium, TRI, Hantane on the 31st October.

Delivered a lecture on "Soil management in tea plantations" for first year students of the Faculty of Agriculture, Peradeniya on 17th November.

Addressed the Regional Scientific Committee, Ratnapura on "Intercropping tea and rubber" in a seminar held at the TRI, Low-country Station, Ratnapura on the 28th November.

Mr P. B. Ekanayake and Dr M. A. Wijeratna addressed a workshop on Plucking and Pruning held at Hatale Estate, Panwila on 14th October for Asst. Superintendents and Field Staff of the SPC estates in the region.

Mr P. B. Ekanayake and Dr M. A. Wijeratna addressed the Tea Inspectors and Assistant Regional Managers of the TSHDA on "Plucking" in a seminar held at TRI, Talawakele on 1st December.

Dr M. A. Wijeratna participated in an International Conference on "Climate change adaptation assessments" held in St. Petersburg, Russia, from 22nd – 25th May and presented a paper on "Some adaptations of the tea plant to dry environments."

Ms R. M. S. S. Rajapakse presented a paper on "Some studies on earthworms in tea lands" at the workshop on Soil Biology held at the ARTI and organised by the University of Calgary, Canada and University of Kelaniya, Sri Lanka on 23rd March.

9. Visitors

(a) Ratnapura

Dr Froud-William, University of Reading, visited the Agronomy Unit to discuss the research project of Mr K. G. Premathilaka.

Dr R. Fordham, Wye College, UK visited the Agronomy Unit in July to discuss research papers with Dr M. A. Wijeratne.

Mr Andears Brockmann, Mechanical Engineer from UK visited the Agronomy Unit to discuss and collect information on plucking machines.

(b) Hantane

The following visitors visited the centre for consultations/familiarization.

Mr Ranjith Rajakaruna, Consultant GTZ-UMWP, Polgolla

Mr Jacob Law-Beer, UP-OFI Link Programme

Dr Joanne Chandserlin, Consultant, UP-OFI Link Programme

Mr Abey Ekanayake, Plantations Controller, Maturata Plantations Ltd, Colombo.

BIOCHEMISTRY DIVISION

Acting Head – I. S. B. Abeysinghe

1. General

Dr N. L. Herath, Head, Biochemistry Division is on sabbatical leave in Japan for a period of one year w.e.f 1st March 1995.

Dr I. S. B. Abeysinghe was appointed as Acting Head of the Biochemistry Division w.e.f. 20th February.

Drs I. S. B. Abeysinghe and A. C. Liyanage were promoted to Grade 1 of the Institute's service with effect from 25th June 1993 and 5th August 1993 respectively.

Mr A. M. T. Amarakoon, Research Assistant continued his PhD research project at the Department of Biochemistry of the Faculty of Medicine, University of Peradeniya and at the Biochemistry Division of the Tea Research Institute, Talawakele.

2. Project B/PDEV – *Product Development*

Project Leader – N. L. Herath

2.1. Attempts to improve the solubility of the TRI formulated Cold Water Soluble Instant Tea

A cold water soluble instant tea has been developed using a chemical method. In the past, Sephadex was used in the development of the above product. Sephadex is an expensive matrix and it cannot be recycled. Therefore, this method was not economically feasible. A more economical method is now being employed. RTD (Ready To Drink) product was formulated and samples of the formulated product were sent to professional tasters. Tasters remarks were favourable. Further trials are currently in progress to improve the product.

N. L. Herath, A. C. Liyanage, H. Jayaweera and M. W. Silva

2.2 Attempts to increase the soluble solid content of the TRI formulated Liquid Tea Concentrate

Various extraction ratios were tried to maximize the soluble solid content and a product with 7% soluble solid content was obtained. Trials are in progress to further increase the concentration of the liquid tea concentrate. The dilution ratio of 1:3 has been increased to 1:6. The keeping qualities of the diluted product has to be observed. Experiments are in progress to check the stability of this product.

N. L. Herath, A. C. Liyanage, H. Jayaweera and M. W. Silva

3. Project D/BIOC – *Divisional Activities*

Project Leaders – N. L. Herath, I. S. B. Abeysinghe and A. C. Liyanage

3.1. Effect on quality characteristics, yield and profitability of tea manufactured by varying the standard of plucking (i.e. 2 and a bud, 3 and a bud, normal plucking)

The effect of standard of plucking on quality and profitability was studied in the Uva and Dimbulla regions during the off season. The yield, quality parameters, taster's evaluation and profitability of black teas manufactured from 3 different plucking standards in the Uva and Dimbulla regions were assessed. In both Uva and Dimbulla regions the results indicated that the main grade BOP gave significantly higher values for bud and three and bud and two compared to normal plucking. In both regions the best quality teas are obtained from bud and three leaves (Tables 1 and 2). This was clearly reflected in taster's evaluation where highest prices were obtained for bud and three and lowest for normal plucking standard. The highest profitability was obtained for normal plucking (60% good leaf) in both Uva and Dimbulla regions. These results were presented at the 191st E & E meeting. This project was a part fulfillment of Mr. Botheju, Research Assistant's MPhil programme.

TABLE 1 – *Quality parameters for Uva region*

Standard of plucking	*TF%*	*TR%*	*TC*	*BR%*	*Price*
Bud+2	1.32a	14.32	4.46a	27.38	81.88a
Bud+3	1.33a	14.58	4.52a	27.45	84.51a
Normal	1.25b	14.28	4.26b	27.23	79.23b
LSD (P=0.05)	0.05	NS	0.15	NS	3.65
CV%	4.89	3.25	4.18	6.77	

TF=Theaflaviin TR=Thearubegins TC=Total colour BR=Brightness

TABLE 1 – *Quality parameters for Dimbulla region*

Standard of plucking	*TF%*	*TR%*	*TC*	*BR%*	*Price*
Bud+2	1.26a	14.20a	4.44b	25.97a	84.12ab
Bud+3	1.25a	15.73b	4.61a	24.74ab	86.75a
Normal	1.13b	15.54ab	4.31b	23.75b	81.81b
LSD (P=0.05)	0.07	0.50	0.16	1.52	3.98
CV%	7.44	3.70	4.30	7.21	

W. S. Botheju and N. L. Herath

3.2. Studies on the interaction of tea with milk

It has been observed that teas of certain marks interact better with milk than others, thereby fetching higher prices. Investigations are being carried out to determine the underlying reasons for this disparity. Initially samples with different interactions with milk were collected from the brokers and analysed for oxidised polyphenols such as TF, TR. It has been shown that teas which interact well with milk contain more TF than those which interact poorly. TF, TF gallates and TR fractions were separated according to the method described by Crispin (1968). Binding capacities of each compound with milk protein (α – casein and β – casein) were determined using Sephadex G–25. The results revealed that binding properties of TF with α – casein and β – casein is much greater than TR's thereby indicating that teas containing more TF will interact better with milk than teas having more TR. When TF and TF gallates are considered, ITF have stronger binding properties than TFMG and TFDG.

I. S. B. Abeysinghe and H. Jayaweera

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

It is known that some clones of tea are more susceptible to SHB attack than others e.g. TRI 2025 is more susceptible than TRI 2023. The existing hypothesis is that the degree of susceptibility of tea clones was related to the saponin content of tea stems. A CARP funded project was initiated in collaboration with the University of Peradeniya to test this hypothesis. In addition the following aspects are also being investigated.

1. Studies on the biochemical relationship between the fungus and the beetle.
2. Investigations of susceptible/resistant clones for the presence of beetle attractants or repellents in their stems.
3. Studies on the polysaccharides of the fungus to ascertain whether they could influence beetle or larval growth; possibilities of using plants showing activity against other beetles as insecticides/insect repellents. The two clones TRI 2023 and 2025 were examined for differences in total crude saponin. No significant differences in saponin content were observed between TRI 2025 (14.2% saponin) and TRI 2023 (14.7% saponin). The beetle was allowed to complete its life cycle on a diet medium which did not contain sterol sources, yeast extract and tea bark extract. The beetle was able to complete four life cycles without showing any adverse effects. This indicated that the beetle did not require sterols from the medium to complete its life cycle. The hypothesis that saponins were responsible for the resistance of tea clones by making steroids unavailable to the insect was therefore shown to be invalid.

Crude saponin was separated and this had no effect on the growth of the fungus and it increased spore germination in comparison with the control.

The possible presence of chemical defence compounds, such as antifungal compounds, in tea stems was studied by screening solvent extracts of the two clones for fungal activity. The dichloromethane extracts displayed antifungal activity. Activity guided fractionation of these extracts showed that caffeine was the major antifungal compound present and that it was active against *M. ambrosium.*

The sugar content of tea stems were also studied. The only difference in free sugar content between the resistant clone TRI 2023 and the susceptible clone TRI 2025 was that inositol was present in higher concentrations in the former than in the latter. Differences seen in the glucose/inositol ratio was 3:1 in TRI 2025 and 5:1 in TRI 2023.

Caffeine in fairly low concentration was found in the susceptible clone TRI 2025 which acts as a phagostimulant to the SHB beetle. However it ceases to act as a phagostimulant at high concentration. CARP funding for this project was terminated in September 1995 but the project is continuing with SAREC funding.

N. L. Herath, I. S. B. Abeysinghe, V. Kumar and S. Kumar

3.4. Studies on the flavour profile and liquor characteristics of Dimbulla and Uva seasonal teas

This is an ongoing project where samples of teas collected from various estates from the Uva & Dimbulla regions during the flavour season are being monitored for their flavour profiles.

N. L. Herath and J. Jayasundera

3.5. Kinetic studies of polyphenoloxidase and peroxidase enzymes

The two enzymes PPO and peroxidase play a major role during black tea manufacture, namely in the formation of quality contributing compounds TFs (Theaflavins) and TRs (Thearubigins). Available publications on PPO and peroxidase in tea, quote contradictory values on the optimum temperature and pH for the activity of these two enzymes. It is therefore important to know the optimum conditions of their activity.

The two enzymes were partially purified by ammonium sulphate precipitation followed by desalting on a Sephadex G–25 column and subsequently fractionated on a Sephacryl–300 (S–300) column. The S–300 fraction was used to study the kinetics of the two enzymes.

Both enzymes were active within the temperature range 0–85^{0}C with optimum activity around 45^{0}C. PPO was active within the pH range 4.0 - 7.5 with optimum activity around pH 6.5 while peroxidase was active within the pH range 4.0 - 6.0 with optimum activity around pH 5.

3.5.1. PPO and peroxidase activity in the dhool

A method was developed to assay the enzyme activity in the dhool in order to study changes that take place during various stages of firing.

The changes in enzyme activity, moisture content. TFs and TRs in relation to temperature in the ECP and FBD driers were studied. The results indicated that both FBD and ECP driers do not irreversibly denature the enzymes PPO and peroxidase. This project was carried out in collaboration with the Technology Division and the details of these experiments are presented in the report of that Division.

3.5.2. Changes in PPO and peroxidase activity of teas during storage

Experiments were carried out to check the residual enzyme activity in tea during storage. Four samples of made tea having a moisture content of 4.8, 7.06, 12.66 and 12.7 were used. The results (Table 3) indicate that at a moisture content of 4.8%, PPO had around 8.5% of the activity of the fermented unfired dhool while peroxidase had an activity of around 10.5%. The enzyme activity increased with increase in moisture content up to about 12.66% and decreased with further increase in the moisture content. The decline in enzyme activity could be attributed to the depletion in available oxygen.

TABLE 3 – *Enzyme activity of teas during storage*

Moisture content %	*Change in PPO activity* % *	*Change in peroxidase activity* % *
4.80	8.57	10.46
7.26	10.20	11.95
12.66	12.40	13.20
12.70	10.20	11.10

* Polyphenoloxidase and peroxidase in the fermented unfired dhool was assumed to be 100%.

3.5.3. Changes in TF, TR and TC of teas during storage

The changes in TF, TR and TC were monitored in the samples used in the above experiment (Table 4). The results indicate that at a moisture content of 12.7% the TF levels decreased by 11% of that found in black tea from the drier mouth while the total colour decreased by 7% and the TR% increased to around 17. The presence of excessive levels of TR pigments is organoleptically undesirable.

TABLE 4 – *Changes in TF, TR and TC in teas during storage*

Moisture content %	*Decrease in TF%* *	*Increase in TR%* *	*Decrease in TC%* *
4.80	2.70	3.45	3.00
7.06	4.80	9.20	4.20
12.66	9.70	16.10	5.10
12.70	11.20	17.40	6.40

* TF, TR and TC in the black tea from the drier mouth was assumed to be 100%

From the results of experiments 3.5.1. and 3.5.2. it could be concluded that both enzymes PPO and peroxidase are reactivated with the absorption of moisture during storage of black tea and acts on the TFs thus reducing the TF content and increasing the TR content in the made tea.

A. C. Liyanage, P. A. N. Punyasiri and P. S. F. Perera

3.6. Comparison of the rate of extractability of soluble solids from CTC teas with corresponding small grade tea

Orthodox and CTC samples were collected from 6 estates and analysed for various chemical parameters and for their extractability. Analysis of the results are in progress.

I. S. B. Abeysinghe, N. L. Herath and H. Jayaweera

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

Experiments were initiated to study the effect of foliar application of different types and rates of phosphorous fertilizer, namely DAP and TSP on the quality of made tea and their effect on clonal improvement in terms of black tea quality. The clones used were CY9 and DT1. There were 4 treatments (2% and 4% DAP, 2% and 4% TSP) and a water spray as the control. The quality of the made tea was assessed by analysing its liquor characters, desirable flavours and organoleptic properties after the 1st, 2nd and 3rd week of application (Table 5). The results revealed that most desirable and physical quality characteristics with both DAP and TSP were obtained with 4% foliar spray in CY 9 clone at the end of the 1st week after the foliar application. In clone DT1 the 4% DAP treatment showed the most desirable quality characteristics than the other treatments (Table 6). The organoleptic evaluations carried out by the tasters also confirmed the above results.

TABLE 5 – *Quality parameters in clone CY 9 one week after foliar application*

Treatments	*P%*	*TF%*	*TR%*	*TC*	*QI*
2% DAP	0.15	0.67	14.2	1.96	1.13
4% DAP	0.15	0.70	14.3	1.91	1.49
2% TSP	0.16	0.76	13.4	1.91	1.29
4% TSP	0.18	0.96	14.4	2.09	1.23
Control	0.16	0.72	13.2	1.75	1.49
LSD (P=0.05)	0.01	0.02	0.21	0.12	0.29

TABLE 6 – *Quality parameters in clone DT1 one week after foliar application*

Treatments	*P%*	*TF%*	*TR%*	*TC*	*QI*
2% DAP	0.13	0.74	8.86	1.72	2.16
4% DAP	0.15	0.84	9.52	2.15	2.26
2% TSP	0.14	0.51	7.67	2.06	2.33
4% TSP	0.14	0.78	6.76	1.84	2.05
Control	0.13	0.88	9.50	1.95	2.12
LSD (P=0.05)	0.01	0.02	0.21	0.11	0.29

I. S. B. Abeysinghe and H. Jayaweera

3.8. Biological effects of black tea consumption

Experiments were carried out to study the effect of black tea consumption on serum cholesterol. Total cholesterol (TC), high density lipo-protein-cholesterol (HDLC) and triglyceride (TG) levels were determined on forty three male 'Sprague Dawley' rats. The rats were divided into three groups. Each group was subdivided into two. Each rat in a subgroup received a dose of 1 ml tea extract daily. The other animals in the subgroup were kept as a control. Blood was obtained from the rats by cardiac puncture after 3, 5 and 7 weeks from each group respectively. The results are presented in Table 7.

TABLE 7 – *TC, HDLC and TC content of serum (mg dl^{-1})*

Period of sampling (weeks)	*Test animals*	*TC*	*HDLC*	*TG*
3	Tea	82.23 (.10)*	64.64 (.14)	100.00 (.45)
	Control	69.89 (.18)*	59.41 (.19)	72.50 (.19)
5	Tea	73.77 (.17)	55.06 (.19)	137.59 (.33)
	Control	73.33 (.12)	51.89 (.19)	87.10 (.20)
7	Tea	70.92 (.14)	54.09 (.14)	60.14 (.13)
	Control	78.76 (.20)	59.86 (.17)	75.64 (.14)

* CV%

Triglyceride concentration in rats which received tea were significantly lower than that of the control rats (P=0.0073) after seven weeks. No other differences were observed between the groups. However there was a large variation in the results obtained for the replicates as reflected by the coefficient of variation. This may be due to haemolysis of blood samples obtained. Therefore it was decided to repeat the experiment and obtain heparinized plasma by using heparinized syringes and vessels to collect blood. This heparinized plasma will be used to measure TC, HDLC and TG.

A similar experiment was carried out to study the effect of black tea consumption on serum cholesterol levels of rats consuming a cholesterol rich diet and the analysis of serum is in progress.

A. M. T. Amarakoon

4. Meetings/Seminars

Dr (Ms) A. C. Liyanage and Mr Jayaweera attended a training course on tea tasting at John Keels and Forbes & Walker from 29th May to 2nd June.

Dr (Ms) A. C. Liyanage and Ms P. S. F. Perera attended a workshop on "Sampling for Chemical Analysis" at the Department of Chemistry, University of Colombo from 19th to 21st July.

Mr H. Jayaweera attended a workshop on "Scientific Instrument Repair and Maintenance" sponsored by IFS Sweden, held in the University of Peradeniya from 28th November to 8th December.

Dr (Ms) A. C. Liyanage and Ms Jayanthi Jayasundera attended the 5th Annual Congress of the PGIA held in Kandy from 16th to 17th November. Dr (Ms) A. C. Liyanage presented a research paper at the above congress. This paper was selected for the best presentation award.

ENTOMOLOGY DIVISION

Head – Sushila I. Vitarana

1. General

The Nematology Division of the Institute was amalgamated with the Entomology Division with effect from 14th July, the combined division being named as the Entomology Division; the post of Head of Nematology Division was suppressed. This report includes nematological studies of the Institute as well.

Mr K. M. Mohotti, Research Assistant, continued his post-graduate studies in UK.

Mrs I. Aladeniya, Experimental Officer, continued at her temporary posting as Promotion Assistant, Ceylon Tea Bureau, London, throughout the year.

Messrs E. R. Perera and A. K. Prematunga, Experimental Officers were transferred to the Termite Research Unit at TRI Low-country Station, Ratnapura with effect from 1st February and 1st March respectively.

Mr D. D. Liyanage, Experimental Officer, was transferred to the Head Office from the TRI Southern Province Advisory and Extension Centre, Kottawa with effect from 23rd April.

Dr (Ms) L. D. Amarasinghe and Mr K. Thirugnanasuntharan, Research Officers, were promoted in June, to Senior Research Officer Grade I Recruitment Segment (with effect from 29th October 1993) and Senior Research Officer Grade I (with effect from 1st October 1994) respectively.

Mrs S. M. Nagahaulla, Research Officer, commenced her post-graduate training leading to a PhD, in July, at the University of New England, Armidale, Australia.

Mr K. Thirugnanasuntheran continued to function as the Actg. Officer–in-Charge, Plant Pathology Division, up to 29th September and also, represented the TRI on the Pesticides Technical and Advisory Committee up to August when Mrs S. I. Vitarana took over the latter duties.

Ms S. M. Samarasinghe, Experimental Officer, resumed work at the Termite Research Unit at Low-country Station on 5th October, after completing the course component of the M. Phil. programme undertaken at the PGIA, Peradeniya.

Ms S. M. Samarasinghe and Mr D. D. Liyanage were promoted to Grade III of the Institute's service with effect from 1st November.

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 tested 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 – (1994)*

(13 treatments x 6 replicates, Nematology Experimental Area, TRI, Talawakele)

The final assessment of nine test clones and four standards namely TRI 2024 (susceptible), TRI 2142 (hypersensitive), TRI 2025 (tolerant) and DT 1 (resistant) planted in cement lined tanks containing soil heavily infested with *P. loosi,* was carried out from July to November.

As there had been death of test plants in some of the replicates the data has been analyzed adopting the missing data technique of Incomplete Block Design.

The results indicated that there was no statistically significant difference between the clones with regard to nematode counts either in the root or in the soil.

Even though significant differences in shoot and root weights were seen between clones, the nematode counts between the test and susceptible clones were not different. Therefore the difference between the clones in relation to growth parameters cannot be attributed to the difference in their susceptibility to the nematode. This experiment will be repeated before arriving at any conclusion.

N. C. Gnanapragasam, U. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar 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, TRI, Hantane)

Anthurium plants were maintained in infested beds to build up the population of *R. similis.* Fifteen test clones and one standard clone, TRI 2025 were planted in February 1994. At planting, the plants were innoculated with laboratory reared pure strains of *Radopholus similis* and the final assessment was carried out in July 1995. The shoot and root weights, nematodes per gramme of roots and nematodes per 100 g of soil were recorded and the data analysed as a Randomized Complete Block Design.

No differences in shoot and root weights were seen between test plants. No nematodes were recovered from the soil other than in one replicate of clone TRI 3069. Nematodes recovered per gramme root showed significant differences between clones (Table 1).

TABLE 1 – *Nematode infestation in the roots of test plants*

Clones	*Mean nematode/g root* ($\sqrt{n+1}$)
TRI 2025	2.167 a
TRI 3022	2.100 a
TRI 3053	1.600 ab
TRI 3016	1.300 ab
TRI 3017	1.000 b
TRI 3014	1.000 b
TRI 3015	1.000 b
TRI 3018	1.000 b
TRI 3013	1.000 b
TRI 3025	1.000 b
TRI 3051	1.000 b
TRI 3052	1.000 b
TRI 3055	1.000 b
TRI 3069	1.000 b
TRI 3019	1.000 b
TRI 3020	1.000 b
LSD (P=0.05)	0.0822
Critical Value of T = 1.99	

However, as the nematode count was very low even in the susceptible clones, no meaningful conclusions could be arrived at based on the above data. This experiment will be repeated.

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar and N. Navaratne.

2.1.3. N 1 C – *Clonal screening against the reniform nematode, Rotylenchulus reniformis – (1994)*

(16 treatments x 6 replicates, Nematology Experimental Area, TRI, Talawakele)

This experiment has been suspended with effect from May 1995, as there were doubts on the pest status of this particular species of soil nematode. This matter has been referred to Dr Rohinie Ekanayake, Nematologist, Central Agricultural Research Institute, Gannoruwa and Prof Sumana Wijekoon of the University of Peradeniya.

2.2. Chemical Control

2.2.1. N 309 – *Evaluation of the efficacy of a new formulation of neem extract ("Neemazal F1") for control for P. loosi, in young tea– (1994)*

(11 treatments x 5 Replicates, Nematology Experimental Area, TRI, Talawakele)

Four different concentrations of a new formulation of neem extract, "Neemazal F 1" (T_1 – T_4 at 1000, 500, 100 and 50 ppm) are being compared with neem seed oil cake (T_6 at 500 g/plant), refuse tea (T_7 and T_8 at 500 and 1000g/plant) and standard nematicides in order to evaluate its efficacy in controlling *Pratylenchus loosi,* in young tea. The nematicides "Nemacur 3G" (T_9 at 7 g/plant), "Furadan 3G" (T_{10} at 7 g/plant), refuse tea (1000 g/plant) and "Jawan" (T_5 at 17 l/ha) are the standards for comparison.

The final assessment was carried out in November and the results are given in Table 2.

TABLE 2 – *Efficacy of nematicides on P. loosi*

Treatment	*Shoot weight (g)*	*Root weight (g)*	*Mean count/ g root (√n+1)*	*Mean count/ 100g soil (√n+1)*
T_1 – Neemzal F1 (1000ppm)	190.80 bc	130.62 abc	12.08 abc	6.12
T_2 – Neemzal F1 (500ppm)	159.30 bc	141.54 abc	11.72 abc	5.72
T_3 – Neemzal F1 (100ppm)	165.92 bc	187.56 ab	12.08 abc	4.26
T_4 – Neemzal F1 (50ppm)	152.08 c	122.60 bc	14.34 abc	5.50
T_5 – Jawan (171 ha^{-1})	144.38 c	94.94 c	9.92 abc	6.76
T_6 – Neem oil cake (500g/plant)	222.32 abc	147.10 abc	12.02 abc	3.88
T_7 – Refuse tea (500g/plant)	185.36 bc	210.74 a	8.26 a	1.76
T_8 – Refuse tea (1000g/plant)	285.80 a	176.64 ab	15.84 bc	7.66
T_9 – Nemacur 3G (7g/plant)	242.38 ab	183.88 ab	16.36 c	4.86
T_{10}– Furadan 3G (7g/plant)	208.66 abc	148.88 abc	10.48 abc	9.42
T_{11}– Control	171.68 bc	171.68 abc	9.16 ab	2.32
LSD (P=0.05)	89.22	81.01	6.78	5.90

With respect to the nematodes in the root, only the treatments "Nemacur 3G" and refuse tea at 1000 g/plant were found to be significantly different from the untreated control, but both treatments have had higher nematode counts than the control which is contrary to previous observations. Thus, no conclusions can be arrived at from this trial. It is proposed to repeat this experiment both in pots and in the field.

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar, N. Navaratne and D. D. Liyanage

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

N 315 – *Isolation of endemic biological control agents of tea nematodes in 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.

S. I. Vitarana, D. D. Liyanage, N. Navaratne and U. B. Herath

2.3. Cultural Control

2.3.1. Studies on botanicals

The plant species which were earlier proved to be immune to *Pratylenchus loosi, Radopholus similis* and *Rotylenchulus reniformis* were being 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)

T_1 – *Teckoma stans,*
T_2 – *Cestrum nocturnum* (Queen of the night),
T_3 – *Plectranthus zeylanicus* (Irriweriya),
T_4 – *Piper longum* (Tippili),
T_5 – *Kaempferia galanga* (Inguru piyali),
T_6 – *Cajanus cajan* (ICPL 84045 & ICPL 87),
T_7 – *Arachis sp.,*
T_8 – *Hibiscus rosa sinensis*
T_9 – TRI 2024
T_{10} – Fallow

This experiment is in progress.

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar, N. Navaratne and D. D. Liyanage

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

(9 treatments x 5 replicates, TRI, Talawakele, 1994)

T_1 – *Teckoma stans,*
T_2 – *Cestrum nocturnum* (Queen of the night),
T_3 – *Plectranthus zeylanicus* (Irriweriya),
T_4 – *Kaempferia galanga* (Inguru piyali),
T_5 – *Cajanus cajan* (ICPL 87),
T_6 – *Cajanus cajan* (ICPL 84045),
T_7 – *Hibiscus rosa sinensis*
T_8 – TRI 2025
T_9 – Fallow

This experiment is in progress.

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar, N. Navaratne and D. D. Liyanage.

N 298 – *To test for nematicidal properties of non susceptible plants on Rotylenchulus reniformis – (1994)*

(6 treatments x 5 replicates, TRI, Talawakele)

T_1 – *Teckoma stans,*
T_2 – *Cestrum nocturnum* (Queen of the night),
T_3 – *Arachis* sp.
T_4 – *Hibiscus rosa sinensis*
T_5 – TRI 2025
T_6 – Fallow

This experiment has been suspended from May as the pest status of the particular species of nematode is questionable.

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar, N. Navaratne and D. D. Liyanage.

2.3.2. Studies on soil amendments

N 308 – *To evaluate the efficacy of different soil amendments in reducing the damage caused to tea by P. loosi – (1994)*

(14 treatments x 5 replicates, TRI, Talawakele)

T_1 – Ground nut cake at 250 g/plant
T_2 – Ground nut cake at 500 g/plant
T_3 – Coconut poonac at 100 g/plant
T_4 – Coconut poonac at 250 g/plant

T_5 – Water hyacinth at 500 g/plant
T_6 – Water hyacinth at 1000 g/plant
T_7 – Castor oil cake at 1000 g/plant
T_8 – Castor oil cake at 250 g/plant
T_9 – Decomposed poultry manure at 500g/plant
T_{10} – Tea waste 1000 g/plant
T_{11} – Castor oil cake + tea waste at 100g and 250g respectively/plant
T_{12} – "Nemacur 3G" at 7g/plant
T_{13} – "Carbofuran 3G" at 7g/plant
T_{14} – Untreated control

The results are presented in Table 3.

TABLE 3 – *Effect of soil amendments on nematode infestation*

Treatment	*Shoot weight (g)*	*Root weight (g)*	*Mean count/ g root* $(\sqrt{n+1})$	*Mean count/ 100g soil* $(\sqrt{n+1})$
T_1	12.680 abc	10.780 ab	7.222 be	9.938 d
T_2	15.340 a	10.480 ab	8.496 b	10.072 d
T_3	10.400 c	8.340 bcd	7.828 b	6.478 b
T_4	11.840 bc	6.880 cd	8.400 b	7.834 c
T_5	13.620 ab	6.520 d	6.242 de	6.416 b
T_6	12.760 abc	8.280 bcd	4.386 c	5.644 b
T_7	13.740 ab	7.440 cd	8.406 b	7.984 c
T_8	11.240 bc	9.480 abc	5.780 d	6.572 b
T_9	11.700 bc	7.560 cd	3.060 bc	6.430 b
T_{10}	11.960 bc	9.020 abcd	3.060 bc	5.628 b
T_{11}	11.000 bc	9.200 abcd	1.954 ab	5.978 b
T_{12}	12.560 abc	11.200 a	1.000 a	1.000 a
L S D (P=0.05)	2.945	2.680	1.381	1.048
Critical value of T	2.02	2.02	2.02	2.02

N. C. Gnanapragasam, G. P. Udumulla, W. A. M. Dharmasena, B. Sureshkumar, N. Navaratne and D. D. Liyanage.

3. 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

3.1. Resistance of tea clones to the borer

Clonal blocks of TRI 3000 and TRI 4000 series at Luckyland, Sheen, Stockholm and Gordon Estates were assessed this year. The observations on the incidence of borer galleries in 30 cm length of primary wood are given in Table 4.

TABLE 4 – *Incidence of S H B in different clones of tea*

Luckyland Estate		*Sheen Estate*		*Stockholm Estate*	
Clone	*Mean No. of galleries*	*Clone*	*Mean No. of galleries*	*Clone*	*Mean No. of galleries*
TRI 4041	1.2	TRI 4075	1.2	TRI 3018	0.6
TRI 4075	2.1	TRI 4053	1.8	TRI 3069	1.3
TRI 4080	3.2	TRI 4085	1.8	DN	1.3
TRI 3018	3.2	TRI 4067	2.3	K 145	1.4
TRI 4083	3.9	TRI 4052	2.5	TRI 3048	1.6
B 275	4.6	TRI 4083	2.6	TRI 3016	2.4
TRI 3015	4.6	TRI 4076	3.2	TRI 3020	2.6
TRI 2025	4.6	TRI 3069	3.4	TRI 3019	2.7
		TRI 4071	3.5	N2	3.8
		TRI 4078	3.5	TRI 3015	4.7
		DT1	3.5	TRI 3017	4.7
		TRI 4072	3.8	TRI 3013	4.8
		TRI 4063	4.2	TRI 3014	5.1
		TRI 2025	4.5		
		TRI 4079	6.0		

At Gordon Estate, infestation in all test clones including the standard was found to be too low for comparison.

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

3.2. 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.

3.2.1. E 248 – *Kenilworth Estate, Ginigathena*

This trial was initiated in January 1994. Four post-treatment assesments were carried out during the current year. The experiment is in progress.

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

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

Project Leader – L. D. Amarasinghe

4.1. Economics of SHB damage

4.1.1. E 258 – A study in collaboration with the Economics Unit commenced in February 1995. It was revealed that the past data collected on borer control and yield is inadequate to derive conclusions with regard to economic profitability of borer management strategies recommended by the Institute. It is proposed to redesign the study in the near future.

L. D. Amarasinghe and D. P. B. Herath

4.2. Control of the borer

4.2.1. E 266 – *Screening of insecticides against SHB – (1994).*

(8 treatments x 2 pruning times x 3 replicates, Field No. 17, 1st Division, Attampettia Estate)

A total of 48 plots were laid down in 1995 in a randomized block design. Each plot had on an average 60 bushes of clone TRI 2025 (planted in 1987, last pruned October 1992). Eight chemicals were tested at two times of pruning, viz. September/October as currently recommended by the Institute and referred to as "escape-strategy" and in February as practiced by the estates in the area taking advantage of the rush crop. Each treatment was replicated thrice.

The chemical treatments were:

T_1 Admire SL200 at 500 ml ha^{-1}
T_2 Admire SL200 at 750 ml ha^{-1}
T_3 Ekalux 25EC at 1000 ml ha^{-1}
T_4 Ekalux 25EC at 2000 ml ha^{-1}
T_5 Laybacid 50EC at 4500 ml ha^{-1}
T_6 Chlorpyrifos 20EC at 1500 ml ha^{-1}
T_7 Chlorpyrifos 20EC at 2500 ml ha^{-1}
T_8 Untreated control

Pruning treatments:
P_1 – Prune in September/October, P_2 – Prune in February

Plots scheduled to be pruned in September/October were pruned in the month of October. A clean prune was given at a height of 45 cm according to estate practice.

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

4.2.2. E 275 – *Screening of insecticides against SHB – (1994)*

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

Two experimental sites were chosen that were planted in June 1994 and June 1995 with the clone TRI 2025. The experiment is in progress.

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

4.3. Clonal Studies

4.3.1. Laboratory screening of clones for SHB resistance

The methodology of laboratory screening was being studied based on the index of growth of the ambrosia fungus on bark extracts.

L. D. Amarasinghe

4.4. Clonal selection for resistance to the UCLWT

Work was initiated on three estates in the Maskeliya region. This study is in progress.

L. D. Amarasinghe and L. S. Abeysinghe

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

E 267 – *Effect of mico-pesticides and systemic insecticides on the up-country live-wood termite in intact old seedling tea bushes at Strathspey Estate, Upcot*

The effect of the treatments was assessed monthly by taking the survival count of the termites in each bush in three replicates. No promising results were obtained from the second post-treatment assessment (2 months from treatment) in respect of 'Naturalis–L' and 'Admire' compared to the untreated control (Table 5). However, the assessments were continued up to the 10th post-treatment assessment and the experiment was concluded as both treatments were not effective on this termite at the rates tested on termite colonies in intact bushes.

TABLE 5 – *Survival of termites over a 10 month period*

Months from treatment	*Admire SL 200*			*Naturalis – L*			*Control*		
	R1	*R2*	*R3*	*R1*	*R2*	*R3*	*R1*	*R2*	*R3*
2	0	0	500	1000	1000	1000	2000	1000	1000
3	2	500	150	1000	0	175	200	150	0
4	500	15	30	0	150	2000	25	20	2000
5	0	100	100	200	200	300	75	25	300
6	0	2000	20	500	300	300	0	2000	200
7	100	1000	1000	1	3000	3000	2000	500	300
8	25	150	1000	0	0	300	500	0	500
9	0	25	70	1000	1000	1000	0	1000	1000
10	200	1000	200	3000	100	0	1000	0	100

R= Replicate

Data given in the above Table are to the nearest round figure. Untransformed data are presented to show the variation among the replicates.

E 269 – *Effect of mico-insecticides and systemic insecticides on up-country live-wood termite in old seedling tea bushes split opened and buried at Strathspey Estate, Upcot.*

The treatments were the same as in E 267 but the application was changed. The treatments were given to uprooted termite infested tea bushes after splitting open them at the uprooted pits. After the treatments, the wood materials were buried *in situ.*

It was envisaged to carry out termite assessments for 12 months but these were discontinued from the 7th month as there were no promising results from any of the treatments compared to the untreated control. Data obtained are presented in Table 6.

TABLE 6 – *Survival of termites over a period of 7 months*

Months from treatment	*Admire SL 200*			*Naturalis – L*			*Control*		
	R1	*R2*	*R3*	*R1*	*R2*	*R3*	*R1*	*R2*	*R3*
1	100	1000	1000	5	20	50	100	1000	10
2	75	300	500	300	100	0	30	200	75
3	500	250	0	0	0	20	25	250	0
4	250	6	250	0	0	5	125	1500	0
5	0	0	50	0	0	250	200	500	175
6	0	1000	4000	100	0	3000	10	25	250
7	200	200	0	300	0	500	500	0	200

R=Replicate

This experiment was terminated in August.

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

E 274 – *Testing 'Admire' on termites in old seedling tea at Mocha Estate, Upcot*

As the latest systemic insecticide ('Admire') was not promising at recommended rates higher dosages of the chemical were tested in September:

T_1 – Admire SL 200 – 0.25 ml/bush
T_2 – Admire SL 200 – 0.5 ml/bush
T_3 – Untreated control

The treatments were given as in E 269. Post-treatment termite survival were assessed over a shorter time period (Table 7).

TABLE 7 – *Survival of termites*

Weeks from treatment	*Admire 0.25 ml*			*Admire 0.5 ml*			*Control*		
	R1	*R2*	*R3*	*R1*	*R2*	*R3*	*R1*	*R2*	*R3*
1	426	783	2003	1527	257	758	220	240	425
2	1584	50	334	1117	340	761	348	431	377
3	235	1117	71	545	114	52	206	0	630
8	434	645	1730	178	224	789	33	857	456
10	0	156	0	613	411	392	0	0	554

R=Replicate

Five post-treatment assessments on termite mortality and their survial were carried out. No conclusive results were found compared to the untreated control. The experiment was terminated.

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

E 277 – *Testing 'Admire', Metarhizium anisopliae and 'Naturalis' against up-country live-wood termite in VP tea at Brunswick Estate, Maskeliya*

Treatment applications were carried out on buried termite colonies at following rates:

T_1 – *Metarhizium anisopliae* 4.6 x 10^8 spores/bush
T_2 – Naturalis–L 2.3 x 10^7 spores/bush
T_3 – Admire SL 200 2.5 ml/bush
T_4 – Untreated control

M. anisopliae, the well known entomopathogenic fungus employed to control many insect pests was detected accidentally, growing in the laboratory cultures of up-country live-wood termite. This was isolated, purified and mass cultured in the laboratory. 'Naturalis', is a marketed formulation of the entomopathogenic fungus *Beauveria bassiana.* Both were tested for their viability and infectivity in the laboratory using termite colonies prior to application in the field. *M. anisopliae* was excellent in killing termites while 'Naturalis' was not effective even under laboratory conditions. Post-treatment assessments are due from January 1996.

This experiment is in progress.

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

E 254 – *Mass culture of endemic strains of entomopathogenic nematodes*

Wax moth larvae *(Galleria mellonella)* were used as an alternative host to the tea tortrix. Cultures of this larvae were established at the Dept. of Zoology of the University of Ruhuna. As a preliminary step, the nematode strains isolated from the Southern coast were reinfected to wax larvae and multiplied. The infectives were sent to the International Institute of Parasitology for identification.

L. D. Amarasinghe, K. A. D. W. Senaratne and D. Premachandra

4.6. Clonal selection for resistance to the UCLWT at Mocha Estate, Upcot

A study on clonal selections was intitiated in Field No. 5 of Lower Division, Mocha Estate in old seedling tea heavily infested with the up-country live-wood termite. Tea roots of about 1 cm diameter were taken from uninfested bushes and labelled.

Laboratory assays were conducted to determine termite infestation levels of the roots taken from each bush and they were categorized as susceptible, tolerent or completely resistant. Out of 25 selections, none were tolerant or completely resistant. This study is in progress.

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

4.7. Economics of UCLW termite damage

A study on the economics of management of up-country live-wood termite was initiated in February. The study is in progress.

L. D. Amarasinghe and D. P. B. Herath

5.0 Project B/TERM – *Pest ecology and productivity of tea lands in relation to the containment and management of the live-wood termites in the low-country*

Project Leader – Sushila I Vitarana

Work on this project came to a standstill in September 1994 for want of staff as one retired in May and the other went on study leave in September 1994. Work resumed with the redeployment of staff as well as upon the return of a trained member in October.

5.1. Clonal Screening

Susceptibility of clones to the live-wood termites were being studied on 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 included Watapotha, St. Joachim, Noragolla, Hulandawa, Berubcula, Endana, 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.

5.2. Clonal Selections

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

5.2.1. LE 50 – From a total of 113 selections carried out up to 1986, the promising ones have been planted in a test area replicated twice amidst termite affected tea typical of the low-country. Further work in selections is necessary, but, the Termite Unit at Low-country Station cannot cope with the work. Estate authorities can be advised to do the selections on their own estates and supply the promising material for the TRI to screen (this is a short cut method for the interim period, so that the valuable material from the seedling tea would not be lost at replanting).

5.3. Fertilizer and shade trial

Effect of different combinations of N and K fertilizer and their interaction with low shade on termite infestation and other parameters is being studied : except for the direct effect of nitrogen, no interactions have been seen.

5.4. Biological Control Studies

Different formulations of termites of biological and conventional nature are being studied alone and in combination with different models of injector type applicators. The defects of the injectors, encountered at usage and suggestions for improvements were communicated to the supplier and improvements are being made.

5.5. Laboratory screening of extracts of plant origin and susceptibility of termites

Bioassaying of plant extracts for their kairomonal and allomonal properties is in progress using laboratory cultures of *G. dilatatus*. The new staff is being trained to revive this study.

5.6. Economics of LCLW termite damage

One study using data collected from the clonal screening trial located at TRI station Kottawa was completed. The clone TRI 2016 was considered as the immune clone for comparison with the other clones. The Net Incremental Gain in controlling the termite and the break even Net Sale Average for the different clones could be calculated. The study is in progress.

S. I. Vitarana, D. P. B. Herath and A. Jayakody

6. Project C/NEMA – *Analytical Services*

Project Leader – Sushila I Vitarana

The divisional staff continued to service the industry by analyzing soil and root samples from suspect fields, fields earmarked for replanting, soil meant for nurseries and plants in nurseries. A total of 2310 root/soil samples were analysed for advisory and research purposes and 118 reports have been issued.

7. Project D/ENTO – *Divisional Activities*

Project Leader – Sushila I Vitarana

7.1. Insecticidal trials on tea tortrix

The insecticides that are being presently recommended for leaf eating caterpillars are : "Mimic" (RH 5992, the ecdysone agonist), at 750ml ha^{-1}; "Atabron" (chlorfluazuron), at 150 ml ha^{-1} and "Dipterex" (trichlophon), at 3.2 l ha^{-1}.

From time to time new, safer and cheaper insecticides are being tested for their efficacy and compared with the present recommendation. The insecticides that are being studied are :
"Javan" (azadirachtin), at 2.47 l ha^{-1} and at 3.0 l ha^{-1};
"Neemazal" (azadirachtin) at 750 ml ha^{-1},
"Agree BT" (*Bacillus thuringiensis* formulation), at 1665 g ha^{-1},
"Larvo BT 2XWP" (*Bacillus thuringiensis* formulation), at 140 ml ha^{-1}
"Lannate 40SP" (methomyl), at 20 g $10/1^{-1}$ dilution.

The quantitative effect of the above on non target fauna is part of this study.

Simultaneously assessments on the effect of the chemicals on the re-establishment of the natural control agents of tea tortrix are carried out. However, similar investigations on their effect on natural control agents of other tea pests has not yet been studied.

7.2. Acaricidal trials on tea mites

The acaricides that are being presently recommended are : "Morestan" 25% (quinomethionate), at 550 g ha^{-1}; "Omite 57E" (propargite), at 1 l ha^{-1} and Sulphur 80%, at 5 g l^{-1}.

Testing of new formulations is undertaken in order to find safer and cheaper alternatives to the current recommendation.

While "Neoron" (Bromopropylate) is awaiting release, "Neemazal", a neem product is awaiting testing.

7.3. Factors limiting the efficiency of the natural control agents of Tea Tortrix

A new study has been initiated to determine the biotic and abiotic factors limiting the efficiency of the natural control agents of tea tortrix. A questionnaire was sent out to all estates in the districts where the pest is active. Special emphasis is being placed on the parasite, *Macrocentrus homonae.* The study is in progress.

S. I. Vitarana, A. Abeysekara and P. de Silva

7.4. Biological Control of tea mites

Studies were initiated on the behaviour of the predatory mites, *Phytoseiulus persimilis* and *Amblysius californicus* released in mite affected tea fields in four locations in the Uva (Telbedde, Cullen, Ury and Gonakelle), four in Maturata (Brookside, Park, Eskdale and Court Lodge) and one in Balangoda (Balangoda Estate).

The preliminary studies confirmed that the predator formulations are promising. The Red Spider Mite species was found to be totally cleared in the majority of the release sites while in others the pest was brought under very good control to the extent that no acaricidal treatment was warranted. Arrangements have been made to conduct properly designed trials in relation to dosages, times of release, radius/residual activity in 1996.

8. Project D/NEMA – *Miscellaneous Studies*

8.1. N 288, N 289 and N 290 – *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 and U. B. Herath

8.2. Biotypes of *Radopholus similis*

This is a follow up of the international project entitled "**Biological characterization of the pathogenic forms of the burrowing nematode, *Radopholus similis* on perennial and other crops from different regions of the world.**"

N 312 – *To compare the behaviour of the different strains of Radopholus similis on two hosts, namely tea and pepper–(1994)*

(10 treatments x 5 replicates, TRI, Talawakele)

T_1 – RA5 (isolate from Morawaka tea) on tea.
T_2 – RA5 (do) on pepper.
T_3 – RA7 (isolate from Imboolpitiya tea) on tea.
T_4 – RA7 (do) on pepper.
T_5 – RA10(isolate from Imboolpitiya pepper) on tea.
T_6 – RA10(do) on pepper.
T_7 – RA20(isolate from Imboolpitiya Night Shade) on tea.
T_8 – RA20(do) on pepper.
T_9 – Uninfested tea (Control).
T_{10} – Uninfested pepper (Control).

Determination of shoot and root weight of plants, nematode counts in roots and soil after 17 months from innoculation were carried out. Significant differences were seen between treatments (Table 8).

TABLE 8 – *Development of different strains of R. similis on tea and pepper as hosts and their effect on the hosts*

Treatment	*Shoot weight (g)*	*Root weight (g)*	*Mean count/ g root* $(\sqrt{n+1})$	*Mean count/ 100g soil* $(\sqrt{n+1})$
T_1	4.002 ab	3.165 ab	12.180 b	9.740 c
T_2	4.065 ab	2.340 d	3.700 b	6.213 d
T_3	3.865 ab	3.092 ab	18.983 b	11.467 b
T_4	3.593 bc	2.105 d	5.315 c	3.960 c
T_5	3.853 ab	2.330 d	8.485 d	5.717 d
T_6	3.203 dc	2.592 cd	9.050 de	5.035 cd
T_7	3.880 ab	3.253 ab	10.075 e	4.033 c
T_8	2.745 d	2.973 bc	2.628 b	2.378 b
T_9	4.200 a	3.520 a	1.000 a	1.000 a
T_{10}	3.070 dc	2.415 d	1.000 a	1.000 a
LSD(P=0.05)	0.535	0.491	1.384	1.178

The results confirmed the earlier observation that on tea, the Imboolpitiya isolate builds up to a higher level than the Morawaka isolate and that both these and the isolate from night shade find tea as a better host than pepper.

N. C. Gnanapragasam, A. K. Prematunga, U. B. Herath, B. Sureshkumar, N. Navaratne and D. D. Liyanage.

8.3. 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 is expected from the Environment Authority)

8.3.1. N 315 – *Isolation of endemic biological control agents of tea nematodes (fungi, bacteria and soil micro-organisms) in order to formulate methods of augmenting their activity.*

Work has been initiated in December in the laboratories at Talawakele and Hantane.

S. I. Vitarana, D. D. Liyanage, N. Navaratne, U. B. Herath and B. V. Sureshkumar

8.4. Miscellaneous Work

The executive staff conducted lectures for training courses, seminars, field days and group discussions on specific topics; rendered advisory services when called upon to do so; wrote scripts and were involved in audio visual productions and contributed towards extension services and publications.

PLANT PATHOLOGY DIVISION

Officer-in-Charge – A. Balasuriya

1. General

Mr A. Balasuriya reported back to work in September, after spending one year at the Imperial College of Science, Technology & Medicine, in the United Kingdom. Mr T. S. Gunasekara proceeded to UK (Lancaster University) in March, to continue his post-graduate training. Ms N. K. Karunatillake (Technical Assistant) was promoted to grade IV of the TRI services as an Experimental Officer, with effect from 1st August.

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 – *Fungicide Screening Trial*

This was completed after 15 rounds of infection assessments. Fytolan, a copper fungicide (Copper oxychloride) gave a significant control in 11 out of 13 post-spray counts. Some of these results are given in Table 1.

TABLE 1 – *Comparison of blister blight incidence, in control and Fytolan treated plots*

Treatments	*Assessments*								
	1	2	3	4	5	6	7	8	9
Fytolan	18.3	4.6	22.3	24.2	20.9	14.5	13.9	14.0	12.7
Control	33.1	21.1	38.4	57.2	59.5	24.8	33.9	31.1	31.9
LSD (P=0.05)	10.4	6.6	13.0	12.4	8.5	9.5	9.2	8.8	10.2
CV%	27.8	37.4	28.0	20.6	15.2	33.6	29.8	24.9	30.5

2.1.1.2. P/BB2 – Clonal resistance/susceptibility

Clones TRI 2043, N2, K 145 and DT 1 were found to be very resistant to blister blight disease both in the laboratory as well as in the field, while clones TRI 2023 and 2025 were highly susceptible (Tables 2 and 3). However, the clone DN behaved differently, under the two conditions. This has to be further established before we are able to use the laboratory method as a quick guide in testing the resistance of tea clones to blister blight.

TABLE 2 – *Incidence of blister blight in different clones in the laboratory.*

Clone	*Mean No. of blisters*
TRI 2043	1.000
K 145	1.167
N 2	1.583
PK 2	3.333
TRI 2027	3.500
DT 1	4.167
KEN 16/3	5.167
CY 9	15.417
TRI 2024	20.417
TRI 2025	24.417
TRI 2023	26.417
DN	35.250

LSD (P=0.001) = 8.90

TABLE 3 – *Incidence of blister blight in different clones in the field*

Clone	*Mean No. of blisters*
TRI 2043	17.50
N 2	39.50
DT 1	71.75
DN	78.50
K 145	83.50
TRI 2027	93.25
KEN 16/3	100.75
PK 2	129.00
TRI 2024	138.00
CY 9	147.00
TRI 2025	188.00
TRI 2023	221.25

LSD (P=0.05) = 71.40

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

2.1.1.3. Studies on Leaf Surface Microbiology

Experiment 1. P/BB3 – Effect of UV–b radiation on blister blight

Experiment 2. P/BB4 – Leaf Surface Microbiology

The results of the above two projects will be presented once Mr Gunasekara's PhD. programme is completed.

T. S. Gunasekara and A. Ratnayake

2.2. Stem Diseases

2.2.1. Hypoxylon Wood Rot

2.2.1.1. P/WRH 1 – Survey on wood rot

The second round of assessment to establish the rate of spread of the *Hypoxylon* wood rot was undertaken in Diyagama East Estate, in November. A scoring rate of 0–5, was adopted from uninfected to the dead in that order (Table 4). For the 20 month period that has lapsed since the first assessment, the intensity of the disease has increased by 32.9% (an approximate increase of 20% for one year).

TABLE 4 – *The rate of increase of Hypoxylon wood rot damage under natural conditions at Diyagama East, clone K 145.*

Description	*1st count 22.03.94*	*2nd count 30.11.95*	*% increase (decrease)*
Uninfected	91	11	(87.9)
Slightly infected	43	69	60.5
Moderately infected	31	53	71.0
Heavily infected	129	157	21.7
Dead	6	10	66.7
Total bushes	300	300	
Disease score	516	686	
Increased intensity %			32.9

Note the big drop in the percentage of uninfected bushes.

2.2.1.2. P/WRH2 (NE) – Chemical control of the Hypoxylon wood rot, using hydrated lime, protective paints and systemic fungicides

There was one repeat treatment of fungicides and four assessments of disease, undertaken during the year. This trial is being continued.

2.2.1.3. P/WRH3 (DGW) – Chemical control of the Hypoxylon wood rot, using hydrated lime and systemic fungicides at two levels of K fertilizer

Two fertilizer applications and three assessments were completed during the year. This trial is being continued.

A. Balasuriya, D. Pallemulla and A. Ratnayake

2.2.1.4. Micromorphological studies of wood decay

Several laboratory experiments were undertaken at the Imperial College, London, to establish the kind of decay involved in *Hypoxylon* and Thorny Stem Blight (TSB) infections. Both these organisms are found to be involved in producing what is known as 'soft rot decay' of tea bush wood.

2.2.1.5. Morphological studies of different wood tissues

Tissue components of four clones of tea were studied using (microtome) cross sections. Major differences in fibre cell and total cell counts were seen between susceptible (PK 2 and K 145) and resistant (HS 10A and TRI 2025) clones. The higher total cell counts of the susceptible clones is a direct reflection of the higher fibre cell counts found in them (Table 5). It is possible that the abundance of fibre cells in their wood anatomy, attracts this fungus *(Hypoxylon)* to cause what is now known as 'soft rot decay' in the susceptible clones.

TABLE 5 – *Composition of major tissues in cross sections of four clones in a field under 400 magnification.*

Clones	*Fibre cells*	*Wood parenchyma*	*Ray parenchyma*	*Vessels*	*Total cells*
PK 2	297	49	60	26	405
K 145	241	58	58	35	357
HS 10A	127	40	40	17	207
TRI 2025	159	52	54	26	265
LSD (P=0.05)	30	NS	7	7	35
CV%	9.5	16.8	8.4	17.4	7.4

A. Balasuriya

2.2.2. General Wood Rot

2.2.2.1. P/WRG1 (St. Coombs) – Use of RRI Latex/Bitumen protective paint in the control of general wood rot in tea (observational trial)

It was found that the RRI latex/bitumen paint does not physically last very long. However, after the second round of assessments, both RRI paint alone and the RRI paint+Calixin 6% significantly reduced the extent of the general wood decay in seedling tea (Tables 6, 7, 8). Based on this it would be possible for us to use RRI latex/bitumen mixture in containing wood decay in tea.

TABLE 6 – *First wood rot assessment (16.09.93).*

Treatment	*Visual damage*	*No. of main branches*	*No. of primaries*	*Total decay area (cm²)*
RRI paint+Calixin 6%	68.3	5.7	21.3	588.0
RRI paint+Baycor 3%	98.3	4.2	15.0	328.2
RRI paint alone	87.5	5.3	16.3	273.1
Control	86.3	5.2	18.3	346.5

TABLE 7 – *Second wood rot assessment (15.02.96).*

Treatment	*Visual damage*	*No. of main branches*	*No. of primaries*	*Total decay area (cm²)*
RRI paint+Calixin 6%	57.5	6.2	24.8	293.3
RRI paint+Baycor 3%	94.2	4.5	16.5	247.9
RRI paint alone	68.3	5.2	16.5	136.8
Control	81.3	5.7	22.7	271.7

In Table 8, columns 2 (except with RRI point alone) and 3 indicate increases in actual numbers while columns 1 and 4 indicate actual decreases after a two and a half year treatment period. These results also show that there is a reduction in the extent of wood decay under natural conditions (control) probably due to improved weather and growing conditions. Overall, the number of primaries and frame branches have increased and both visual and actual decay areas have decreased.

TABLE 8 – *Difference in wood rot parameters after two and half years of treatments.*

Treatment	*Visual damage*	*No. of main branches*	*No. of primaries*	*Total decay area (cm²)*	*% reduction of decay*
RRI paint +Calixin	10.83	0.50	3.50	294.7	50.1***
RRI paint +Baycor	4.17	0.33	1.50	80.3	24.5 NS
RRI paint alone	19.17	–0.17	0.17	136.3	49.9***
Control	5.0	0.20	4.40	74.8	21.6 NS

CV = 37.1%

A. Balasuriya and A. Ratnayake

2.2.2.2. P/WRG2 (UH) – Chemical control of general wood rot using systemic fungicides and protective paints, at two levels of K fertilizer

Two rounds of fertilizer application and two assessments to estimate the extent of damage due to general wood rot, under the different treatments have been completed. This trial is being continued.

A. Balasuriya, D. Pallemulla and A. Ratnayake

2.2.3. *Phomopsis* Canker

2.2.3.1. P/CANK 1 & 2 – Control of *Phomopsis* canker with systemic fungicides

The two trials at Bearwell and Mattakelle Estates were concluded after six canker assessments. At Bearwell, there was 39% natural infections at the beginning of the trial. Only Baycor (Bitertanol) spray gave a highly significant control (Table 9). At Mattakelle, the initial infection level was 20%. In this trial, Baycor gave significant control while Atemi (Cyproconazole) and Folicur (Tebuconazole), gave very highly significant controls (Table 10). At Mattakelle, the clone was DT 1, while this was N 2 at Bearwell Estate. DT 1 clone is known to have better callussing properties. Therefore, it is possible that at relatively low level of infections, clones with better callussing properties are bound to respond to a range of systemic fungicides (triazoles), more significantly.

TABLE 9 – *Phomopsis canker incidence before and after fungicide sprays, Bearwell Estate, Clone N 2.*

Treatment	*Total No. of bushes*	*Initial infection count*	*Final infection count*
Control	45	15	13 NS
Baycor	33	13	07 ***
Atemi	40	19	18 NS
Folicur	35	13	09 NS

Average initial infections = 39%; CV% = 13.2

TABLE 10 – *Phomopsis canker incidence before and after fungicide sprays, Mattakelle Estate, Clone DT 1.*

Treatment	*Total No. of bushes*	*Initial infection count*	*Final infection count*
Control	68	08	09 NS
Baycor	82	20	09 *
Atemi	57	16	08 ***
Folicur	64	11	08 ***

Average initial infections = 20%; CV% = 31.0

Note: The data in Tables 9 and 10 were analysed using the 'tests of two proportions' technique, where every treatment was individually compared with the control.

A. Balasuriya and A. Ratnayake

2.3. Shot-hole Borer/Ambrosia control studies

2.3.1. P/AMBI (Kenilworth) – Efficiency of selected systemic fungicides as an indirect control of SHB damage, compared with the direct control (Lebaycid – insecticide) on tea recovering from pruning.

This is a repeat trial to establish the trends seen in the first trial completed at Stonycliff Estate. There were four treatments and two samplings, undertaken during the year. The SHB population studies were carried out by the Entomology staff. One round of dissected samples were subsequently assayed to compare the incidence of ambrosia fungus. This trial is in progress.

A. Balasuriya, K. Thirugnanasuntharan and A. Ratnayake

3. Seminars

Mr A. Balasuriya addressed a seminar on the 'Control of Blister Blight', for the Assistant Superintendents of the Kandy RSC, held at the Auditorium at Hantana substation.

4. Advisory Visits

Visited High Forest Estate on several occasions in connection with the 'High Forest problem'. Visited Spring Valley Estate twice where the clone TRI 2025 was badly affected from an unknown problem.

5. Acknowledgements

The co-operation extended by the Superintendents of respective estates where several trials were undertaken are gratefully acknowledged. We also thank the agro-chemical firms who have provided pesticide samples for trial purposes.

TISSUE CULTURE UNIT

Project B/TC – Tissue Culture of Tea

Studies on the effect of different media and sterilents on the rate of establishment and multiplication of shoots tips and nodal explants

Several experiments were carried out to find out a method for the reduction of the rate of contamination and browning of explants. Latent bacterial contamination was observed when some of the cultures were transferred to fresh medium. Filter sterilized Streptomycin sulphate solution (1w mg l^{-1}) incorporated in 1/2 strength modified MS solid medium was found suitable to reduce this problem. Shoots with 5-6 internodes were dipped (cut end) in Streptomycin solution (100 mg l^{-1}) and injected filter sterilized Streptomycin solution (100 mg l^{-1}) to the vascular system, just above the 3rd node. After 3-4 days nodal explants were taken for culturing. This helped to reduce bacterial contamination but fungal contamination appeared near the injected point after a few days.

These experiments are in progress.

Quantitative study on the rate of multiplication and rooting of seedlings

Open pollinated seeds of TRI 2023 x DG 39 from the Hantane seed garden were used. Out of 30 seeds three were contaminated while 13 did not germinate but the cotyledons turned green and produced roots. The balance 14 seeds germinated. Three subcultures were done and the number of shoots and the length of the shoots were recorded.

This experiment is in progress.

Morphological and histological study on plant regeneration from cotyledon callus cultures

The green coloured globular structures formed in the cotyledon callus culture and maintained in the regeneration medium have started to develop into embryolike structures and produced few shoots. However, the rate of growth was very slow.

Some of the globular structures were fixed for future histological studies.

Liquid medium consisting of IAA, 2, 4-D and kinetin and green coconut water have shown some suspensions in the medium.

This experiment is in progress.

Studies on the field performance of tissue cultured plants.

Hantane – The yield and the activity of the terminal buds of individual plants are being recorded.

Talawakele – Six growth assessments were done on 24 plants of clone TRI 3031. After the 2nd cut across the fresh and the dry weights were recorded.

Micropropagation of other trees found in tea plantations

Cultures of *Eucalyptus* are being maintained in multiplication and rooting media.

Out of 100 rooted plants planted in the Hantane nursery, 50 rooted plants were acclimatised in the plant house.

P. D. Upali

Experiment ME 94 1.0 (2) Studies on contamination of explants obtained from tea plants under clean conditions

Contamination was rather high in the explants directly collected from the field. The above study was initiated on the assumption that the management of stock plants under clean conditions, in a glasshouse could greatly reduce the initial load of contamination. In this experiment the treatments were replicated thrice. The results of the experiment are given in Table 1.

TABLE 1 – *Level of contamination of explants*

Source of explants	*Treatments*	*No. of explants*	*% contamination*
Field	Streptomycin 1/2 MS medium	60	26.67
Glasshouse	Streptomycin 1/2 MS medium	60	22.22
Field	Streptomycin	60	28.33
Glasshouse	Streptomycin	60	22.77
LSD (P=0.05)			
CV% = 5.73			1.96

T. M. Sarathchandra

Experiment SE 94 2. (2) – A study on the regeneration ability of callus

There was no significant growth leading to regeneration, in the leaf callus of clones 2025, CY 9 and DG 7; these turned to brown colour after two months in culture. However the callus of clone 3016 in the medium containing 2, 4-D and kinetin showed a soft and greenish callus growth after two months in culture. This experiment is being continued with different concentrations of hormones and cytokinins.

Somatic embryogenesis on tea leaf callus

As somatic embryogenesis is the process with the greatest potential for achciving rapid clonal multiplication when compared with micropropagation, a new study was initiated to determine the embryogenic ability of tea leaf callus. Preliminary studies confirmed the possibility of obtaining a suspension of single cells and cell aggregates from leaf callus fragments (clones TRI 2025, DG 7) transferred to an agitated liquid medium. Further investigations and histological studies revealed the presence of pre-embryogenic cells among cell aggregates. These results are encouraging.

This study is in progress.

T. M. Sarathchandra and K. Sarathchandra

Experiment ME 94/95 – A study on the multiplication of clones

Twenty shoots free of contamination from each of clones DG 7, TRI 3016 and CY 9 were used for this experiment. Shoots of clones DG 7 and CY 9 had a multiplication rate of 2.5 to 3 while shoots of clone TRI 3016 recorded a multiplication rate of 2. This experiment is in progress.

K. Sarathchandra

PLANT PHYSIOLOGY DIVISION

Acting Head – A. Anandacoomaraswamy

1. General

Dr David W. Lawlor of the Department of Biochemistry and Physiology, Rothamstead Experimental Station, UK visited the division for two weeks under an IAEA program and trained the staff in the measurement of photosynthesis and assimilate partitioning.

Dr Mohamed Bazza from Morocco visited the division in June for two weeks and trained the staff on the use of the Neutron moisture meter.

Ms J. Mohotti continued her post-graduate studies at the University of Reading, UK.

Mr W. M. A. B.Weerasinghe (Faculty of Agriculture, University of Peradeniya) and Ms Loga Tharmalingam (Faculty of Agriculture, University of Jaffna) completed their 500 series projects in the division.

2. Studies on Photosynthesis and Dry Matter Partitioning

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

Under this experiment, the amino acid content of flush as well as the yield were monitored in clones TRI 2025 and DT 1. The monthly yield is presented in Table 1.

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

Clone	*TRI 2025*					*DT 1*				
Year from prune	*I*	*III*	*IV*	*V*	*VI*	*I*	*III*	*IV*	*V*	*VI*
1994										
Jul.	–	390	330	246	314	–	376	250	202	195
Aug.	0		452	435	314	0		403	367	235
Sep.	0		455	415	332	0		427	333	255
Oct.	0		439	358	336	0		362	371	241
Nov.	0		436	315	313	0		320	257	243
Dec.	47		385	259	266	41		338	310	226
1995										
Jan.	564		553	402	387	292		422	315	302
Feb.	134		317	242	229	96		295	216	187
Mar.	444		221	185	212	254		240	108	78
Apr.	176		289	260	0	185		363	234	0
May.	634		579	468	0	388		442	411	0
Jun.	235		247	199	0	252		296	234	0
Total	2234		4703	3784	2703	1508		4159	3358	1962

During the current year, there was no second year field in this experiment. The results suggest that the yield increased from the first to the fourth year and declined thereafter.

2.2. Partitioning of assimilates of clonal tea as influenced by levels of N and ageing in a pruning cycle, St. Coombs Estate – (1992)

The yield for the 3rd and 5th year is presented in Table 2.

TABLE 2 – *Effect of levels of N and ageing on yield (kg ha^{-1}) of clone TRI 2025.*

	Age after pruning	
Levels of N	*3rd year*	*5th year*
0	2988	2193
300	3387	2447
450	3776	2415
LSD (P = 0.05)	214	180
CV(%)	14.2	11.7

The mean amino acid content is presented in Table 3.

TABLE 3 – *Effect of levels of N and ageing on mean amino acid content of flush stems (mg g^{-1})*

	Age after pruning	
Levels of N	*3rd year*	*5th year*
0	33.3	39.4
300	41.5	42.7
450	47.1	44.9
LSD (P = 0.05)	2.5	1.5
CV (%)	6.5	3.2

The results suggest that increasing N level increases the amino acid content and yield in the third year field. In the 5th year field, increasing N level increased the amino acid content but not the yield.

V. Sithakaran

2.3. Seasonal accumulation of root starch in tea, St. Coombs Estate – (1992)

The results of root starch level for clones TRI 2025 and DT 1 are presented in Tables 4 and 5 respectively.

TABLE 4 – *Starch content (%) of roots with age (after pruning)*

	Clone TRI 2025			
Year after pruning	*I*	*II*	*III*	*IV*
1995				
Jan.	11.8	31.9	30.8	40.4
Feb.	19.3	23.4	51.8	28.8
Mar.	16.9	30.3	48.6	29.5
Apr.	21.0	22.2	27.3	18.0
May	19.5	24.7	28.9	18.6
Mean	17.7	26.5	37.5	27.1

Root starch levels increased from the first to the third year and declined in the fourth year.

TABLE 5 – *Starch content (%) of roots with age (after pruning)*

	Clone DT 1			
Year after pruning	*I*	*II*	*III*	*IV*
Jan.	12.2	42.8	60.4	42.1
Feb.	26.1	31.2	45.9	46.7
Mar.	25.5	33.0	36.2	29.8
Apr.	32.5	29.9	44.4	28.7
May	39.4	26.2	52.5	27.5
Mean	27.1	32.6	47.9	34.9

The starch content increased with age from pruning up to third year and declined thereafter. DT 1 had higher starch content than TRI 2025 in all years of the pruning cycle.

2.4. Seasonal accumulation of root starch in tea, Gonekelle Estate – (1992)

The root starch for clones TRI 2023 and TRI 2025 are presented in Table 6 and 7 respectively.

TABLE 6 – *Starch content (%) of roots with age (after pruning).*

	Clone TRI 2023				
Year after pruning	*I*	*II*	*III*	*IV*	*V*
1995					
Jan.	36.6	32.6	27.9	26.1	23.0
Feb.	23.5	20.9	28.9	27.3	17.8
Mar.	39.5	14.0	43.0	15.8	18.7
Apr.	17.2	15.6	23.0	25.1	20.0
May	6.8	11.0	29.4	33.0	18.3
Jun.	9.5	12.5	18.3	42.1	20.2
Jul.	11.3	13.2	29.9	16.0	16.9
Aug.	12.9	16.5	34.7	22.0	16.6
Sep.	11.1	15.9	18.6	13.0	12.3
Oct.	21.5	29.2	24.9	15.0	23.3
Nov.	18.8	25.8	24.8	13.0	17.4
Dec.	21.5	22.5	21.1	16.0	32.2
Mean	19.1	19.9	27.0	21.4	18.9

TABLE 7 – *Starch content (%) of roots with age (after pruning).*

	Clone TRI 2025				
Year after pruning	*I*	*II*	*III*	*IV*	*V*
1995					
Jan.	10.5	27.3	24.7	23.7	14.5
Feb.	20.8	25.1	17.3	21.9	9.2
Mar.	12.3	26.0	23.5	19.1	14.9
Apr.	13.5	24.8	22.0	18.6	13.1
May	13.5	26.4	12.0	5.2	3.9
Jun.	17.8	13.3	15.5	20.5	8.3
Jul.	13.5	16.2	22.0	15.7	11.2
Aug.	14.5	14.6	15.2	10.0	9.3
Sep.	19.5	18.9	17.0	13.2	8.6
Oct.	15.3	23.0	30.8	14.0	12.1
Nov.	18.4	24.4	31.2	20.8	15.8
Dec.	15.5	22.5	23.9	21.3	17.6
Mean	15.4	21.2	21.3	16.9	12.4

TRI 2023 had higher starch content than TRI 2025. In both clones starch content increased with age from pruning up to the third year and declined thereafter.

2.5. Effect of resting before pruning on root starch, New Peacock Estate – (1995)

An observation trial was commenced in clone TRI 2023 to investigate the effect of resting prior to pruning on root starch reserves. The root starch content is presented in Table 8.

TABLE 8 – *Starch content (%) of roots*

Treatments	*Root starch (%)*				
	Aug.	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Control (No resting)	25.7	29.0	24.6(P)	20.1	27.4
One month resting	33.5	30.1	26.4(P)	21.1	28.2
Two months resting	29.7	30.3	29.3(P)	22.5	28.4

(P) – pruned

The results suggest that resting helps to improve the root starch content. At the time of pruning in October, bushes rested for two months had the highest root starch content while bushes not rested had the lowest root starch. The yield loss due to resting and gain in yield, if any, during the first year after pruning will be assessed.

2.6. 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 was compared with continuous plucking on root starch. Resting of the plot commenced in September. The root starch content is presented in Table 9.

TABLE 9 – *Starch content (%) of roots*

Treatments	*Root starch (%)*			
	Aug.	*Sept.*	*Oct.*	*Dec.*
Control (No resting)	19.6	13.6	16.7	17.0
Resting	25.8	14.6	23.9	20.5

Though there was monthly variation in the starch content, the rested plot had greater root starch compared to the plots that were continuously plucked.

D. M. S. Navaratne

2.7. C^{14} Studies

Mature leaves of two-year-old pot plants (TRI 2025) were labelled with C^{14}. After 72 hours, about 20% of the C^{14} was found in the original leaf while about 32% was found in the growing shoot above it and only 0.4% was found in the growing shoot of the other branches. No C^{14} was found in the other mature leaves seen below.

V. Shanmugarajah

2.8. Effect of soil moisture and N on photosynthesis and transpiration of nursery plants (TRI 2025)

In this experiment, two soil moisture levels (near field capacity and near permanent wilting point) and three N levels (two in the deficient range and one in the optimum range) were tested on nusery plants. Photosynthesis and transpiration were measured and the water use efficiency was estimated.

The results of the study indicated that photosynthesis and transpiration were higher in the wet treatments. Photosynthesis was highest in the plant with optimum N level. Water use efficiency was highest at the optimum range of N in both dry and wet treatments.

T. Loga

2.9. Effect of age in a pruning cycle on shoot growth and yield of clonal tea, TRI 2025, St. Coombs Estate – (1995)

An investigation was carried out to study the effect of age (1st, 3rd and 5th year after pruning) in a pruning cycle on shoot growth and yield of mature clonal tea (TRI 2025) under up-country conditions.

The results are presented in Table 10.

TABLE 10 – *Photosynthesis parameters*

Maximum Photosythesis rate	4–10 μmoles of CO_2 m^{-2} s^{-1}
Light Saturation Point	400–500 μmoles of Photon m^{-2} s^{-1}
Light Compensation Point	50–75 μmoles of Photon m^{-2} s^{-1}
Base Temperature	12.4°C

Thermal time requirement for an axillary bud to become a pluckable shoot is 350 day degrees. It took about 225–250 day degrees for the fish leaf to unfurl. After that it took approximately 45 day degrees for each leaf to unfurl. Mean amino acid content was highest during the first year (85 mg. g^{-1}) and lowest during the fifth year (57 mg. mg^{-1}). Mean pluckable shoot density was lowest during the first year (26 shoots m^{-2}) and increased towards the third year (45 shoots m^{-2}) but decreased towards the fifth year (30 shoots m^{-2}). Mean shoot weight was highest during the first year and decreased thereafter.

W. M. A. B. Weerasingha

3. Tea Physiology and Potassium Nutrition

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

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

The yield is presented in Table 11.

TABLE 11 – *Effect of N:K ratio on yield (made tea kg ha^{-1})*

Main treatments	*Sub treatments*	*Yield*
(a) Pre–prune	2:1	4127
	1:1	4236
	1:2	4106
	1:3	4629
(b) Post–prune	2:1	4426
	1.1	4162
	1:2	4013
	1:3	4209
(c) Pre– and Post–prune	2:1	4344
	1:1	4151
	1:2	4369
	1:3	4038
LSD (P=0.05)		650
CV (%)		15.5

There was no significant difference in yield with various N:K ratios and different times of applications.

V. Sithakaran

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 in clone TRI 2025. The following treatments were given as foliar application at monthly intervals from November.

1. Control (water spray only)
2. Green Miracle (1%)
3. Green Miracle (1%) + Potassium chloride (1%) + Urea (1%)
4. Potassium chloride (1%) + Urea(1%)

A. Anandacoomaraswamy and V. Sithakaran

4. Modeling Tea yields from Weather Data

Weather measurements (air temperature, relative humidity, solar radiation, wind and soil temperature) continued at three locations, St. Coombs Estate, Court Lodge Estate and Uva Highlands Estate. A detailed canopy photosythesis model was built for tea using the light response curve and canopy light interception curve (canopy extinction coefficient).

A. Anandacoomaraswamy and D. N. S. Navaratne

PLANT PROPAGATION AND PLANT BREEDING DIVISION

Officer-in-Charge – A. R. M. Hassim / V. Shanmugarajah

1. General

Mr A. R. M. Hassim, Acting OIC retired from the services of the Institute on 28 February 1995 and Mr V. Shanmugarajah was appointed as the Acting OIC with effect from 1 March 1995.

Mr J. H. N. Piyasundara was transferred to the Plant Breeding Unit at the Low-country Station, Ratnapura w.e.f from 16th February.

Mrs K. Amarakoon who returned to the Island began her local research component for her Ph.D. programme on 6 January.

Mrs S. U. A. K. Gunasekera was away, on no-pay leave.

Mr M. Ratnayake participated in the annual Training Programme in Experimental Design, Quantitative Genetics and Breeding and Recombinant DNA Technology conducted at the Faculty of Agriculture, University of Peradeniya from 15 August to 5 September.

Two NDT students from Kuliyapitiya Technical College and one from Hardy Technical Institute, Ampara completed their training in this division.

2. Project B/CLON – *The development of new clones*

Project Leader – A. R. M. Hassim / 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)*

The trial was terminated after the selected bushes were vegetatively propagated in 1995.

A. R. M. Hassim, S. Gunasekera, S. W. Gunadasa and S. Umah

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)*

VP 64 and VP 65 – The growth and performance of the seedlings were monitored.

2.1.4. VP 66 – *Evaluation of polyclonal seed – Luckyland Estate, Udapussellawa – (1992)*

Visual assessments of growth and performance were made.

A. R. M. Hassim, M. Ratnayake, S. Umah, S. W. Gunadasa and B. A. Rathnagoda

2.1.5. LVP 49 – *Evaluation of polyclonal seed from Karandupona and Urumiwella seed gardens, St. Joachim Estate, Ratnapura – (1991)*

The yield of the seedlings was monitored and 25,586 cuttings of 536 selected bushes were propagated.

2.1.6. LVP 53 – *Evaluation of polyclonal seed on Hapugastenne Estate – (1991)*

This was plucked by the estate.

2.1.7. LVP 69 – *Evaluation of polyclonal seed from Karandupona and Urumiwella seed gardens in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)*

and

Biclonal (DN x 2025) seed from Hugoland seed garden in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)

The growth of the plants in the field was monitored and a second centering was given.

A. R. M. Hassim, A. K. M. Jayasena, M. Ratnayake, S. W. Gunadasa and J. H. N. Piyasundara

2.1.8. VP 74 – *Evaluation of biclonal seed from E1–Teb seed garden in Uva (DN x 2025) in Field No. 14, St. Coombs Estate, Talawekele – (1995)*

and

Polyclonal seed from Sapumalkande seed garden in St. Joachim Estate, Ratnapura – (1995)

Four hundred and fifteen seedlings were established in three blocks.

A. R. M. Hassim, S. Gunasekera, M. Ratnayake, S. W. Gunadasa, S. Umah and B. A. Rathnagoda

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*

Seven plants each of 26 selections and of control clones were planted in two replicates.

A. R. M. Hassim, S. Gunasekera, S. Umah and B. A. Rathnagoda

4. Testing of clonal progenies (Phase I)

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)*

The bushes were brought into plucking during the last quarter and the yields recorded.

4.1.2. LVP 56 – *Evaluation of clones from VP 37 (St. Coombs) in Field No. 5, St. Joachim Estate, Ratnapura – (1992)*

Of the 107 clones evaluated the yields of the highest yielding 14 clones and the control clones over 33 plucks are given in Table 1.

TABLE 1 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
146	7064
294	6967
241	6750
2027 (control)	6578
2023 (control)	6234
2025 (control)	6189
310	6003
131	5857
304	5837
29	5658
250	5624
282	5595
139	5438
379	5402
39	5385
324	4969
443	4959
2026 (control)	4949

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)*

Of the 166 clones evaluated the yields of the 23 highest yielding clones and those of the control clones over 33 plucks are given in Table 2.

TABLE 2 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
107	10414
163	9322
106	9241
171	9147
150	8836
2026 (control)	8423
60	8337
148	8231
69	8222
133	8143
59	8053
30	7813
144	7783
67	7684
145	7571
68	7562
179	7548
16	7399
142	7348
62	7333
114	7290
176	7222
2023 (control)	7173
2025 (control)	6068
2027 (control)	6040

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)*

Of the 12 clones evaluated the yields of the 6 highest yielding clones along with those of control clones over 33 plucks are given in Table 3.

TABLE 3 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
2027 (control)	7283
1	7176
2023 (control)	6901
2025 (control)	6852
7	5667
2026 (control)	5473
10	4967
12	4539
11	4009
3	3957
S 106 (control)	3411

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)*

Of the 15 clones evaluated the yields of the ten highest yielding clones along with those of control clones over 33 plucks are given in Table 4.

TABLE 4 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
28/4	7754
10/1	7543
4/6	6497
7/7	6029
12/11	5803
22/1	5373
5/6	5139
23/5	5132
26/4	5061
26/1	5042
2027 (control)	7283
2023 (control)	6901
2025 (control)	6852
2026 (control)	5473
S 106 (control)	3411

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 12 highest yielding clones along with control clones over 33 plucks in 1995 are given in Table 5.

TABLE 5 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
18	5009
298	4836
281	4568
65	4332
340	4332
68	4258
2023 (control)	4076
107	4052
109	4010
342	3982
160	3941
2	3875
168	3865
375	3865
374	3824
140	3803
2027 (control)	2730
2025 (control)	2667

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 13 highest yielding clones along with control clones over 33 plucks in 1995 are given in Table 6.

TABLE 6 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
14	4657
66	4609
57	4420
2023 (control)	4360
63	4282
12	4232
64	4225
51	4056
36	4053
11	3971
59	3860
37	3831
55	3819
2025 (control)	3783
13	3615
2027 (control)	3578

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 13 highest yielding clones along with control clones over 33 plucks in 1995 are given in Table 7.

TABLE 7 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
15/18	4812
31/1	4639
30/7	4567
29/10	4545
21/23	4407
29/23	4278
24/6	4263
2027 (control)	4164
2023 (control)	4128
28/37	4117
14/11	4025
28/4	3872
6/10	3819
24/29	3815
14/17	3792
2025 (control)	3413

4.1.9. LVP 64 – *Evaluation of clones from ASM 1988 Introduction seed in Field No. 2A, St. Joachim Estate, Ratnapura – (1993)*

The yields of the 8 clones along with control clones over 33 plucks in 1995 are given in Table 8.

TABLE 8 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
2023 (control)	4611
5D	3925
10D	3807
2025 (control)	3655
12D	2600
18D	2579
11D	2497
19D	2225
16D	2096
6D	1567
2027 (control)	951
LSD (P=0.05)	1.98
CV % = 42.59	

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4.1.10. LVP 66 –*Evaluation of clones from VP 39 in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)*

Height measurements were done and the plants were centered.

4.1.11. LVP 67 – *Evaluation of clones from VP 43 in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)*

Height was measured, plants were centered and fresh weight of the shoots taken.

4.1.12. LVP 68 – *Evaluation of clones from VP 44 in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)*

Plants were centered after the height measurements and fresh weights of shoots were taken.

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 growth of the plants were monitored and were centered twice.

4.1.14. LVP 72 – *Evaluation of clones from VP 39 in Field No. 2A, St. Joachim Estate, Ratnapura – (1994)*

Plants were centered twice at 30 and 40 cm.

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4.2. Up–country

4.2.1. VP 49 – *Evaluation of clones from VP 37 in Lamiliere Division, St. Coombs Estate, Talawakele – (1990)*

Seventy four high yielding clones were propagated in the nursery and are due for planting in the field in 1996.

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)*

The plucking was concluded and the yields of the 15 highest yielding clones along with control clones from January 1992 to December 1995 are given in Table 9.

TABLE 9 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
59	2595
132	2229
449	2059
237	2059
470	2043
A 138	2698
A 12	2406
A 136	2304
A 14	2267
A 15	2151
2025 (control)	3298
2023 (control)	2723
DT 1 (control)	2385
DN (control)	1951

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4.2.3. VP 55 and VP 56 – *Evaluation of clonal selections from Aislaby, Hugoland and Hantane seed (VP 38). Field No. 9, St. Coombs Estate, Talawakele – (1991)*

Plucking was concluded after recording the yield from September 1993 to August 1995 (99 plucking rounds). The yields of some of the highest yielding clones along with controls are given in Table 10.

TABLE 10 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
116	3137
48	2787
42	2733
47	2661
55	2609
58	2600
20	2581
120	2480
76	2466
90	2427
22	2421
50	2394
40	2392
43	2349
125	2291
79	2199
133	2187
118	2178
135	2158
143	2133
98	2120
2025 (control)	1788
2024 (control)	1786
DN (control)	1501

4.2.4. VP 57 – *Evaluation of 'Betjan' Jat clones from Hapugastenne Estate. Field No. 9, St. Coombs Estate, Talawakele – (1991)*

This trial was terminated.

4.2.5. VP 60 – *Evaluation of clones from VP 37. Field No. 10, St. Coombs – (1992)*

Plucking was continued and the yields recorded.

4.2.6. VP 61 – *Evaluation of clones from ASM 1988 Introduced Seed; Field No. 10, St. Coombs Estate, Talawakele – (1992).*

Of the 23 clones evaluated the yields of the 3 highest yielding clones along with control clones from June 1994 to June 1995 (41 plucking rounds) are given in Table 11.

TABLE 11 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
21	2188
9	2059
19	1915
2027 (control)	1869
DT 1 (control)	1843

4.2.7. VP 63 – *Evaluation of clones developed from VP 37 and from Aislaby seed, Venture Estate, Norwood – (1992)*

The yields of the 20 highest yielding clones along with control clones from June 1994 to June 1995 (41 plucking rounds) are given in Table 12.

TABLE 12 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
192	4944
593	4368
A 135	3829
651	3771
147	3667
574	3197
A 20	3183
A 147	3181
264	3166
252	3104
582	3104
A 136	3062
474	2999
629	2928
558	2811
A 17	2785
583	2770
350	2748
148	2743
2025 (control)	2634
268	2596
2027 (control)	2570
DN (control)	1897

4.2.8. VP 67 – *Evaluation of clones from VP 39 in Field No. 10, St. Coombs Estate, Talawakele – (1993)*

The yields of the 5 highest yielding clones along with control clones from June 1994 to June 1995 (41 plucking rounds) are given in Table 13.

TABLE 13 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
49	1696
533	1689
B	1533
501	1485
603	1402
2025 (control)	1358

4.2.9. VP 69 – *Evaluation of clones developed from ASM 1988 Introduction seed in Field No. 10, St. Coombs Estate, Talawakele – (1993)*

Plucking was continued and the yields recorded

4.2.10. VP 70 – *Evaluation of clones from VP 39 in Venture Estate, Norwood – (1993)*

The bushes were brought into plucking.

A. R. M. Hassim, S. Gunasekera and B. Rathnagoda

4.2.11. VP 71 – *Evaluation of clones from VP 39 in Field No. 14, St. Coombs Estate, Talawakele – (1994)*

The plants were centered.

4.2.12. VP 72 – *Evaluation of clones from VP 43 in Field No. 14, St. Coombs Estate, Talawakele – (1994)*

The plants were centered.

4.2.13. VP 73 – *Evaluation of clones from VP 44 in Field No. 14, St. Coombs Estate, Talawakele – (1994)*

The plants were centered.

A. R. M. Hassim, M. Ratnayake, S. Umah and S. W. Gunadasa

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)*

Visual observations of growth were made.

A. R. M. Hassim, M. Ratnayake, M. B. A. Perera and S. Umah

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 were harvested from these plots and issued to estates and smallholders for establishing '4000' series multiplication plots.

5.1.2. VP 62 – *Testing ten 4000 series clones at St. Coombs Estate, Talawakele*

The yields of the clones over 41 plucks from July 1994 to July 1995 are given in Table 14.

TABLE 14 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
2025 (control)	2479
4085	2442
4042	1786
4072	1750
4046	1640
4080	1604
4014	1458
4015	1437
4075	1240
4076	1203
LSD (P=0.05)	16.17
CV % = 20.06	

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5.2. Low-country

5.2.1. LVP 43 – *Testing 42 clones on Diyadawa Estate, Deniyaya – (1990)*

Cuttings were propagated in callussing beds and 8800 cuttings were issued to three estates.

5.2.2. LVP 60 – *Testing nine clones at Golinda Estate, Kegalle*

The yields of the clones along with controls over 36 plucks (from February to December 1995) are given in Table 15.

TABLE 15 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
4042	6095
2023 (control)	5911
4083	5029
4014	4520
4080	4157
4046	4149
4075	3987
2025 (control)	3882
4076	3554
4015	2704
LSD (P=0.05)	1.06
CV% = 52.63	

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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.

A. R. M. Hassim and M. B. A. Perera

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 (from February 1995) are given in Table 16.

TABLE 16 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
3020	2711
2025 (control)	2506
DN (control)	2479
3048	2465
3016	2270
3069	2249
3019	2219
3018	2186
K 145 (control)	2010
3015	1935
3017	1790

6.1.3. *Gordon Estate, Udapussellawa – (1991)*

The yields of the clones over 48 plucks (from July 1994) along with control clones are given in Table 17.

TABLE 17 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
3016	3476
3015	2798
2025 (control)	2640
3017	2135
DT 1 (control)	1858
3018	1402

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)*

Bushes were brought into plucking.

6.1.6. *Venture Estate, Norwood. Field No. 10 – (1993)*

Visual assessment of growth and performance were carried out.

6.1.7. *Sheen Group, Pundaloya Field No. 3 NC 59A – (1992)*

The yields of the clones along with control clones are given in Table 18.

TABLE 18 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
4083	2475
4075	2309
4063	2054
3069	1970
4071	1952
4079	1618
2025 (control)	1618
4052	1534
4078	1478
4072	1189
4076	1041

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6.2. Uva

6.2.1. *Verellapatana Estate – Doomo Division – (1988)*

The yields of the clones along with controls over 53 plucks (from January to November 1995) are given in Table 19.

TABLE 19 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
4046	8900
2025 (control)	8052
4042	8024
3022	7776
3019	5185
3018	4572
3044	1126

M. Ratnayake, S. Umah and S. W. Gunadasa

6.2.2. *Smallholdings in Bandarawela, Hali-ela and Boralanda – (1992)*

Bushes were brought into plucking and visual assessment for drought was carried out.

6.2.3. *TSHDA – Hali–ela – (1992)*

Bushes were brought into plucking.

6.2.4. *Hakgala Estate, Boragas – (1993)*

Periodic assessment of growth was carried out.

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6.3. Mid–country wet zone

6.3.1. *Hantane Estate, Kandy – (1991)*

This trial was given up.

6.3.2. *Smallholdings in Ukuwela, Danture, Teldeniya, Dodanwela and TSHDA nursery Muruthalawa.*

The clones were brought into plucking in the smallholdings in Ukuwela and in TSHDA, Sooriyagoda, Muruthalawa.

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6.4. Low–country

6.4.1. LVP 38 – *Watapotha Estate, Nivitigala – (1988)*

The yields of the clones along with controls over 26 plucks (from 6–7–95 to 28–12–95) are given in Table 20.

TABLE 20 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
2023 (control)	4876
DG 39 (control)	3873
4055	3387
4047	3222
KEN 16/3 (control)	3117
4054	2867
4059	2746
4056	2574
4053	2386
3020	2258
LSD (P = 0.05)	0.70
CV% = 31.15	

6.4.2. LVP 40 – *Noragalla Estate, Nivitigala – (1988)*

The trial was concluded.

The yields of the clones along with controls over 94 plucks (from 8-11-91 to 3-8-94) are given in Table 21.

TABLE 21 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
3069	6346
62/1	3316
3051	3251
2022	3200
2021	3086
NIL 262	2972
2027 (control)	2926
62/6	2886
KP 204	2851
4048	2777
3014	2722
DG 7	2697
S 106	2520
PET 14/4	2341
62/9	2268
KEN 16/3	2237
DG 39	2217
3032	2184
PO 37	2008
3025	1957
3055	1938
H 1/58	1707
3063	1489
3046	1482
62/3	1424
3020	1263
PET 13B/1	1149
3041	1085
4002	1046
PW 55	872
4052	871
PW 39	817
4062	709
4074	524

6.4.3. *Smallholding at Dehiowita*

The yields of the clones along with controls over 26 plucks (from 6–7–95 to 28–12–95) are given in Table 22.

TABLE 22 – *Yield of clones (kg ha^{-1} an^{-1})*

Clone	*Yield*
4061	6793
4053	6172
4055	5912
4059	5291
2023 (control)	5223
4006	4575
2026 (control)	4189
4004	4084
4033	3881
4054	3803
2027 (control)	3756
4024	3720
4049	3233
4048	2666

6.4.4. LVP 65. – *St. Joachim Estate, Ratnapura – Multiplication rows of 4000 series and estate clones.*

The mother bush area was extended by planting 150 plants each of clones TRI 3029, 3035, 4003, 4006, 4052, 4061.

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7. Supply of clonal cuttings

Cuttings of 3000 and 4000 series clones were supplied to estates and small-holdings 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*	*Cuttings/Clone*
3000 Series		
Dunkeld	3013, 3014, 3016, 3017 3019, 3020, 3031, 3049 3052, 3061, 3069, 3072 3073	400 each
Gordon	3013, 3014, 3015, 3016 3017, 3018, 3019, 3020	200 each
Bambarakelly	3013, 3014, 3015, 3016 3017, 3020, 3069	80 – 400 each
Sri Krishna	3049, 3052	400 – 2800 each
Venture	3014, 3020, 3052	800 each
Diyanilakelle	3013, 3015, 3016, 3017 3018, 3027, 3021, 3022 3041, 3042, 3047, 3048 3057, 3019, 3014, 3029 3033	200 – 400 each
Bunyan	3013, 3015, 3016, 3017 3019, 3020, 3049, 3059	100 – 200 each
Gampaha	3013, 3014, 3015, 3016 3017, 3018, 3019	100 – 200 each

Tillyrie	3013, 3014, 3015, 3016 3017	100 each
Blink Bonnie	3013, 3014, 3015, 3016 3017	100 each
Brunswick	3013, 3014, 3015, 3016 3017, 3019, 3020, 3055	100 – 200 each
4000 Series		
Mattakelle	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4085	100 – 800 each
Bambarakelly	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4085	80 – 1200 each
Queensberry	4006, 4034, 4053, 4067 4071, 4078, 4079, 4004	100 – 1000 each
Sri Krishna	4006, 4052, 4053, 4071 4079	400 – 2800 each
Venture	4006, 4052, 4053, 4071 4078, 4079	1200 – 1600 each
Bunyan	4052, 4053, 4067, 4071 4078	60 – 200 each
Gampaha	4043, 4047, 4052, 4053 4070, 4078	100 – 200 each
Dessford	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 – 200 each
Moray	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 – 200 each
Glentilt	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 each

Bogahawatte	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 – 200 each
Ferham	4006, 4034, 4052, 4053 4063, 4067, 4071, 4078 4079, 4083, 4085	100 each
St. Coombs	4006, 4041, 4045, 4047 4052, 4053, 4054, 4055 4063, 4071, 4078	100 each
Greenwood	4042, 4046, 4047, 4052 4053	100 – 200 each
St. Clair	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4085	100 each
Mousakelle	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4085	100 each
Tillyrie	4034, 4052, 4053, 4063 4067, 4071, 4083	100 each
Hapugastcnnc	4034, 4052, 4053, 4063 4067, 4071	100 each
Blink Bonnie	4034, 4052, 4063, 4067 4071, 4083	100 each
Brunswick	4052, 4053, 4067, 4071 4078, 4079	100 – 200 each
Strathspey	4034, 4052, 4053, 4063 4067, 4071, 4078, 4079 4085	100 each
Hapugastenne	4034, 4052, 4053, 4067 4071, 4078, 4079	120 each

7.2. Low-country

3000 Series

TSHDA, Agalawatte	3014, 3047, 3069	400 – 1200 each
Smallholder, Galle	3048, 3052	400 – 1200 each
Kiruwanaganga	3033	880
TRI, Kottawa	3022, 3041, 3051, 3058 3069	300 – 400 each

4000 Series

TSHDA, Agalawatte	4004, 4006, 4049, 4053 4055, 4061	400 – 800 each
Smallholder, Galle	4006, 4052, 4053, 4063	600 – 2400 each
Enselwatte	4059, 4055, 4053, 4018 4036, 4061, 4024, 4002 4054, 4004, 4049, 4052	800 – 1200 each callused cuttings
Beverley	4049, 4055, 4018, 4036	400 callused cuttings
Kiruwanaganga	4006, 4061, 4018, 4054 4024, 4059, 4002, 4053 4055, 4052, 4036, 4004 4049	700 – 3200 each
TRI, Kottawa	4004, 4006, 4024, 4033 4047, 4054	400 each

7.3. Mid-country

3000 Series

Alagolla	3013, 3014, 3015, 3017 3018, 3019, 3020, 3025 3069	100 each
Loolecondera	3013, 3014, 3015, 3017 3018, 3019, 3020, 3069	100 – 400 each

4000 Series

Deltota	4006, 4046, 4047, 4053 4055, 4061, 4071	100 – 400 each
Greenwood	4047, 4042, 4046, 4053 4052, 4070, 4071, 4078	60 – 800 each
Nagastenne	4006, 4047	200 each
Alagolla	4006, 4042, 4046, 4047 4053, 4070, 4071, 4078	100 – 400 each
Loolecondera	4042, 4046, 4047, 4052 4053, 4070, 4071	100 – 400 each

7.4. Uva

Ampitikande	4042, 4046, 4047, 4053 4070, 4071, 4078	100 each

SOILS AND PLANT NUTRITION DIVISION

Head – G. D. Wimaladasa

1. General

Mr S. W. Wijethunge was promoted as Experimental Officer with effect from 1st October 1995.

The following students underwent a training programme on the analysis of soil, plant and fertilizer samples; Messrs B. P. G. Sandanayake and W. A. N. N. Karunaratne, NDT Trainees, Kuliyapitiya (four months) commencing from April and November, respectively; Messrs C. R. Puhambugoda and S. C. P. Wijerathna, NDT trainees of Hardy Institute (four months) commencing from early July; Mr D. G. M. Shanthadeva, final year student, Aquinas College (six months) beginning from July.

Mr P. Gopal Raj, final year Chemistry student from the University of Peradeniya, underwent a six weeks work programme on Instrumentation in relation to analysis of soil, plant and fertilizer samples from May.

Ms B. Anjelika, an undergraduate trainee from the Soil Science Department, University of Jaffna, underwent her 500 series, 5–months research project entitled "The variation of mineral composition in 2000, 3000 and 4000 clonal series in relation to leaf maturity" from the 1st week of August.

2. Project B/FERT – *Improvement and maintenance of fertility and productivity of tea soils*

Project Leader – G. D. Wimaladasa

The overall research objective of this division is to improve the fertility of Sri Lankan tea lands by efficient use and/or control of both organic and inorganic fertilizers, and by soil borne native nutrient reserves to improve the productivity of the tea crop.

Field investigations are reported under Project B/FERT while laboratory and glasshouse studies under Project D/AGCH. Developments in soil/plant chemical aspects and analysis of soil, plant and fertilizer samples received from both private and public sector tea estates are 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 in the 3rd year of the 4th cycle is given in Table 1.

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* *SA (N)*	*Urea (N)*	*Yield* (*made tea kg ha^{-1} yr^{-1}*)
240	100	0	2277
	75	25	2485
	50	50	2374
	25	75	2391
	0	100	2340
360	100	0	2746
	75	25	2564
	50	50	2670
	25	75	2498
	0	100	2654
LSD (P = 0.05)			311
CV %			7

Applicaion of N at 360 kg ha^{-1} yr^{-1} increased the yield significantly, compared to 240 kg ha^{-1} yr^{-1}, but no significant yield differences were found between any of the treatment combinations. However the yield increase from 240 kg N to 360 kg N did not reach the potential yield for an application of 360 kg N.

The effect of application of SA/urea on sulphur status of both mature leaves and soil (0-15 and 15-30 cm) are given in Tables 2 and 3 respectively.

TABLE 2 – *Effect of application of different proportions of SA/urea on sulphur status of mature leaf*

Level of N (*kg ha^{-1} yr^{-1}*)	*Proportions (%) of* *SA (N)*	*Urea (N)*	*Leaf S (%)*
240	100	0	0.23
	75	25	0.21
	50	50	0.24
	25	75	0.24
	0	100	0.23
360	100	0	0.21
	75	25	0.22
	50	50	0.21
	25	75	0.21
	0	100	0.22
LSD (P = 0.05)			0.029
CV %			8

No consistent differences in mature leaf S concentrations were observed, although the differences of some treatment means were greater than the LSD value.

TABLE 3 – *Effect of application of different proportions of SA/urea on sulphur status (mg kg^{-1} soil) in soil at 0–15 and 15–30 cm depths*

Level of N	*Proportions (%) of*		SO_4^{2-} –S (mg kg^{-1} soil)	
(kg ha^{-1} yr^{-1})	*SA (N)*	*Urea (N)*	*0-15 cm*	*15-30 cm*
240	100	0	123	246
	75	25	114	118
	50	50	85	101
	25	75	50	178
	0	100	58	81
360	100	0	172	270
	75	25	122	219
	50	50	95	84
	25	75	55	73
	0	100	58	67
LSD (P = 0.05)			26	47
CV %			16	19

The SO_4^{2-} –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. This trend was not observed in the foliage (Table 2). This experiment is in progress.

S. Ananthacumaraswamy and G. D. Wimaladasa

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 adverse effects of high levels of nitrogen. The yield obtained for the period December 1994 to November 1995 i.e. 5th year of the 1st cycle is given in Table 4.

TABLE 4 – *Effect of application of very high levels of urea and SA on yield of tea*

Nitrogen (kg ha^{-1} yr^{-1})	*Yield (made tea kg ha^{-1} yr^{-1})*	
	Urea	*SA*
0	2028	1768
300	2149	1751
600	2148	1927
900	2585	2379
1200	2336	2585
1500	2584	2709

Although no clear trend was observed either with increasing levels of nitrogen or with the source, the yield increase from 0 to 1500 kg ha^{-1} yr^{-1} N with SA is almost double (941 kg ha^{-1}) the yield increase obtained with urea (556 kg ha^{-1}).

This experiment is in progress.

G. P. Gunaratne and G. D. Wimaladasa

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 5th year of the 1st cycle is presented in Table 5.

TABLE 5 – *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	2512	2480	2352	2197
Cow dung	2613	2360	2332	2476
Mana	2470	2563	2478	2357
Gautemala	2388	2280	2345	2386
Control 1 (no fertilizer and organic manure addition)	2446			
Control 2 (no organic manure addition)	2322			
LSD (P = 0.05)	NS			
CV %	6			

No overall effect was observed due to application of N and/or organic matter this year.

This experiment is in progress.

A. K. N. Zoysa, S. M. Dissanayake and G. D. Wimaladasa

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 3rd year of the 1st cycle is given in Table 6.

TABLE 6 – *Effect of different levels of nitrogen with and without compost on yield*

Treatments *N Level*	*Yield (made tea kg ha^{-1} yr^{-1})* *No compost*	*5 t compost*
0	1860	1800
120	2269	2435
240	2226	2278
360	2364	2316
480	2400	2393
600	2206	2228
720	2317	2309
LSD (P = 0.05)	NS	
CV %	4	

No significant difference in yield was found as a result of the incorporation of compost with any of the N levels applied. It is to be noted that the application of 120 kg ha^{-1} yr^{-1} N increased the yield by about 635 and 409 kg ha^{-1} yr^{-1} with and without compost respectively over the control N plots that received no nitrogen.

This experiment is in progress.

R. G. A. Wijayawardhana and G. D. Wimaladasa

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 5th year of the 1st cycle is presented in Table 7.

TABLE 7 – *Effect of split application of potassium on yield of tea*

K fertilizer applied (%) *Initially*	*6 weeks after*	*Yield (made tea kg ha^{-1} yr^{-1})* *K – Fertilizer (kg K_2O ha^{-1} yr^{-1})* *120*	*240*
100	0	2119	2179
80	20	2437	2370
60	40	2196	2401
40	60	2288	2347
20	80	2163	2180
0	100	2159	2286
LSD (P = 0.05)		269	
CV %		8	

There was no clear effect of split application of K fertilizer on the yield even after 5 years from commencement.

This experiment is in progress.

G. P. Gunaratne and G. D. Wimaladasa

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 programme. The investigations have been concluded and the results will be made available once the thesis is 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 and the soil pH obtained in the 3rd year of the 3rd cycle are given in Tables 8 and 9 respectively.

TABLE 8 – *Effect of application of increasing levels of potassium (kg K_2O $ha^{-1}y^{-1}$) with two nitrogen sources on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})*
1. Main	
N 240	2565
N 360	2642
LSD (P = 0.05)	NS
CV %	9
2. Sub (K_2O)	
K 60	2555
K 120	2541
K 180	2592
K 240	2583
K 300	2622
K 360	2730
LSD (P = 0.05)	149
CV %	9
3. Sub – Sub	
Urea	2580
SA	2627
LSD (P = 0.05)	NS
CV %	9

During this year, there was no significant increase in yield between the two levels of N (240 to 360 kg N ha^{-1} yr^{-1}) and the sources.

Even though no general trend in yield increase was observed with increasing levels of Potassium, the yield obtained at 360 kg K_2O ha^{-1} yr^{-1} was significantly greater than that obtained at either 60 or 120 kg K_2O ha^{-1} yr^{-1}.

TABLE 9 – *Effect of application of increasing levels of potassium (kg K_2O $ha^{-1}yr^{-1}$) with two nitrogen sources on soil pH*

Treatments	*pH*
1. Main	
N 240	4.52
N 360	4.34
LSD (P=0.05)	0.102
CV %	6
2. Sub (K_2O)	
K 60	4.44
K 120	4.41
K 180	4.33
K 240	4.45
K 300	4.40
K 360	4.57
LSD (P = 0.05)	0.177
CV %	6
3. Sub – Sub	
Urea	4.82
SA	4.04
LSD (P = 0,05)	0.102
CV %	6

Soil pH values significantly decreased with increasing levels of N from 240 to 360 kg ha^{-1} yr^{-1}, and with the sources. There was no significant effect of application of increasing levels of potash on soil pH.

This experiment is in progress.

G. P. Gunaratne and G. D. Wimaladasa

2.2.4. Effect of application of potash (48 to 480 kg K_2O ha^{-1} yr^{-1}) with and without Mg (0 and 60 kg MgO ha^{-1} yr^{-1}) fertilizer, on soil/plant K/Mg status and yield of tea, Glenanore Estate, Haputale, clone TRI 2025–(1991)

The yield obtained in the 4th year of the 1st cycle is given in Table 10.

TABLE 10 – *Effect of different N:K_2O ratios and MgO on yield of tea*

Main treatments N	K_2O (kg ha^{-1} yr^{-1})	MgO	N:K_2O	Yield (made tea kg ha^{-1} yr^{-1})
240	48	0	5:1	3373
240	48	60	5:1	3142
240	60	0	4:1	3160
240	60	60	4:1	3183
240	80	0	3:1	3354
240	80	60	3:1	3215
240	120	0	2:1	3096
240	120	60	2:1	3296
240	240	0	1:1	3212
240	240	60	1:1	3206
240	360	0	2:3	3239
240	360	60	2:3	3247
240	480	0	1:2	3254
240	480	60	1:2	3158
LSD (P=0.05)				NS
CV %				6

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 of MgO on soil K status at two soil depths*

Level (kg ha^{-1} yr^{-1}) N	K_2O	MgO	N:K_2O	Soil K (mg kg^{-1}) 0–15 cm	15–30 cm
240	48	0	5:1	132	145
240	48	60	5:1	126	119
240	60	0	4:1	121	115
240	60	60	4:1	138	135
240	80	0	3:1	116	138
240	80	60	3:1	141	153
240	120	0	2:1	137	160
240	120	60	2:1	134	146
240	240	0	1:1	188	181
240	240	60	1:1	203	196
240	360	0	2:3	239	244
240	360	60	2:3	214	197
240	480	0	1:2	275	215
240	480	60	1:2	226	264
LSD (P = 0.05)				63	72
CV %				29	33
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				173	173
60				169	171
LSD (P = 0.05)				NS	NS
CV %				29	33

Ground application of potash beyond 120 kg ha^{-1} yr^{-1} increased the soil K levels at both depths. Soil K levels were not affected by the application of MgO at 60 kg ha^{-1} yr^{-1}.

TABLE 12 – *Effect of different N:K_2O ratios and of 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*	*0–15cm*	*15–30cm*
240	48	0	5:1	118	87
240	48	60	5:1	136	93
240	60	0	4:1	95	79
240	60	60	4:1	122	96
240	80	0	3:1	52	63
240	80	60	3:1	100	87
240	120	0	2:1	106	56
240	120	60	2:1	97	88
240	240	0	1:1	107	90
240	240	60	1:1	102	67
240	360	0	2:3	56	47
240	360	60	2:3	116	92
240	480	0	1:2	110	73
240	480	60	1:2	114	77
LSD (P = 0.05)				54	46
CV %				42	46
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				92	86
60				112	71
LSD (P=0.05)				20	NS
CV %				42	46

Soil Mg levels at 0-15 cm depth were increased due to ground Mg fertilizer application at 60 kg ha^{-1} yr^{-1} compared to the control, but only up to the level of 120 kg K_2O ha^{-1} yr^{-1} .

The effect of N:K_2O ratios and of MgO on leaf Mg and K is given in Table 13.

TABLE 13 – *Effect of different $N:K_2O$ ratios and of 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	1.33	0.25
240	48	60	5:1	1.31	0.29
240	60	0	4:1	1.21	0.29
240	60	60	4:1	1.30	0.29
240	80	0	3:1	1.17	0.28
240	80	60	3:1	1.28	0.30
240	120	0	2:1	1.31	0.27
240	120	60	2:1	1.34	0.38
240	240	0	1:1	1.38	0.29
240	240	60	1:1	1.37	0.29
240	360	0	2:3	1.32	0.28
240	360	60	2:3	1.46	0.30
240	480	0	1:2	1.40	0.27
240	480	60	1:2	1.43	0.31
LSD (P = 0.05)				0.17	0.078
CV %				10	21
Sub treatments					
MgO (kg ha^{-1} yr^{-1})					
0				1.30	0.28
60				1.36	0.31
LSD (P = 0.05)				NS	0.029
CV %				10	21

Mg concentration in the foliage was increased with the ground Mg fertilizer application at the rate of 60 kg ha^{-1} yr^{-1}. However, foliar K levels were unaffected by the ground Mg fertilizer application.

This experiment is in progress.

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 4th year of the 1st 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 ratio*	*(made tea kg ha^{-1} yr^{-1})*
100	100	1:1	1694
200	100	2:1	1834
300	100	3:1	1811
400	100	4:1	1971
500	100	5:1	1826
100	300	1:3	1829
200	300	2:3	1794
300	300	3:3	1839
400	300	4:3	1783
500	300	5:3	1936
100	500	1:5	1763
200	500	2:5	1819
300	500	3:5	1791
400	500	4:5	1794
500	500	5:5	1844
LSD (P = 0.05)			206
CV %			10

No overall consistent pattern in yield was observed due to ground application of N and K fertilizers at 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 was no yield increase with the application of increasing levels of either N and/or K fertilizers.

This experiment is in progress.

A. Wijayawardhana 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 is given in Table 15.

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	2700
20	2547
40	2565
60	2756
80	2551
100	2539
120	2735
LSD (P = 0.05)	NS
CV %	9

Application of increasing levels of phosphate fertilizer (ERP) did not have a significant effect on yield.

This experiment is in progress.

S. Wijethunge and S. Ananthacumaraswamy

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 1st year of the 1st cycle is given in Table 16.

TABLE 16 – *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	4892	4553
20	4643	4635
40	4675	4653
60	4659	4617
80	4653	4648
100	4695	4684
120	4668	4648
LSD (P = 0.05)	NS	
CV %	6	

No differences in yield were observed due to either the rates of P or mode of application i.e. surface applied or soil incorporated.

This experiment is in progress.

A. K. N. Zoysa and S. Wijethunge

2.3.3. Effect of foliar application of phosphorus (0, 0.5, 0.75, 1.00 and 2.00 % DAP and TSP) on plant P status, quality (biochemical parameters) and yield of tea, St. Coombs Estate, Talawakele, clones DT 1 and CY 9– (1992)

The yield obtained from December 1994 to September 1995 is presented in Table 17. The harvested flush samples were subjected to miniature manufacture and assessed for biochemical/quality parameters. However, in general, no marked effect of foliar P application was observed on quality and leaf P content. Therefore the above concentrations were modified to 1, 2, 3 and 4% with effect from September 1995.

TABLE 17 – *Effect of foliar application of phosphate on yield*

Treatments	*Yield (made tea kg ha^{-1} yr^{-1})* Clone	
	CY 9	DT 1
Control	2343	2217
0.5% TSP	2174	2166
0.75% "	2465	2092
1.0% "	2083	2177
2.0% "	2259	2063
0.5% DAP	2124	2054
0.75% "	2193	2548
1.0% "	2250	2017
2.0% "	2778	2043
LSD (P = 0.05)	538	408
CV %	10	8

No consistent differences in yield were observed although the differences of some mean yields were greater than the LSD value, particularly where DAP was applied.

A. Wijayawardana and G. D. Wimaladasa

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 18.

TABLE 18 – *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	3558
15	3371
30	3431
45	3588
60	3183
75	3391
LSD (P = 0.05)	NS
CV %	8

No significant differences in yield were observed due to different Mg fertilizer rates.

The effect of kieserite on soil Mg levels is given in Table 19.

TABLE 19 – *Effect of increasing levels of kieserite on soil Mg levels at two soil depths*

Level of kieserite (kg MgO ha^{-1} yr^{-1})	*Soil Mg (mg kg^{-1})*	
	0–15 cm	*15–30 cm*
0	89	73
15	84	84
30	93	103
45	104	111
60	157	127
75	232	189
LSD (P = 0.05)	101	74
CV %	53	43

The soil Mg levels increased markedly with the elevation of Mg fertilizer rates.

S. Wijethunge, S. Ananthacumaraswamy and G. D. Wimaladasa

2.4.2. Application of increasing levels of dolomite fertilizer at three frequencies (cycle, mid and yearly basis) on soil/plant nutrient status and yield of tea, Field No. 4, St. Coombs Estate, Talawakele, clone TC 9–(1989)

The yield obtained in the 1st year (June to December 1995) of the 2nd cycle is given in Table 20.

TABLE 20 – *Effect of increasing levels of dolomite (kg ha^{-1} yr^{-1}) application on yield*

Level of dolomite (kg ha^{-1})	*Yield (made tea kg ha^{-1} yr^{-1}) Frequency of dolomite application*		
	Cycle	*Mid-cycle*	*Yearly*
0	1486	1486	1486
1250	1452	1427	1500
2500	1395	1508	1393
5000	1404	1360	1353
10000	1345	1349	–
LSD (P = 0.05)		158	
CV %		9	

No marked differences in yield were observed due to both the levels and the frequency of dolomitic limestone application.

This experiment is in progress.

2.4.3. Application of increasing levels of dolomite fertilizer at three frequencies (cycle, mid and yearly basis) on soil/plant nutrient status and yield of tea, Field No. 2, Morogolla Estate, Imaduwa, clone TRI 2025–(1990)

The yield obtained in the 2nd year of the 2nd cycle is shown in Table 21.

TABLE 21 – *Effect of increasing levels 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	3725	3725	3725
1000	3789	3827	3859
3000	3764	3844	3768
5000	3915	3820	3726
LSD (P = 0.05)		167	
CV %		3	

Even 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.

L. S. K. Hettiarachchi, H. A. P. Warnasiri and G. D. Wimaladasa

2.4.4. Effect of different particle sizes of applied dolomite fertilizer on soil pH, soil/plant Mg status and yield of tea, Mattakelle Estate, Talawakele, clone TRI 2023–(1991)

The yield obtained in the 4th year of the 1st cycle is given in Table 22.

TABLE 22 – *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})*				
	2568	2386	2318	2718	2700
LSD (P = 0.05)			334		
CV %			9		

* Presently recommended particle size

No consistent pattern in yield was observed due to application of dolomitic limestone with different particle size combinations.

The effect of different particle size combinations of dolomite on soil Mg status is given in Table 23.

TABLE 23 – *Effect of different sizes (BS) of dolomite particles on soil Mg status*

	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})				
	146	128	80	137	104
LSD (P = 0.05)			67		
CV %			46		

* Presently recommended particle size

No significant differences in soil Mg levels were found due to application of dolomitic limestone with these different particle size combinations.

This experiment is in progress.

L. S. K. Hettiarachchi and H. A. P. Warnasiri

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 1st 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})				
	1334	1308	1346	1431	1306
LSD (P = 0.05)			164		
CV %			9		

* Presently recommended particle size

No consistent pattern in yield was observed due to application of dolomitic limestone with different particle size combinations.

TABLE 25 – *Effect of different sizes (BS) of dolomite particles on soil Mg status*

	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})				
	60	72	60	56	87
LSD (P = 0.05)			31		
CV %			33		

* Presently recommended particle size

No significant differences in soil Mg levels were found due to application of dolomitic limestone with these different particle size combinations in this site as well.

L. S. K. Hettiarachchi, H. A. P. Warnasiri and G. D. Wimaladasa

2.4.6. Effect of application of potassium and/or magnesium from Sul–Po–Mag and kieserite at 2 levels of N on soil/plant nutrient status and yield of tea, Kiruwanaganga Estate, Galle, clone TRI 2025–(1993)

The yield obtained in the 2nd 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)	4592	4915
U 709 + Kieserite	4636	4636
U 750 Sul–Po–Mag	4896	4767
UT Mix. (Urea & SA)	5261	4657
T 1130 (SA)	5287	4894
LSD (P = 0.05)	NS	
CV %	48	

No significant differences in yield were observed due to application of either Mg enriched fertilizer mixtures or two levels of nitrogen.

TABLE 27 – *Effect of application of potassium and/or magnesium from kieserite and Sul–Po–Mag on soil Mg at two soil depths*

Treatments	*N level (kg ha^{-1} yr^{-1})*	*Soil Mg (mg kg^{-1})*	
		0–15 cm	*15–30 cm*
U 709 (Urea)	240	9.5	6.8
U 709 + Kieserite	240	24.3	14.5
U 750 Sul–Po–Mag	240	10.3	7.8
UT Mix. (Urea & SA)	240	9.0	5.8
T 1130 (SA)	240	11.0	7.5
U 709 (Urea)	360	8.0	6.0
U 709 + Kieserite	360	14.0	11.3
U 750 Sul–Po–Mag	360	17.8	14.0
UT Mix. (Urea & SA)	360	9.5	6.8
T 1130 (SA)	360	8.0	6.5
LSD (P = 0.05)		8.65	6.06
CV %		49	48

No overall increases in soil Mg levels were observed due to the addition of Mg enriched NPK fertilizer mixtures such as U 709 + kieserite and U 750 Sul-Po-Mag.

This experiment is in progress.

L. S. K. Hettiarachchi, S. M. Dissanayake and G. D. Wimaladasa

2.4.7. The effect of application of potassium and/or magnesium nutrition 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 2nd year of the 1st cycle and the soil Mg levels are presented in Tables 28 and 29 respectively.

TABLE 28 – *Effect of application of potassim 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)	3377	3714
U 709 + Kieserite	3495	3295
U 750 Sul–Po–Mag	3496	3250
UT Mix. (Urea & SA)	3452	3294
T 1130 (SA)	3576	3474
LSD (P = 0.05)	NS	
CV %	10	

No significant increase 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*

Treatments	*Soil Mg (mg kg^{-1})*			
	Without dolomite		*With dolomite*	
	0–15 cm	*15–30 cm*	*0–15 cm*	*15–30 cm*
U 709 (Urea)	34.5	22.8	48.0	32.0
U 709 + Kieserite	36.3	24.8	42.5	29.3
U 750 Sul-Po-Mag	34.5	23.8	63.5	38.0
UT Mix. (Urea & SA)	27.5	20.3	40.5	24.0
T 1130 (SA)	40.5	25.3	37.0	27.3

LSD (P = 0.05) at 0–15 cm depth = 29.34
CV % 50

LSD (P = 0.05) at 15–30 cm depth = 16.94
CV % 44

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.

L. S. K. Hettiarachchi and S. Wijethunge

2.4.8. Effect of application of potassium and/or magnesium (U 709, U 709+Kie, U 750, UT Mix & T 1130 & 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 1st 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)	2582	2466
U 709 + Kieserite	2394	2733
U 750 Sul-Po-Mag	2613	2902
UT Mix. (Urea & SA)	2677	2541
T 1130 (SA)	2504	2710

LSD (P = 0.05) 252
CV % 6

No significant yield differences were found due to the application of different fertilizer mixtures with or without Mg. Further, no consistent trend was observed with 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 two soil depths*

Treatments	*N Level (kg ha^{-1} yr^{-1})*	*Soil Mg (mg kg^{-1})*	
		0–15 cm	*15–30 cm*
U 709 (Urea)	240	22.7	25.0
U 709 + Kieserite	240	31.7	21.3
U 750 Sul–Po–Mag	240	24.7	30.3
UT Mix. (Urea & SA)	240	20.3	27.3
T 1130 (SA)	240	31.3	29.7
U 709 (Urea)	360	51.0	61.3
U 709 + Kieserite	360	47.7	66.7
U 750 Sul–Po–Mag	360	68.0	25.7
UT Mix. (Urea & SA)	360	17.3	32.7
T 1130 (SA)	360	20.0	25.0
LSD (P = 0.05)		NS	NS
CV %		63	38

Although Mg enriched NPK mixtures were applied in this trial, so far no differences in soil Mg levels were observed.

This experiment is in progress.

L. S. K. Hettiarachchi and S. M. Dissanayake

3. Project D/AGCH – *Divisional Activities*

3.1 High Forest Estate problem, clone TRI 2025 – Die-back of shoots

The details of the problem were given in the *Annual Report for* 1994.

Three plots (50 bushes/plot), i.e. 02 affected and 01 unaffected were marked out in the above field (No 18A). Dolomite was applied to two affected plots at the rate of 2000 kg ha^{-1} in order to see the improvement of soil pH and thereby to eliminate suspected Mn toxicity.

Periodically, soil and leaf samples were collected from the affected and relatively unaffected areas in this field and analyzed. Some of the data in relation to soil/plant nutrient status are given in Table 32.

TABLE 32 – *Some chemical parameters of the soil in the affected and unaffected areas of Field No. 18A at two depths*

Pre-treatment analysis

Sample description

Soil	*Cu* ppm	*Zn* ppm	*Mn* ppm	*pH*
Affected (0–15 cm)	3.96	1.19	1.69	4.75
Affected (15–30 cm)	1.24	1.28	1.60	4.65
Unaffected (0–15 cm)	1.68	1.20	2.92	4.70
Unaffected (15–30 cm)	0.70	1.10	1.92	4.80

Post-treatment analysis (05 months after dolomite application)

Sample description

Leaf	*Cu* ppm	*Zn* ppm	*Mn* ppm	*Al* ppm	*EC* µs/cm	*pH*
Affected (0–15 cm)	1.73	2.89	2.99	140	124	4.7
Affected (15–30 cm)	1.31	1.70	3.05	140	105	4.7
Unaffected (0–15 cm)	0.84	2.05	2.77	203	123	4.6
Unaffected (15–30 cm)	0.62	1.09	2.60	195	141	4.3

Sample description

	Cu ppm	*Zn* ppm	*Mn* ppm	*Al* ppm	*K* %
Affected mature leaf	14	12	132	2362	1.61
Unaffected mature leaf	18	11	139	2865	1.8

However so far no firm observations were made to eliminate the above toxicity either.

This study is in progress.

3.2. Soil and Plant Sulphur Survey

Soil and plant sulphur survey was commenced in July 1995 to assess soil and plant sulphur nutrient reserves in low, mid, up and Uva tea growing regions. About 4–5 tea estates from each region i.e. Kottawa, Deniyaya, Passara and Ratnapura were selected, where solely urea-based fertilizer mixtures such as U 709 and U 346 were used for the past ten years or more. Soils at 0–15 and 15–30 cm depths and mature leaf samples were also collected from the selected fields of the above mentioned regions.

A range of extractants were used in this study in order to assess different forms of sulphur present in the soil and thereby to relate with leaf S levels and to establish the most suitable method of extraction as well.

The soil S levels obtained from each extractant are given in Table 33. Mature leaf sulpur concentrations varied from 0.2 to 0.45%.

TABLE 33 – *The sulpur ranges in tea soils extracted by different extractants*

Extractant	*So_4^{2-}–S range (mg kg^{-1})*
H_2O	5 – 102
KCl	1 – 96
CH_3COONH_4	9 – 317
$NaHCO_3$	25 – 1606
$Ca(H_2PO_4)_2$	3 – 265

This study was completed and is being prepared for publication.

S. Ananthacumaraswamy

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	272	181	186	639
Phosphorus	216	400	176	792
Potassium	257	407	181	845
Magnesium	371	505	207	1083
Calcium	–	05	–	05
Zinc	06	04	14	24
CEC	–	12	–	12
Sulphur	–	262	–	262
Moisture	4	2	–	6
Mesh size	311	5	–	316
Biuret	03	–	–	03
Copper	03	–	–	03
pH	–	1673	–	1673
Carbon	–	1310	–	1310
Manganese	–	10	–	10
Sand	05	–	–	05
Boron	–	03	–	03
Iron	–	–	14	14
Aluminium	–	20	14	34
EC	–	05	–	05
Total	1448	4804	792	7044

G. P. Gunaratne, A. Wijayawardhana, W. M. S. Wijethunge, H. A. P. Warnasiri and S. M. Dissanayake

5. Meetings/Seminars/Workshops

Mrs S. Ananthacumaraswamy, Dr L. S. K. Hettiarachchi and Mr A. K. N. Zoysa attended a seminar on "Creative Thinking" organized by the Soil Science Society of Sri Lanka at the PGIA, Peradeniya on 27th January.

Dr L. S. K. Hettiarachchi delivered a talk on "Recent advances in the knowledge of secondary and micro nutrients in mature tea in Sri Lanka" in Colombo on 2nd February.

Dr L. S. K. Hettiarachchi and Mr Kapila Zoysa attended a five day International workshop on "Direct application of Phosphate Rock and Appropriate Technology in Asia; What Hinders Acceptance and Growth" organized by the International Fertilizer Development Center and IFS Hantane, from February 20th to 24th at IFS, Kandy.

Mrs S. Ananthacumaraswamy delivered a talk on "Fertiliser Use in Tea" to the TSHDA extension staff at TRI substation, Hantane on 28th April.

Dr L. S. K. Hettiarachchi delivered a talk on "Micro nutrients status in Tea" at Ramada Renaissance Hotel, Colombo, on 15th June.

Dr L. S. K. Hettiarachchi attended the 08th meeting of the 'Working group on fertilizer', held at the Sri Lanka Standards Institution, Colombo, on 26th June.

Dr L. S. K. Hettiarachchi attended the 1st workshop on the 'Composite Approach of Decision Making in Agricultural Research (CADMAR)' i.e. Identification of problems and constraints affecting the tea industry in Sri Lanka, organised by the GTZ – CARP Agricultural Research Management Project in collaboration with TRI, held at SLAAS Auditorium on 5th August.

Drs G. D. Wimaladasa and L. S. K. Hettiarachchi, Mr A. K. N. Zoysa and Mrs S. Ananthacumaraswamy attended the 26th Annual General Meeting of the Soil Science Society of Sri Lanka, held at SLAAS Auditorium on 25th August.

Dr L. S. K. Hettiarachchi attended a meeting organised by the Board of Study of Soil Science of the PGIA on the restructuring of the soil science courses at PGIA Board room on 26th October.

Dr G. D. Wimaladasa served as a Panel Advisor at the seminar on 'Good Tea, Good Crop and Good quality' organised by PA on 27th October at SLTB Auditorium.

Dr G. D. Wimaladasa delivered a talk on 'Fertilizer use in tea' at the series of seminars organised by NFS for Agricultural Officers in the Kandy region on 10th November at Gannoruwa Agricultural Station.

Dr L. S. K. Hettiarachchi, attended a workshop on 'Soil & Water resources management on tea estates', organised by the BNF project in collaboration with UMWP–FORLUMP at IFS, Kandy on 12th November.

Drs G. D. Wimaladasa and L. S. K. Hettiarachchi, Mr G. P. Gunaratne and Mrs S. Ananthacumaraswamy attended the Post Graduate Institute Seventh Annual Congress, held at PGRC Auditorium on 16th and 17th November.

Dr L. S. K. Hettiarachchi delivered a talk on 'Fertiliser Use in Tea' at the series of seminars organised by NFS for Agricultural Officers in the Kalutara region on 23rd November at Bombuwala Agricultural Research Station.

Mr H. A. P. Warnasiri, Technical Assistant of this Division attended an IFS (Sweden) sponsored workshop on 'Scientific Instrumentations Repair' at PGRC, Peradeniya from 28th November to 9th December.

Dr L. S. K. Hettiarachchi delivered a talk on 'Fertiliser Use in Tea' to the Superintendents of the Watawala Plantations Ltd at TRI Auditorium on 13th December.

Dr G. D. Wimaladasa attended a meeting on the 'Use of Eppawella Rock Phosphates' organised by Lanka Phosphate Limited in Colombo on 22nd December.

6. Visitors

Mr R. M. Dias, General Manager (Tea), Kotagala Plantations Ltd visited the division on 19th July to discuss fertilizer related matters.

Dr S. Ramarethinam, Executive Director, T. Stanes & Company Limited, India and Mr S. Narangoda, Managing Director of Lanka Agro Systems (Pvt) Ltd visited the division on 23rd August to discuss the use of some of their products in relation to tea fertilizers.

Dr Gerry Hagstrom from IMC U. S. A. visited the division on 27th November to discuss the performance of Sul–Po–Mag fertilizer trials that are partially financed by IMC.

TECHNOLOGY DIVISION

Head – M. T. Ziyad Mohamed

1. General

The Technologist was appointed as Actg. Deputy Director Research with effect from 22nd February 1995. Mr S. Koneswaramoorthy spent four months at the Royal Institute of Technology (KTH), Stockholm, Sweden commencing March as part of his post-graduate studies.

Mr W. C. A. de Silva, Consultant, Process Technology left the services of the Institute in March.

Mr V. Wickramasinghe's designation was changed to Experimental Officer w.e.f. January.

Dr M. T. Ziyad Mohamed was selected as a member of the panel of the Professional Examination in Tea Manufacture and Factory Practices by the Chairman, National Institute of Plantation Management. He continued to serve as a member of the CTC Technical Committee.

The graduate membership of Mr P. A. N. Punyasiri was transferred to that of Corporate membership of the Royal Society of Chemistry, U. K. w.e.f. 7th July.

Messers W. S. Botheju, P. A. N. Punyasiri, B. W. S. Kariyawasam, G.L.C. Galahitiyawa and L. Jayasinghe participated in a tea tasting training programme at the Tea Departments of John Keels Ltd. and Forbes & Walker Ltd at the end of August.

Ms B. W. S Kariyawasam was transferred back to the Head Office from the Technology Unit, TRI Low-country Station w.e.f. 4th September.

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

No progress was made since the staff member involved in this project had spent a fair amount of time with the solar energy project. The factory did not use the drier for the last few months due to some mechanical problem. The trials are expected to recommence in 1996.

W. S. Botheju, L. Jayasinghe, S. H. P. Waduge and M. T. Ziyad Mohamed

3.2. Trials with 'Economizers'

Economizers were installed and trials are expected to commence together with the FBD 3 trial in 1996.

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 the St. Joachim Estate. The initial results show that the air could be heated from about 32°C to 92°C using solar energy. In order to determine the design of the collector, initially solar collectors made out of wooden frame and double glazing with corrugated aluminium plate coated with black paint as the absorber plate were tested. Later collectors with Zinc Alum frame with single glazing were tested. Results of some initial trials are given below (Tables 1 and 2).

Dimensions of the collector fabricated

Outer Frame — Width 86.4 cm – 88.9 cm
length 2.181 m
height 12.7 cm

Glass — 1.83 m x 67.3 cm

Absorbent plate — 175.26 cm x 67.3 cm

TABLE 1 – *Performance of the collectors with single and double glazing*

	I (W/m^2)	*Temp. (°C) ambient*	*Temp. (°C) out 1*	*Temp. (°C) out 2*	*dT1/I* (cm^2/W)	*dT2/I* (cm^2/W)	*E1(%)*	*E2(%)*
Day 1	680	30.9	54.0	46.8	0.034	0.023	28.8	19.0
Day 2	755	42.0	60.4	61.0	0.037	0.038	30.5	31.3
Day 3	680	31.3	49.1	46.9	0.026	0.023	21.4	18.9
Day 4	506	27.7	39.6	35.2	0.023	0.014	76.5	48.2

Note : Although trials were carried out over a period of one month the results of only four days are presented.

E1 – Efficiency of the collector with single glazing
E2 – Efficiency of the collector with double glazing
Temp out 1 – Outlet temperature in the collector with single glazing
Temp out 2 – Outlet temperature in the collector with double glazing
I – Average solar intensity

Efficiency E is calculated as follows.

$$E = \frac{m.\ Cp.\ dT}{I.A}$$

m – mass of the air flow
Cp – Specific heat of air
dT – Temperature rise
A – Absorber plate area

By comparing the efficiencies (E1 & E2) of the two collectors it could be concluded that there is hardly any difference in the performance between the two collectors.

TABLE 2 – *Performance of the Collectors made out of Wood and Zinc Alum*

Light Inten I	*Amb. Temp. °C*	*Zinc Alum T1 °C (out)*	*Wooden T2 °C (out)*	*dT/I Zinc Alum*	*dT/I Wooden*	*h*	
						mm	*mm*
1206	33.3	43	43.2	0.0080	0.0082	6	6.5
1270	34.4	44	42.6	0.0075	0.0064	6	7
770	33.3	45	43.7	0.0150	0.0135	6	7
1250	33.3	46	44.2	0.0102	0.0087	7	7
1253	32.2	45	43.1	0.0102	0.0087	7	7
509	34.4	47	46.1	0.0248	0.0229	7	7
1280	33.3	40	40.6	0.0052	0.0057	6	8
475	34.4	45	43.5	0.0223	0.0192	7	8
1175	34.4	46	44.5	0.0079	0.0095	6	7
1060	33.3	42	40.3	0.0082	0.0066	7	8
960	32.8	46	44.2	0.0138	0.0119	6	7
286	33.3	40	38.3	0.0234	0.0174	6	7
275	34.4	42	40.5	0.0276	0.0222	6	7
630	33.9	41	40.3	0.0113	0.0112	6	6

P = ¢. g. h. Sin Q
¢ = density
g = gravitational force
h = inclined manometer difference
= angle of the plate

Note : Although trials were carried out over a period of one month the results of only one day are presented to show the trend.

In the above trials the volume of air through each collector was kept almost constant. From the values of dT/I it could be concluded that the performance of the two collectors are comparable. This work is in progress.

S. Koneswaramoorthy and M. T. Ziyad Mohamed

3.4. Studies on Polyphenoloxidase activity

This project was carried out in collaboration with the Biochemistry Division.

The Objectives:

1. To check the degree of activity of two enzymes polyphenoloxidase (PPO) and peroxidase during different stages of drying.

2. To monitor some of the chemical changes that take place at different stages during drying.

3. To investigate the possibility of two stage drying with a view to reduce the cost of drying.

The results of the experiments on the enzyme activity in the FBD driers indicate that, at the commencement of drying, the enzymes are still active and the fermentation reactions take place and enzyme activity declines steadily with loss of moisture and increase in temperature as the drying continues (Tables 3 and 4). At temperatures above 40°C in the dhool particles, high enzyme activity combined with lower O_2 solubility, becomes a major issue and the fermentation process appears to be severely inhibited. However, it was seen that around 50% of the initial activity (activity in the fermented unfired dhools) of PPO is retained at around 52°C and at this stage the moisture content of the dhool was around 27.7%. In the case of peroxidase, around 58% of the initial activity was seen at around 60°C. In fully fired teas, both enzymes did not show any activity. It was also seen that with increase in temperature the TF content decreased and the TR content increased. The activity of PPO ceases altogether when the moisture content has fallen to around 13%. Similar experiments were carried out using the ECP drier.

The results of these experiments indicate that, around 47% of initial activity of PPO is still retained at around 49°C and at this stage the moisture content is around 15%. The dhool acquires this temperature when it dhool reaches one but the last tray in the ECP drier. In the case of peroxidase, enzyme activity was observed throughout the drying procedure and even in black tea 42% of the initial activity of the peroxidase was retained. In this case too, the TF content decreased and TR content increased. Thus these results make it clear that conventional drying systems do not irreversibly denature the enzymes.

As such modifications of the existing driers which may result in increased enzyme inactivation should be explored. Approaches such as the introduction of Infrared, Ultraviolet, Microwave, Solar energy to the fermented dhool for drying would irreversibly denature the enzyme during drying. This investigation will be extended further to study the effect on CTC teas as well.

TABLE 3 – *Changes in enzyme activity, moisture content, TF and TR in relation to temperature in the FBD drier*

	Dhool	*S–1*	*S–2*	*S–3*	*BT*
Temperature (°C)	28	39	52	60	34
Moisture content (%)	57.9	44	27.7	13	3.4
% PPO activity	100	80	50	0	0
% PERO activity	100	82	74	58	0
Decrease in % TF	100	89	87	85	80
Increase in % TR	100	107	122	128	140

The polyphenoloxidase (PPO) activity and peroxidase (PERO) activity in the dhool was assumed to be 100% while theaflavin and thearubigin contents were also assumed as 100%.

TABLE 4 – *Changes in enzyme activity, moisture content, TF and TR in relation to temperature in the ECP drier*

	Dhool	*S–1*	*S–2*	*S–3*	*S–4*	*S–5*	*S–6*	*S–7*	*S–8*	*BT*
Temperature (°C)	26	35	36	38	40	46	49	52	55	58
Moisture content (%)	56	45	42	36	21	17	15	14	9	4
% PPO activity	100	82	77	63	50	49	47	0	0	0
% PERO activity	100	85	79	64	54	53	52	52	51	42
Decrease in % TF	100	91	89	89	88	87	87	86	85	84
Increase in % TR	100	105	106	110	112	115	121	128	130	138

The polyphenoloxidase (PPO) activity and peroxidase (PERO) activity in the dhool was assumed to be 100% while theaflavin and thearubigin contents were also assumed as 100%.

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

4 Project B/GRNT – *Green tea/Brick tea*

No progress has been made due to lack of staff. Since the machinery in the Lamiliere factory cannot be used for miniature scale experiments, 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*

A miniature FBD drier was fabricated at the workshop and transferred to Dunsinane Estate to facilitate the above research program. 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. Since the rollers were replaced after 50 hours it was not possible to draw the samples. The estate is aiming for a higher percentage of PF1 and PD and therefore, they did not wish to use the rollers for more than 50 hours. The amount of flaky particles also tend to increase slightly with usage of rollers. This is in progress.

M. T. Ziyad Mohamed, W. S. Botheju, L. Jayasinghe, V. Wickramasinghe

5.2. Identifying clones for CTC manufacture

The objective of this experiment is to identify suitable clones for CTC manufacture. Iodometry method developed in this division was used for determination of optimum fermentation time for each clone. Ten different popular clones were selected for this trial and the dry matter content was also determined (Table 5). The results revealed that the optimum fermentation time for different clones varied. The same observation was made in another study carried out in this division sometime back.

Miniature CTC manufacture was carried out with each clone. Initial indications are that some of the clones (TRI 2025, CY 9, K 145, etc.) did not develop the colour, even after extending the fermentation time. Such clones when exposed to high temperature, developed the colour within a short period. Even at 20 – 24°C some of the clones like DT 1, TRI 777, TRI 2024 developed coppery colour rapidly during fermentation.

Corresponding samples were analysed for TF, TR, colour and brightness (Table 6). The results revealed that the TR content of each clone increased with increasing fermentation time, but the TF content increased up to a certain point and started decreasing. Thereafter total colour also increased with increasing fermentation time. From the results presented below it is clear that the quality clones like DT 1, TRI 777, TRI 2024 have high value for total colour when compared to other clones. TRI 2026, TRI 2023 and DN produced very bright CTC teas, when given their optimum fermentation time. The samples were also sent for tasters evaluation.

TABLE 5 – *Optimum fermentation time (range) in ten clones*

Clone	*Optimum fermentation time (h)*	*fermentation rate*
DT 1	$1^{1/2} - 1^{3/4}$	Fast
TRI 777	$1^{3/4} - 2$	Fast
K 145	$2 - 2^{1/4}$	Moderate
CY 9	$2 - 2^{1/4}$	Moderate
TRI 2024	$2^{1/4} - 2^{1/2}$	Slow
TRI 2142	$2^{1/4} - 2^{1/2}$	Slow
DN	$2^{1/4} - 2^{1/2}$	Slow
TRI 2025	$2^{1/2} - 2^{3/4}$	Slow
TRI 2026	$2^{1/2} - 2^{3/4}$	Slow
TRI 2023	$2^{3/4} - 3$	Slow

TABLE 6 – *TF, TR, TC, BR percentage ranges of 10 different clones at their optimum fermentation time*

Clone	**TF%*	**TR%*	*+√TC*	*+√BR%*
TRI 2025	1.17 – 1.23	14.79 – 15.40	4.84 – 4.99	22.84 – 23.40
DT 1	1.62 – 1.65	16.47 – 16.86	5.93 – 6.16	25.89 – 27.22
TRI 777	1.48 – 1.51	18.14 – 18.91	6.58 – 6.78	22.84 – 23.12
TRI 2024	1.61 – 1.64	16.71 – 16.95	6.23 – 6.25	25.18 – 25.36
K 145	1.13 – 1.26	13.01 – 13.69	4.25 – 4.40	24.88 – 28.90
CY 9	1.50 – 1.62	15.36 – 16.92	5.22 – 5.69	28.23 – 28.55
TRI 2023	1.40 – 1.65	16.13 – 16.77	4.34 – 4.55	28.14 – 32.55
TRI 2026	1.75 – 1.79	16.43 – 16.76	4.65 – 4.71	32.27 – 33.60
DN	1.39 – 1.46	12.44 – 15.56	4.43 – 4.49	30.43 – 30.78
TRI 2142	1.28 – 1.35	14.85 – 15.28	4.95 – 5.19	23.18 – 25.36

*TF = Theaflavins
*TR = Thearubigins
+TC = Total Colour
+BR = Brightness

The above results and the tasters evaluation indicated that quality clones (for orthodox manufacture) produce quality CTC teas as well. This disproves the hypothesis that succulent clones are better for CTC manufacture.

M. T. Ziyad Mohamed, W. S. Botheju, L. Jayasinghe and S. H. P. Waduge

5.3 Monitoring CTC manufacture

A performance test was carried out on the boiler installed at Poonagalla Estate. It was found that the firewood consumption was around 0.86 kg kg^{-1} made tea. The boiler was coupled to two fluid bed driers during the test. In other words two lines of CTC were used on the day of the test. Similar results were obtained with the test carried out at Spring Valley Estate. The McCloy 2 stage drier was tested at the same factory and found that it was more efficient than our conventional TRI – CCC fluid bed drier, probably due to increased bed area.

There was no blow hole suppressor in the drier and the first section worked on a vibratory mode.

M. T. Ziyad Mohamed, W. S. Bothcju and L. Jayasinghe

6. Project D/TECH – *Divisional Activities*

6.1. Study of the best brewing time and the cuppage of graded teas in three different manufacturing methods

6.1.1. Cuppage

Known weights of different grades (BOP, BOPF, Dust 1 and BP, PF, PF clonal and PD) of teas obtained from different manufacturing methods (orthodox and CTC) were brewed for 5 min. and known volume of extractions were evaporated. The extractable soluble solid percentage of each grade was calculated (Table 7). This percentage value determines the number of cups that can be made from 100 g of tea.

TABLE 7 – *Soluble solid % in different grades of different manufacturing methods*

Orthodox manufacture	
Grade	*Soluble Solid %*
BOP	8.04
BOPF	8.85
Dust	10.52
CTC manufacture	
Grade	*Soluble Solid %*
BP	8.23
PF	8.25
PF Clonal	8.70
PD	9.89
Ortho/CTC manufacture	
Grade	*Soluble Solid %*
BOP	8.35
BOPF	8.53

6.1.2. Brewing time

The above experiment was extended further to determine the best brewing time for different grades and brewing times ranging from 1 to 5 min. were tested (Table 8). For the determination of the best brewing time the contents of TF, TR, Total Colour and Brightness were estimated for each extraction obtained from different brewing times.

TABLE 8 – *TF, TR, Total Colour and Brightness of three main grades brewed in different times and two different manufacturing methods*

Orthodox/RV manufacture

Grade	*Brewing time (min.)*	*TF%*	*TR%*	*Total Colour*	*Brightness%*
	1	0.32	4.66	0.94	35.90
	2	0.48	7.03	1.44	27.11
BOP	3	0.62	9.41	1.92	26.82
	4	0.54	7.89	1.63	28.60
	5	0.81	7.63	1.70	32.42
	1	0.42	6.22	1.17	26.66
	2	0.45	5.51	1.17	30.13
BOPF	3	0.61	7.35	1.60	31.68
	4	0.47	5.49	1.21	30.08
	5	0.59	8.01	1.69	27.63
	1	0.60	5.21	1.15	31.13
	2	0.61	6.25	1.36	30.65
Dust	3	0.61	7.13	1.49	29.40
	4	0.62	10.53	2.17	29.99
	5	0.59	9.11	2.02	36.25
	CV%	29.69	25.05	21.44	17.10

CTC manufacture

Grade	*Brewing time (min.)*	*TF%*	*TR%*	*Total Colour*	*Brightness%*
	1	0.34	5.41	1.23	22.28
	2	0.44	6.59	1.53	22.76
BP 1	3	0.46	7.66	1.68	22.84
	4	0.49	7.64	1.69	23.80
	5	0.49	8.15	1.93	20.66
	1	0.47	7.05	1.38	26.29
	2	0.58	7.81	1.68	29.31
PF 1	3	0.46	7.60	1.54	22.08
	4	0.63	9.01	2.10	23.67
	5	0.57	8.87	1.88	24.91
	1	0.59	8.93	2.10	23.56
	2	0.72	9.42	2.20	24.02
PD 1	3	0.72	9.41	2.21	22.63
	4	0.75	9.41	2.21	24.02
	5	0.72	9.46	2.21	22.96
	CV%	9.95	9.25	10.59	8.51

Preliminary indications are that initial extraction of TF and TR contents from Dust was faster than BOP and BOPF. This was true for CTC grades as well. The above trial needs to be carried out in replicates to predict the best brewing time.

M. T. Ziyad Mohamed, W. S. Botheju, S. H. Waduge and L. Jayasinghe

6.2. Packing trial with used Craft Paper

A trial was carried out with used craft papers brought from three different factories. Unused craft paper was used as the control in this experiment. Model tea boxes were prepared using four different craft papers. Two sets of boxes in duplicate were used for storing BOP grade for one and two month periods separately. BOP was used in this trial. The moisture contents are presented in Tables 9a and 9b.

The initial moisture content of tea (BOP) = 4.5%

TABLE 9a – *Moisture contents (%) of three different, used Craft Papers as against unused craft paper (T_1).*

Treatment	*Initial*	*After one month*	*After two months*
T_1	5.2	6.0	7.9
T_2	4.8	5.8	6.5
T_3	4.7	5.0	7.4
T_4	5.4	5.3	7.1

TABLE 9b – *Moisture content (%) of tea packed in used and unused Craft Papers in one and two month period*

Treatment	*After one month*	*After two months*
T_1	5.7	6.6
T_2	5.6	6.4
T_3	5.8	6.7
T_4	5.7	6.5

Preliminary indications are that used craft paper could be used for packing tea in tea chests.

M. T. Ziyad Mohamed and W. S. Botheju

6.3. Use of paper sacks for packaging of large leafy grades

Five types of paper sacks were compared with chests for leaf damaged during transportation. Three grades were used, namely OPA, OP1 and BOP1. Initial results showed that there was no difference whether the teas were packed in chests or sacks. However since more breakage is expected at the ware house, these samples were transported to one of the ware houses in Colombo, exposed to usual handling and then analysed the breakage (Table 10).

Types of sacks used are,

1. Safe – T – Open top
2. Safe – T – Side valve
3. J & C – Open top
4. J & C – Side valve
5. Container sacks.

TABLE 10 – *Breakage % before (B) and after (A) packing*

Grade		*Chest*	*Safe T–OT*	*Safe T–SV*	*JXC–OT*	*JXC–SV*	*Cont. Sacks*
	B	17.1	17.1	17.1	17.1	17.1	17.1
	A	25.6	24.4	24.3	25.0	24.8	24.6
OPA	B	18.9	18.9	18.9	18.9	18.9	18.9
	A	24.6	20.7	22.2	20.2	18.9	19.1
	B	17.6	17.6	17.6	17.6	17.6	17.6
	A	25.5	20.9	21.3	21.6	20.0	19.3
				CV% 15.26			
	B	13.9	13.9	13.9	13.9	13.9	13.9
	A	14.9	15.0	19.7	16.9	17.1	16.7
OP 1	B	15.7	15.7	15.7	15.7	15.7	15.7
	A	17.4	16.9	16.1	16.6	16.0	18.1
	B	14.5	14.5	14.5	14.5	14.5	14.5
	A	16.0	16.6	17.6	18.7	17.8	17.6
				CV% 16.71			
	B	42.2	42.2	42.2	42.2	42.2	42.2
	A	48.9	46.6	47.6	48.3	50.3	43.3
BOP 1	B	40.2	40.2	40.2	40.2	40.2	40.2
	A	47.2	46.3	48.3	53.7	45.4	45.0
	B	44.8	44.8	44.8	44.8	44.8	44.8
	A	45.2	47.3	48.1	48.9	47.5	48.4
				CV% 15.31			

This work is in progress.

B. W. S. Kariyawasam and M. T. Ziyad Mohamed

6.4. Out–turn (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. Twelve replicates were carried out using leaf standards ranging from 49 to 88%. Due to practical problems encountered during this trial it was decided to determine the out-turn by keeping the usual leaf standard between 50–70% and by changing the moisture content of the leaves, to say, between 70 – 83%.

G. L. C. Galahitiyawa, B. W. S. Kariyawasam and M. T. Ziyad Mohamed.

7. Seminars/Lectures

Dr M. T. Z. Mohamed, Technologist addressed the following seminars:

Delivered a lecture for Tea Instructors/ Inspectors on "Tea manufacture" at TRI on 15th February.

Delivered a lecture on "All aspects of Tea Processing" for overseas participants at TRI on 15th March.

Conducted a seminar on "Implementation of Government Policies" at Colombo on 23rd March.

Addressed the ISO 9000 seminar at Colombo on 31st August and 1st September.

Attended a seminar at NARESA on 20th October to discuss progress of energy projects.

Addressed a PA seminar on "Good leaf for good quality tea" held at SLTB on 27th October.

Conducted a lecture on "Technology of Tea Manufacture" for undergraduate students of the Faculty of Agriculture, University of Peradeniya on 25th November.

Attended a seminar for Tea Inspectors and the staff of the Tea Commissioners Division on 6th December at Matara.

Ms. B. W. S. Kariyawasam delivered a lecture on "Biochemistry of Tea" for the undergraduate students of the Faculty of Agriculture, University of Peradeniya on 25th November.

8. Training Programmes/Paper presentations

Dr M. T. Z. Mohamed, Technologist conducted the following training programmes:

Factory Officer training programme on "Tea Manufacture" at NIPM from 7th to 10th February.

Factory Officer training programme on "Tea Manufacture" in Kotagala for Kotagala Plantations Ltd. on 13th February.

Factory Officer training programme on "Tea Manufacture" at NIPM from 26th to 29th March.

Trained 130 Tea Inspectors in 4 batches on 31st July and 14th August.

Factory Officer training programme on "Tea Manufacture" at NIPM from 20th – 27th August.

Assistant Superintendents from Hapugastanna Plantation were trained at TRI from 27th – 29th November on "Tea Manufacture".

Presented a paper "Inter Governmental Co–operation in Tea Regions" at the Inaugural meeting of the Association of Tea Producing Countries in April.

Presented a paper at the Agmma symposium "Problems and constraints faced by Tea machinery manufacturers" held on 30th November.

9. Visitors

Professor Folke Peterson KTH Sweden visited the St., Joachim Estate solar project on 17th October.

Dr Afzal Shen and Mr Ronny Dwell from SAREC visited TRI during 13–14 December.

The number of visitors during the above period to the Technology Division was 9.

10. Advisory Reports

During the period under review, 41 advisory visits to factories were made by the members of the Technology Division on various aspects of tea manufacture and factory development. This excluded the seminars and the NIPM Factory Officer training programmes.

The number of samples received from estates for the determination of the moisture content percentage was 629. These were reported with advice for correction of defects wherever, necessary.

STATISTICS

Nilmini Senaratne

1. General

Ms N. Senaratne continued to assist various research disciplines of the Institute in statistical analysis of their experimental data.

2. Statistical Analysis and Design

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 t 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	Number of analysis
1. RCBD	312
2. RBD	12
3. Factorial	02
4. Split	15
5. Dsplit	06
6. Covariance analysis	17
7. Simple correlation/regression	27
8. One Way	19
9. Incomplete	06

About 400 graphs were drawn using QPRO/Harward graphics and Excel software for various research divisions.

An analysis of the TRI budget for 1995 was undertaken using Excel package. It identified the break-up among the various research and administration divisions, separately on the revenue and capital accounts.

3. Workshops

Prof. R.O. Thatill, Dr J. Costa and Dr B. Marambe from the Agricultural Faculty of University of Peradeniya, conducted a workshop on basic biometrics for the benefit of TRI scientific staff in April 1995.

AGRICULTURAL ECONOMICS UNIT

Officer-in-Charge – J. A. A. M. Jayakody

1. General

Mr B. Sivaram continued to serve as the Consultant Economist. Ms J. A. A. M. Jayakody and Mr G. Ganewatte were transferred to the Head Office, Talawakele, w.e.f. 15th May 1995 and the Agricultural Economics Unit at Hantane substation was closed. The Graduate trainee, R. Paskerathevan continued his training programme. Mr G Ganewatte was granted one year study leave to follow a M. Sc. programme in Agricultural Economics at the PGIA from October. One NDT trainee, D. S. A. Rajakaruna, from the NAB commenced a 4 month training programme in November.

2. Divisional Activities

2.1. Interaction with the other Research Disciplines

A continuing dialogue took place with the research divisions with a view to assess the cost-benefit of the major recommendations. The following assessments were completed.

2.1.1 Cost benefit analysis of weed management

The present recommendation on weed management is an integrated approach of chemical and manual weeding (Advisory Circular W-5, July 1971). The Incremental cost of weeding programme for the low-country is Rs. 5,472/ha/annum. The yield depression due to weeds is estimated at 4.7 – 15% per year for seedling and 4.9 – 9.14% per year for VP (Somaratne, 1989.) Therefore, the incremental gain from weed control has been worked out at Rs. 6075/ha/annum with a net gain of around Rs. 600/ha/annum for seed tea. The corresponding net gain for VP tea is placed at Rs. 3978/ha/annum. Based on similar calculations, the net gain in up-country is around Rs. 250/ha/annum for seedling and Rs. 7581/ha/annum for VP tea. Overall, it is seen that the cost of the recommended method of weed control breaks even at an average yield of 900 kg/ha/yr in the seedling tea and 1000 kg/ha/yr for VP tea. It has been estimated that for young tea, weed control could increase yield by over 30% (Visser, 1961). Accordingly, incremental net gain would be around Rs. 24,000/ha for the first cycle. However, since weeding programmes have to be flexible according to field conditions and the type of weeds in the field, the level of profitability of the operation is subject to change.

J. A. A. M. Jayakody and M. S. D. L. de Silva

2.1.2. Economics of white grub control (Economic threshold levels)

Cost of recommendation (Rs/ha) – Chemical (Suscon Fore)

No. of planting holes per ha 12500
Requirement of the chemical at 1.5g per planting hole = Rs 18.75/ha
Total cost for chemical at Rs 415/kg = Rs 7781/ha

Application cost = Labour cost = 8 Labour man days at Rs. 83/man day = Rs. 664
Total cost of the recommendation = Rs. 8445/ha

For 1st year fields:
Per plant value in 1st year (Rs.) = 7
No. of casualities to be prevented = 1206
There for to cover the application cost, the percentage of casualty at economic threshold level = 10

For 2nd year fields:
Per plant value in 2nd year (Rs.) = 10
No. of casualities to be prevented = 844
Therefore to cover the application cost, the percentage of casualty at economic threshold level = 7

2.1.3. Economics of low-country live wood termite control

Net Incremental Gains (Rs/ha) by controlling the low-country live-wood termite

Clone	*In 3rd cycle*	*In 4th cycle*	*In 5th cycle*
TRI 2022	14000	9000	7000
TRI 2025	17000	12000	9000
TRI 2027	26000	21000	16000
TRI 2021	27000	19000	16000
TRI 2026	45000	33000	20000
TRI 2024	30000	16000	11000
TRI 2023	28000	18000	10000
TRI 2045	20000	11000	7000
TRI 2043	36000	18000	4000

NSA taken at Rs 70 per kg
Control measure is sanitary pruning at 20 man days/ha
Plucking cost Rs 23 per kg made tea
Incremental manufacturing cost Rs 10 per kg made tea

B. Sivaram, D. P. B. Herath and S. I. Vitarana

A report of the work done since 1993 in these aspects was submitted to the Tea Research Board in November.

2.1.4. Economic inputs for 191st Experiments and Extension meeting:

Divisional assistance was provided by the AEU for the following studies:
- Effect of plucking standards on quality and profitability in Uva and Dimbula
- Financial analysis on energy saving in tea factories, with particular reference to solar heating system and comparative merits of boiler *vis-a-vis* air heater.

B. Sivaram and D. P. B. Herath

2.2. Research Prioritisation

Following an in–depth analysis of the problems/constraints of the tea sector, action has been initiated to classify issues according to their researchability and to formulate appropriate research thrusts through the Composite Approach for Decision Making in Agricultural Research (CADMAR). The AEU has been closely associated with the exercise. This will strengthen the researcher - economist interaction at the designing stage of future research programmes of the Institute.

J. A. A. M. Jayakody and B. Sivaram

2.3. Economic Studies

The following studies were presented at the 189th E & E meeting.

2.3.1. Economics of harvesting – *A. Ananthacoomaraswamy*
2.3.2. Optimizing fertilizer application for up-country – *D. P. B. Herath*
2.3.3. Optimum length of pruning cycle – *J. A. A. M. Jayakody*
2.3.4. Economics of field development options – *B. Sivaram*

A booklet entitled "Development Planning in Tea" incorporating the economics of replanting, infilling, intercropping of tea and rubber and diversification to fuel wood was distributed at the above meeting.

2.3.5. Economics of CTC conversion

A financial appraisal on conversion to CTC manufacture was presented at the 191st E & E meeting.

Economic Returns from CTC conversion : individual projects

Factory	*NPV[1] (Rs M)*	*IRR[2](%)*	*PBP[3](yrs)*	*BEIG[4] (Rs/kg)*	*BE NSA[5] (Rs/kg)*
Up–country					
1	20	58	3	–	61.83
2	-ve	-ve	OPS	20.87	75.30
3	17	97	3	–	55.86
4	-ve	-ve	OPS	13.92	59.08
5	-ve	-ve	OPS	22.44	66.15
6	16	30	9	–	60.30
7	24	25	6	–	63.58
8	14	25	6	–	59.58
9	-ve	6	OPS	1.67	81.50
10	19	30	5	–	81.76
11	50	74	3	–	81.15
12	-ve	9	11	0.67	66.32

Mid–country					
1	-ve	-ve	OPS	6.67	59.90
2	106	>100	2	–	43.26
3	95	>100	2	–	43.80
4	7	26	5	–	58.19
5	-ve	10	10	3.76	58.50
6	-ve	-ve	OPS	5.06	58.19
7	-ve	-ve	OPS	5.74	58.42
Low–country					
1	26	23	6	–	76.97
2	-ve	-ve	OPS	8.93	67.57
3	2	17	7	–	71.67

[1]Net Present Value at 14% discount rate over 30 year period.
[2]Internal Rate of Return
[3]Pay Back Period (OPS: outside project span)
[4]Break-even Incremental Gain
[5]Break-even Net Sale Average. A booklet entitled "Out Look for CTC" was distributed at the E & E meeting.

B. Sivaram, D. P. B. Herath, G. Ganewatte and J. A. A. M. Jayakody

The Tea Board set up a four-member committee on the CTC production programme. The AEU asisted the committee in preparing a questionnaire for eliciting information from CTC factories. The report of the committee, on which AEU was represented, has since been submitted.

B. Sivaram

2.3.6. Capacity Utilization in Private Tea Factories

On a suggestion from the ADB review mission (June 1995), a survey was undertaken to ascertain the capacity status of private tea factories in the country. Based on returns received from about 110 units, mostly from the low-country where the bulk of the bought-leaf factories are located, it was seen that 66 per cent in this region were operating at under capacity, 28 per cent at capacity and the balance 6 per cent at over capacity. The report has been submitted which includes suggestions for improving the capacity utilization and ensuring the sustainability of these factories.

B. Sivaram, G. Ganewatte, W. S. Botheju and R. Paskarathevan

2.4. Development of a Tea Information System – GIS applications

The collaborative project between the Tea Research Institute and the Environment and Forest Conservation Division of the Mahaweli Development Authority was continued. Application of GIS for Land Use Planning for a group of estates was initiated. Tea estates in the Nawalapitiya region managed by the Kahawatte Plantations were selected for the study. Development of estate maps was completed

for the following estates, namely, Kataboola, Kadienlena, Queensberry, Westhall and Barcaple. Mapping of Craigehead Estate, which is partly located outside the Upper Mahaweli Catchment was yet to be completed.

On a request made by the Kelani Valley Plantations Ltd, a similar study was undertaken to select suitable lands for a future reforestation programme of some selected estates in Nuwara Eliya and Nanu Oya regions as follows: Pedro, Nuwara Eliya, Glassaugh, Edingburgh and Uda Radella. Development of GIS databases for above estates were completed. Data analysis is in progress.

J. A. A. M. Jayakody, G. Ganewatte, R. M. S. S. Rajapaksa

2.5. Tea Smallholder Studies

The AEU co-ordinated in drawing up an Action Plan for TRI/TSHDA interaction covering a wide range of field practices, research recommendations, adaptive trials and development issues. The report was discussed and accepted at a ministerial level meeting in September and an internal committee has been set up within the TRI to monitor the progress.

2.5.1. A GIS application on tea smallholder has been initiated to study the desirability of this technology being extended to fine tune the method of technology transfer.

J. A. A. M. Jayakody, A. Somaratne[1], H. Manthrithilake[2]

1 Deputy General Manager, TSHDA.

2 Director, Environment & Forest Conservation Division, Mahaweli Authority

2.5.2. As a follow-up of an earlier exercise, a fresh study on the cost of production of green leaf in the smallholder sector is being initiated. A revised questionnaire has been drawn up in consultation with the TSHDA for this purpose. Monthly data to be collected from 18 smallholdings in the different elevational regions where TRI/TSHDA fertilizer trials are to be located.

B. Sivaram, J. A. A. M. Jayakody and A. Somaratne

2.5.3. Replanting study for smallholders

The rate of replanting in tea smallholdings in Sri Lanka is currantly at about 0.8 per cent. In an effort to step up this development activity, the Asian Development Bank has been operating a project which enables credit financing at a concessional rate of interest, thereby supplementing the replanting subsidy from the cess fund and the equity component by the grower. With the project coming to an end, alternative measures are under consideration for ensuring the sustainability of the operation. This study proposes a loan element to be met by the commercial banks and a bridging interest subsidy from a reallocation of the cess fund to overcome the likely impact of the absence of ADB assistance.

B. Sivaram, D. P. B. Herath and M. I. M. J. Samarawickrema[3]

3 Economist, TSHDA

2.6. Diagnostic Surveys

With a view to ascertaining the extent to which TRI recommendations are actually adopted by producers, it is felt that a series of diagnostic surveys be carried out by the Institute. For this purpose, three such areas - fertilizer use, pruning and plucking – have been identified. The survey on fertilizer applications is to be commenced initially for which a questionnaire has been drawn up.

B. Sivaram and J. A. A. M. Jayakody

2.7. Macro Analysis

2.7.1. Wages for tea workers

The Plantation Management Companies have been interacting with the AEU in the preparation of a scheme which, apart from providing a price-wage supplement to tea workers, could also incorporate an element linked to worker productivity. Such a proposal was put up by the AEU.

B. Sivaram

3. Seminars

Following meetings and seminars were attended by the divisional staff.

1. Mrs J. A. A. M. Jayakody and Mr G. Ganewatte addressed TRI/TSHDA seminar held at TRI substation, Hantane in May on "Economics of infilling" and "Cost of production" in smallholder sector respectively.

2. Mr B. Sivaram addressed a meeting of the Planters Association in Colombo in June on "Development options in tea".

3. Mr D. P. B. Herath addressed the RSC meeting held at Walahanduwa, Galle in June on "Optimizing fertilizer application".

4. Mrs J. A. A. M. Jayakody addressed the RSC meeting held at TRI substation, Hantane in August on "Diversification of uneconomic Tea lands into fuel wood cultivation".

5. Mr B. Sivaram addressed a meeting of the Planters Association in Nuwara Eliya in August on "Productivity improvement in Tea Industry".

6. Mr B. Sivaram addressed a meeting of the Planters Association in Colombo in October on "Maximizing Net return through normal plucking".

7. Mrs J. A. A. M. Jayakody addressed a RSC seminar at TRI substation Ratnapura in November on "Economics of Replanting and infilling".

8. Mrs J. A. A. M. Jayakody presented a paper titled on "Use of Computer data base for planning tea estates" at the National workshop on "Soil and water resources Management on Tea Estates" held at IFS, Kandy in December.

ST. COOMBS/LAMILIERE ESTATE

Superintendent – D. Gunasekera

1. General

Mr D. Gunasekera, Superintendent retired on 2nd November, 1995 after eight years of service.

Mr H. C. Munasinghe, Junior Asst. Field Officer resigned w.e.f. 31st August.

Mr K. C. Thangavadivele was appointed as Storekeeper/Clerk (temporary) w.e.f. 4th July.

Messrs Forbes & Walker Co. Ltd., continued as Brokers for St. Coombs during 1995.

2. Hectarage as at 31st December, 1995

	ha
Seedling/VP tea in bearing	146.20
Land under rehabilitation	11.30
Lines, Nursery, clearings, roads, etc.	80.20
	237.70

3. Crop (made tea, kg)

The production on St. Coombs/Lamiliere Estate in 1995 compared to the previous year is as follows :

	1994		*1995*	
	Total	*Yield/ha*	*Total*	*Yield/ha*
St. Coombs	209,006	2150	186,898	1896
Lamiliere	83,524	1705	80,789	1737
	292,350	2110	267,687	1845
Bought Leaf	107,765		91,434	
Total	400,295	2001	359,121	1845

4. Tea Prices

Apart from topping the Western Market on several occasions during the year, St. Coombs recorded the highest price fetched (Rs. 240/-) for BOP in March, 1995, which is an all time record. The working of St. Coombs/Lamiliere Estate resulted in a profit of Rs. 2,965, 831/76 during the year, which is a profit of Rs. 20,286/13 per hectare (Table 1).

TABLE 1 – *Working account of St. Coombs/Lamiliere Estate for the year 1995 compared to previous years*

Year	*Total crop (kg made tea)*	*Bought leaf (kg)*	*Yield (kg made tea per ha)*	*Nett Sale Average (Rs.)*	*Cost of production (Rs./kg)*		*Gross Profit+ Loss – (Rs.)*	*Actual Profit+ Loss – (Rs.)*
					Estimated	*Actual*		
1991	267,593	42,018	1,882	76.86	69.09	68.99	+ 3,462,036.00	+ 3,462,036.00
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

5. Nursery

A total of 20,250 plants of the following clones were raised in the nursery for replanting and infilling : TRI 3000, 4000 series and DT 1.

5.1. Sale of shoots

A total of 49,000 cuttings amounting to Rs. 7350/- were sold to estates.

6. Buildings

Nine rooms 3.3 x 3.3m (10' x 10') were constructed during this year.

7. Labour

The labour on Lamiliere Division were on strike for 4 days in March, demanding the transfer of the Field Officer. The Field Officer was transferred to the Upper Division. The money collected from the labour force of St. Coombs Division has been deposited with the Ceylon Electricity Board to commence work in the electrification of workers quarters.

The money recovered from the labour force of Lamiliere Division for electrification of labour quarters was repaid on their request.

8. Cultural Operations

Field No. 1

Seedling tea	–	Nil
VP tea	–	5.90 ha
Clones	–	TRI 777, 2016, 2023, 2025 & DN
Planting year	–	1953 – 1959
Last pruned	–	August, 1994
Yield per ha 1994	–	1453 kg
Yield per ha 1995	–	2366 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
Planting year	–	1964
Last pruned	–	July, 1991
Yield per ha 1994	–	2495 kg
Yield per ha 1995	–	2117 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 1994	– 2717 kg
Yield per ha 1995	– 3239 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 & CY 9
Planting year	– 1978, 1981
Last pruned	– October, 1995
Yield per ha 1994	– 2123 kg
Yield per ha 1995	– 1618 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	– 1990
Last pruned	– July, 1991
Yield per ha 1994	– 3066 kg
Yield per ha 1995	– 3049 kg
Shade	– Dadaps and *Grevillea*

Field No. 6

Seedling tea	– Nil
VP tea	– 5.9 ha
Clones	– TRI 2025, DN & N 2
Planting year	– 1985 – 1986
Last pruned	– July, 1992
Yield per ha 1994	– 2067 kg
Yield per ha 1995	– 2067 kg
Shade	– *Grevillea*

Field No. 7

Seedling tea	– Nil
VP tea	– 4.7 ha
Clones	– TRI 2024, 2025, 62/9, DT 1 & DT 95
Planting year	– 1962 – 1964
Last pruned	– April, 1995
Yield per ha 1994	– 2171 kg
Yield per ha 1995	– 939 kg
Shade	– Dadaps and *Grevillea*

Field No. 8

Seedling tea	–	Nil
VP tea	–	5.2 ha
Clones	–	TRI 2024, 2025 & DT 1
Planting year	–	1962 – 1964
Last pruned	–	June, 1994
Yield per ha 1994	–	1042 kg
Yield per ha 1995	–	2525 kg
Shade	–	*Grevillea*

Field No. 9

Seedling tea	–	4.80 ha
VP tea	–	3.00 ha
Clones	–	TRI 3000 series and TRI 2025
Last pruned	–	June, 1991
Yield per ha 1994	–	1982 kg
Yield per ha 1995	–	1400 kg
Shade	–	*Grevillea*

Field No. 10

Seedling tea	–	1.60 ha
Clones	–	SALT Area
Planting year	–	1990, 1991
Last pruned	–	July, 1992
Yield per ha 1994	–	2884 kg
Yield per ha 1995	–	3971 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	–	1988
Last pruned	–	July, 1993
Yield per ha 1994	–	3504 kg
Yield per ha 1995	–	2596 kg
Shade	–	*Grevillea* and *Calliandra*

Field No. 12

Seedling tea	–	9.60 ha
VP tea	–	1.20 ha
Clones	–	TRI 2025 & K 145
Planting year	–	1985
Last pruned	–	June, 1994
Yield per ha 1994	–	627 kg
Yield per ha 1995	–	1475 kg
Shade	–	*Grevillea* and *Calliandra*

Field No. 13

Seedling tea	–	9.10 ha
VP tea	–	1.30 ha
Clones	–	TRI 2023, 7/27 & DN
Last pruned	–	July, 1992
Yield per ha 1994	–	1730 kg
Yield per ha 1995	–	1854 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	–	1991
Last pruned	–	June, 1994
Yield per ha 1994	–	1071 kg
Yield per ha 1995	–	2654 kg
Shade	–	*Grevillea* and *Calliandra*

9. Yield data – St. Coombs

The monthly yield of St. Coombs Estate for 1995 in comparison with the yields obtained from 1991 to 1994 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 1991 to 1995 – St. Coombs Estate*

Month	*1991*	*1992*	*1993*	*1994*	*1995*
January	221	192	109	172	206
February	169	76	57	153	168
March	139	34	90	140	136
April	183	24	178	199	184
May	266	259	125	199	276
June	199	212	236	146	172
July	193	80	119	112	119
August	143	133	92	105	190
September	141	73	155	163	132
October	205	108	146	173	205
November	147	136	192	164	184
December	164	156	196	170	178
	2170	1483	1695	1896	2150
Total rainfall (mm)	1927.0	2455.2	2918.7	2356.1	2291.9
No. of wet days	200	190	220	220	188
Average N (kg ha^{-1} yr^{-1})	275	215	222	220	234

TABLE 3 – *Monthly yield (kg ha^{-1}) of fields with fertilizer mixture used and amounts of N applied – St. Coombs (1995)*

Field No.	*Extent (ha)*	*Total N (kg ha^{-1})*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun.*	*Jul.*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Total*
01	5.9	260	47	65	111	190	240	165	179	260	128	420	306	255	2366
02	2.6	180	189	187	130	140	289	258	90	191	105	169	215	154	2117
03A	7.0	220	312	220	119	248	431	243	169	312	208	257	288	280	3155
03B	6.7	220	323	263	200	298	371	295	168	292	201	381	251	300	3343
04A	6.1	300	233	207	222	240	333	167	102	216	18	8	4	9	1759
04B	3.0	300	143	69	45	74	134	113	37	139	29	6	25	12	1333
05	7.4	320	354	236	241	275	377	226	136	273	175	273	222	261	3049
06A	3.0	220	167	108	70	177	254	69	57	127	104	123	127	126	1509
06B	2.9	220	299	114	127	142	328	169	156	181	187	115	252	162	2232
07	4.7	180	180	127	53	2	–	–	–	27	53	167	170	160	939
08	5.2	260	221	187	218	173	312	258	157	169	117	237	197	279	2525
09	7.8	180	73	99	96	103	280	134	86	147	87	142	138	15	1400
10	1.6	260	269	375	174	262	486	330	226	339	433	202	482	393	3971
11A	2.0	220	431	335	344	375	488	224	185	336	296	296	320	354	3984
11B	4.0	220	39	183	126	94	167	137	57	100	49	92	69	96	1209
12	10.8	160	183	123	59	147	147	95	82	126	140	145	100	128	1475
13	10.4	260	159	97	72	202	306	123	87	98	143	181	186	190	1854
14	6.1	260	208	233	199	177	202	236	228	227	166	355	226	197	2654
	97.2		206	168	136	184	276	172	119	190	132	205	184	178	2150

10. REPORT ON LAMILIERE DIVISION

11. Cultural Operations

Field No. 4A

VP tea	–	5.10 ha
Clones	–	TRI 2025
Planting year	–	1984
Last pruned	–	September, 1991
Yield per ha 1994	–	2466 kg
Yield per ha 1995	–	2293 kg
Shade	–	Dadaps and *Grevillea*

Field No. 4B

VP tea	–	1.90 ha
Clones	–	TRI 2025
Planting year	–	1986
Last pruned	–	May, 1993
Yield per ha 1994	–	2027 kg
Yield per ha 1995	–	2393 kg
Shade	–	Dadaps and *Grevillea*

Field No. 5

Seedling tea	–	2.50 ha
Planting year	–	1935
Last pruned	–	June, 1993
Yield per ha 1994	–	1100 kg
Yield per ha 1995	–	1090 kg
Shade	–	Dadaps and *Grevillea*

Field No. 6A

Seedling tea	–	2.00 ha
Planting year	–	1935
Last pruned	–	June, 1992 & 1993
Yield per ha 1994	–	569 kg
Yield per ha 1995	–	679 kg
Shade	–	Dadaps and Grevillea

Field No. 7

VP tea	–	4.5 ha
Clones	–	TRI 2025
Planting year	–	1993
Yield per ha 1994	–	1990 kg
Yield per ha 1995	–	2409 kg
Shade	–	Dadaps and Grevillea

Field No. 8A

VP tea	–	5.00 ha
Clones	–	TRI 2025
Planting year	–	1987/1988
Yield per ha 1994	–	2180 kg
Yield per ha 1995	–	732 kg
Shade	–	Dadaps and Grevillea

Field No. 8B

VP tea	–	4.00 ha
Clones	–	TRI 2025, DN, N 2, WT 26 & CY 9
Planting year	–	1989/1990
Yield per ha 1994	–	1555 kg
Yield per ha 1995	–	2014 kg
Shade	–	Dadaps and Grevillea

Field No. 9A

VP tea	–	4.00 ha
Clones	–	TRI 2025
Planting year	–	1979
Last pruned	–	August, 1991
Yield per ha 1994	–	2258 kg
Yield per ha 1995	–	2283 kg
Shade	–	Dadaps and Grevillea

Field No. 9B

VP tea	–	4.00 ha
Clones	–	TRI 2025, DN and CY 9
Planting year	–	1980
Last pruned	–	August, 1992
Yield per ha 1994	–	2239 kg
Yield per ha 1995	–	2285 kg
Shade	–	Dadaps and Grevillea

Field No. 10

VP tea	–	6.60 ha
Planting year	–	1967/1969
Last pruned	–	May, 1994
Yield per ha 1994	–	1082 kg
Yield per ha 1995	–	2225 kg
Shade	–	Dadaps

Field No. 11

VP tea	–	6.4 ha
Clones	–	DN & TRI 2025
Planting year	–	1970/1971
Last pruned	–	June, 1995
Yield per ha 1994	–	1634 kg
Yield per ha 1995	–	814 kg
Shade	–	Dadaps

12. Yield data – Lamiliere

The monthly yield of Lamiliere for 1995 in comparison with the yields obtained from 1991 to 1994 is given in Table 4 while the monthly yield of each field is given in Table 5.

TABLE 4 – *Monthly yield (kg ha^{-1}), and average N applied from 1991 to 1995 – Lamiliere Division*

Month	*1991*	*1992*	*1993*	*1994*	*1995*
January	176	170	105	167	184
February	130	72	86	129	161
March	103	37	111	149	114
April	170	27	202	143	171
May	154	240	174	172	196
June	160	168	189	134	146
July	167	97	108	107	60
August	117	145	79	112	134
September	96	93	158	192	93
October	143	105	125	115	161
November	97	128	185	156	141
December	126	187	176	161	144
	1639	1469	1698	1737	1705
Average N (kg ha^{-1} yr^{-1})	260	214	222	220	217

TABLE 5 – *Monthly yield (kg ha^{-1}) of fields with fertilizer mixture used and amounts of N applied – Lamiliere Division (1995)*

Field No.	*Extent (ha)*	*Total N (kg ha^{-1})*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun.*	*Jul.*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Total*
04A	5.1	220	236	204	159	205	323	223	75	163	127	217	161	200	2293
04B	1.9	260	253	238	136	164	227	240	92	263	105	217	226	232	2393
05	2.5	200	89	67	80	89	118	82	56	85	68	134	109	113	1090
06A	2.0	180	80	112	34	45	66	80	66	78	73	85	91	75	679
07	4.5	260	200	202	159	214	260	188	106	228	161	269	170	252	2409
08A	5.0	220	176	180	42	87	16	–	13	5	26	25	80	82	732
08B	4.0	180	265	130	121	236	259	179	105	129	148	234	89	119	2014
09A	4.0	260	194	245	104	215	314	202	75	177	139	228	163	227	2283
09B	4.0	180	219	180	146	256	266	220	46	233	109	206	245	159	2285
10	6.6	220	198	142	151	200	190	253	91	225	125	239	233	178	2225
11	6.4	180	153	149	106	159	159	23	–	–	–	–	34	31	814
	49.0		184	161	114	171	196	146	60	134	94	160	141	144	1705

ST. JOACHIM ESTATE

Superintendent – L. A. Seevaratnam

1. General

Mr I. D. Gunaratne, Consultant/Estate Management and Extension Services paid monthly visits and inspected field and factory operations. M/s Bartleet and Co. Ltd. and M/s De Silva, Abeywardena and Peiris continued as Brokers for St. Joachim during 1995.

The factory functioned without a Head Factory Officer during this year as well. A dispute in this matter is pending before the Labour Tribunal at Ratnapura.

2. Hectarage as at 31st December, 1995

	ha	
Mature V. P. tea	50.73	
Land under rehabilitation	37.42	
Estate Nursery	1.59	
Abandoned tea	4.96	
Crop diversified-Coconut	3.34	
Land under Rubber	12.30	
Land under Paddy	2.23	112.57
Other lands		
Line gardens, under acquisition by Government, buildings, roads, ravines and jungle		24.42
Total extent		136.99

3. Crop (made tea, kg)

The production on St. Joachim Estate in 1995 compared to the previous year wass as follows :

Year	*Estate Crop*	*Bought Crop*
1994	57,487	865,691
1995	55,643	887,732

The production on the estate showed a decrease of 1,844 kg in comparison to the previous year. This represents a decrease of 3.2%.

3.1. Bought leaf

The bought leaf manufactured at St. Joachim Factory showed an increase of 22,041 kg in comparison to last year. This represents an increase of 2.5%. This increase is mainly attributed to more smallholders supplying their leaf as better prices were 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 and Peiris sold our tea in equal proportions.

The tea produced during the year was sold at a Nett Sale Average price of Rs. 77/23. The Nett Low Grown Average for the year was Rs. 77/27, which is only –/04 cts above St. Joachim Factory average. The average price paid for bougth leaf during the year under review was Rs. 11/64.9 per kg as against an average of Rs. 10/04.9 paid in the previous year. The working of St. Joachim Estate resulted in a profit of Rs. 2,827,076 (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.)*
1994	13,925	13,925.00	49,620	51,440.00
1995	1,200	1,200.00	7,500	15,283.00

6. Cultural Operations

Field No. 1

V. P. tea	– 5.85 ha
Clones	– TRI 2023, 2025, 2026, 2027 & S 106
Last pruned	– June, 1993
Yield per hectare 1994	– 575 kg
Yield per hectare 1995	– 497 kg
Shade	– *Albizia* and *Gliricidia*
Experiments	– Nil

Routine upkeep of the tea was done during the year and 16,730 V.P. plants of TRI 2027 and 2025 were used in infilling vacancies under Mana grass.

Field No. 1A

V. P. tea	– 1.20 ha
Clones	– TRI 2023, 2027, S 106 & KEN
Last pruned	– May 1995
Yield per hectare 1994	– 1,448 kg
Yield per hectare 1995	– 1,109 kg
Shade	– *Albizia* and *Gliricidia*

Planting of Mana grass was undertaken in vacant patches.

TABLE 1 – *Working account of St. Joachim Estate for the year 1995 compared to previous years*

Year	*Total crop sold (made tea kg)*	*Yield/ha (made tea kg)*	*Nett Sale Average (Rs/kg)*	*Estimated Cost of Production (Rs./kg)*	*Actual*	*+Profit –Loss Rs.*
1989	*750,613 36,519	585	56/83	41/76.72	52/72.01	+5,763,813/-
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	71/65.69	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/-

*Bought crop

Field No. 2

V. P. tea	– 4.12 ha
Clones	– TRI 2025, 2026, 2027 & S 106
Yield per hectare 1994	– 326 kg
Yield per hectare 1995	– 402 kg
Shade	– *Albizia* and *Gliricidia*

This area is under the supervision of the TRI and is used for clonal proving trials.

Field No. 2A

V. P. tea	– .93 ha
Clones	– TRI 2025, S 106
Yield per hectare 1994	– 2,129 kg
Yield per hectare 1995	– 1,403 kg
Shade	– *Albizia* and *Gliricidia*

Intercropping area, planted with coconut in tea.

Field No. 2F

V. P. tea	– 6.78 ha
Clones	– TRI 2025, 2026, 2027 & S 106
Last pruned	– May, 1995
Yield per hectare 1994	– 1,197 kg
Yield per hectare 1995	– 1,262 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	– TRI 2023, 2025
Last pruned	– June, 1994
Yield per hectare 1994	– 1,149 kg
Yield per hectare 1995	– 1,316 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.

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 (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	– TRI 2023
Last pruned	– June, 1994
Yield per hectare 1994	– 528 kg
Yield per hectare 1995	– 1015 kg
Shade	– *Albizia* and *Gliricidia*

Planting Mana grass was undertaken in vacant patches.

Field No. 5

V. P. tea	– 8.20 ha
Clones	– TRI 2023, 2025
Last pruned	– May, 1995
Yield per hectare 1994	– 1,109 kg
Yield per hectare 1995	– 703 kg
Shade	– *Albizia* and *Gliricidia*
Experiments	– Nil

Field No. 6

V. P. tea	– 1.50 ha
Clones	– TRI 2025, 2026 & 2027
Last pruned	– June, 1995
Yield per hectare 1994	– 2,626 kg
Yield per hectare 1995	– 1,740 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.

The following New Clearing work was undertaken during the year.

Field No. 1 - 4.25 ha – Up keep of Mana grass

Upkeep of Mana, lopping, fencing and weeding were undertaken during the year.

Field No. 8B & 8D - 4.85 ha – Up keep of Mana grass

Upkeep of Mana, lopping, fencing and weeding were done during the year.

Field No. 1 - 4.80 ha – Up keep of Mana grass

Upkeep of Mana, lopping, fencing and weeding were done during the year.

Field No. 6 - Oil Palm 7.28 ha – Up keep of Mana grass

Upkeep of Mana, lopping, weeding and fertilizing were undertaken during the year.

Intercropping experiment – An extent of approximately 1.20 ha has been replanted with tea and rubber. Clone TRI 2027 plants were used.

Field No. 5 - 5.60 ha – Upkeep of Mana grass

Upkeep of Mana, lopping and weeding were undertaken during the year

Field No. 4 - 4.14 ha – Upkeep of Mana grass

Upkeep of Mana, lopping and weeding were undertaken during the year.

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

There were no strikes or major disputes on the estate during the year under review. Health of labour was satisfactory. The estate was unaffected by any form of violance or disturbances during the year.

The monthly yield of St. Joachim Estate for 1995 in comparison with the yields obtained from 1990 to 1994 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	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*
January	74	97	89	71	102	94
February	44	74	24	34	94	68
March	87	82	05	52	99	77
April	99	106	12	90	109	96
May	122	144	60	82	66	97
June	111	115	44	96	88	99
July	114	82	61	108	66	102
August	121	113	82	79	79	101
September	79	79	68	88	75	101
October	141	105	70	98	87	89
November	126	98	85	106	89	104
December	115	97	93	110	91	69
	1101	1162	693	1014	1045	1097
Total rainfall (mm)	3448.8	3740.9	3993.7	4589.3	3679.0	4216.2
No. of wet days	214	203	185	226	217	208
Average N (kg ha^{-1} yr^{-1})	165	121	160	154	133	165

TABLE 3 – *Monthly yield (kg ha^{-1}) of fields with fertilizer mixture used and amounts of N applied – St. Joachim Estate*

Field No.	*Extent (ha)*	*Total N (kg ha^{-1})*	*Fertilizer mixture used*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun.*	*Jul.*	*Aug.*	*Sep.*	*Oct.*	*Nov.*	*Dec.*	*Total*
1	5.85	140	U/235	55	19	36	34	39	21	41	54	60	41	54	43	497
1A	1.20	160	U/346	128	50	81	104	43	29	–	46	78	199	222	129	1109
2	4.12	TRI Exper. block		17	14	22	50	56	35	47	32	38	28	86	27	402
2A	.93	160	U/346	248	128	33	222	113	–	–	10	104	266	125	154	1403
2F	6.78	140	U/235	83	84	91	96	102	127	126	117	137	96	121	82	1262
3	8.40	160	U/235	110	84	74	115	115	112	99	130	127	126	138	86	1316
4	5.85	140	U/235	31	40	75	87	69	96	123	109	130	82	108	65	1015
5	8.20	160	U/346	72	51	45	66	99	110	94	55	16	21	36	38	703
6	1.50	180	U/346	247	189	205	144	229	239	283	73	–	56	42	33	1740
8A	6.00	200	U/235	168	135	110	171	161	154	146	219	238	144	186	97	1929
8C	1.90	160	U/346	175	69	234	117	72	67	161	98	50	205	185	116	1549
	50.73			94	68	77	96	97	99	102	101	101	89	104	69	1097

ADVISORY AND EXTENSION SERVICE– TALAWAKELE

Officer–in–Charge – C. C. Rajasingham

1. General

Mr I. D. Gooneratne, Consultant, Estate Management and Extension Services overlooked the activities of the Division.

Mr C. C. Rajasingham was appointed as Acting Officer–in–Charge, Advisory & Extension Service with effect from 1st August 1995.

Mr S. Wimaladharma Senior Advisory Officer was transferred to Ratnapura with effect from 01st August 1995.

2. Advisory and Extension Services

427	Advisory letters were sent out on technical matters
25	Advisory visits were made to smallholdings
40	Seminars/Training programmes were conducted on plucking for estate field staff
04	Nursery skills workshops were conducted for estate staff and Executives
07	Seminars were conducted for bought leaf suppliers and smallholders
07	Lectures were delivered to Agriculture Diploma students
03	Exhibition stalls in public exhibitions were installed and manned by the Advisory Staff
70	Advisory visits were made to the tea plantations
26	Soil samples were tested for pH
1459	Persons visited the Division

60	– from estates
238	– Smallholders
784	– School students
331	– University/Diploma students
46	– Foreigners

3. Regional Scientific Committee Activities

One RSC II Committee meeting was attended by the Advisory staff.

4. Special Meetings, Seminars, Other Activities

Research & Development

1. The survey on 'Evaluation of up-country VP tea nurseries' has been completed by gathering information from 18 Superintendents and nursery Kanganies.

V. S. Sithakaran

2. A survey was carried out in the up-country plantations to update the list of tea factories.

I. D. Gooneratne, V. S. Sithakaran

Preparation of Extension materials

1. An Advisory booklet on 'Pesticide use in tea' is being prepared for the use of field officers of tea estates and for tea smallholders.

V. S. Sithakaran

Special Meetings

Mr B. A. D. Samansiri attended the preliminary discussion to draw up a programme to prepare a 'Teachers Handbook on the Tea Industry' held at the TSHDA Auditorium. The meeting was attended by the following:

National Education Institute, Tea Promotion Bureau, Tea Small Holdings Development, Authority, National Institute of Plantation Management and Tea Commissioner's Division.

Survey on Genetic Resources of Tea in Sri Lanka

Mr B. A. D. Samansiri participated in a survey conducted by two Japanese scientists, Dr Yoshiyuki Takeda, Head of Tea Breeding Division of National Research Institute of Vegetable, Ornamental plants and Tea, Japan and Mr. Niroshi Yoshidome, Research Officer of Tea Branch, Miyazaki Prefectural Agricultural Experimental Station, Japan to investigate the intensity of genetic variation of seedling tea in Sri Lanka. This survey was carried out in 25 locations in Talawakele, Maskeliya, Radella, Badulla, Passara, Spring Valley, Haputale, Dambetenna, Ohiya, Balangoda Hapugastenne, Ratnapura, Rakwana, Deniyaya and Galle.

The survey revealed that there are large variences in the floral characters of teas collected in Talawakele, Badulla and Haputale areas and less variation in Ratnapura, Deniyaya and Galle districts.

LOW-COUNTRY STATION RESEARCH, ADVISORY AND EXTENSION CENTRE – RATNAPURA

Officer–in–Charge – S. Wimaladharma

1. General

Mr D. K. Nawaratne, Actg. Officer-in-Charge was transferred to the Head Office as Actg. Head of the Advisory and Extension Division. Mr S. Wimaladharma assumed duties as Officer-in-Charge of this station w.e.f. 1st August.

The staff strength as at 31st December was 33.

Mr Wimaladharma was promoted as Senior Advisory Officer, Grade 1 w.e.f. 1st January 1994.

Mr A. R. M. Hassim, Research Officer of the Plant Breeding Unit of this Station retired from the services of the Institute w.e.f. 28th February, after serving for a period of 35 years.

Mr S. K. Senadheera, Technical Assistant, Agronomy Unit of this station retired from the services of the Institute w.e.f. 18th July after serving the Institute for a period of 35 years.

Ms S. M. Samarasinghe, Experimental Officer, Entomology Unit of this station continued her research work for her MPhil degree.

Mr S. L. D. Amarathunge, Extension Officer, Advisory and Extension Unit of this station was released to commence his post-graduate studies on Environmental Science leading to the MSc degree at the University of Colombo from October.

The following transfers were effected to the places mentioned in paranthesis:

Mr N. Piyasundera, Technical Assistant (Plant Breeding Unit, Ratnapura) w.e.f. 16th January; Mr A. K. Premathunge, Experimental Officer (Entomology Unit, Ratnapura) w.e.f. 1st March; Mrs E. W. T. Premathunge, Technical Assistant (Agronomy Unit, Ratnapura) w.e.f. 1st March; Mr D. W. Vithana, Experimental Officer (Agronomy Unit, Ratnapura) w.e.f. 17th April; Mr L. C. Yapa, Experimental Officer, Agronomy Unit, Ratnapura (TRI substation, Pelagahatenne) w.e.f. 17th April; Ms B. W. S. Kariyawasam, Research Assistant, Technology Unit, Ratnapura (Head Office, Talawakele) w.e.f. 1st September; Mr L. Weerasooriya, General Mechanic, Head Office, Talawakele (Mechanical workshop, Technology Unit, Ratnapura) w.e.f. 2nd October.

2. Advisory and Extension Services

326 Advisory letters were written
30 Advisory visits were done (15 for estate sector and 15 for smallholdings)
12 Nursery inspections were undertaken (6 for estate sector and 6 for smallholdings)
09 Inspections of research trials were done (3 for estate sector and 6 for smallholdings)
03 Land selections were made (1 for estate sector and 2 for smallholdings)
125 Estate Management personnel visited the station
46 Smallholders sought advice
101 Visitors including 8 foreigners visited the station
263 Students visited the station
58 Field days/Demonstrations/Group discussions/Seminars/Meetings and Educational programmes were held. Skilled Training in Nursery management and plucking (08), RSC Seminars for Superintendents/ Asst. Superintendents
40 Seminars for bought leaf suppliers (15), Special Awareness programmes (14) Lectures for students of School of Agriculture, Karapincha (03), Special Training programmes on Nursery management (06), Training programmes for TSHDA, Ratnapura (02).

01 Mobile Advisory and Extension Service for tea smallholders of Kalawana
01 Exhibition stall was managed by Advisory Staff
01 Educational Awareness programme for students
12 Video films were shown
304 Soil samples were tested for pH

3. Research Activities

The following research activities are being conducted at this station.

Agronomy Division

Project : D/AGRY
B/INCR – Intercropping

Technology Division

Project : D/TECH

Entomology Division

Project : B/TERM – Management of Low-country live wood termite

Plant Breeding Division

Project : B/CLON – Development of new clones

Research activities attached to the above projects were in progress and their progress reports have been forwarded to the respective Heads of Divisions by the Officers responsible.

4. Building and Utility Services

Colour washing of bungalows and buildings of this Station were carried out under the 7 year and 3 year programme.

5. Problems encountered in the Low-country districts

The incidence of Stem and Branch Canker caused by the fungus *Macrophoma theicola* was on the increase. In addition, tea growers visited this station seeking advice on yield decline, live-wood termite damage, Red Borer damage, Shot-hole borer damage, White Root damage and Nursery failures.

The non availability of planting materials of suitable recommended clones in adequate quantities posed a problem to both smallholders and the estate sector.

MID – COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE – KANDY

Officer–in–Charge – P. B. Ekanayake

1. General

Mr J. I. H. Bandaranayake retired from the services of the Institute w.e.f. 2nd January and Mr P. B. Ekanayake was appointed as the Officer–in-Charge.

Mr J. C. K. Rajasinghe was transferred to the Deniyaya Centre as the Officer–in–Charge w.e.f. 1st March.

Mrs J. A. A. M. Jayakody, Research Officer and Mr G. Ganewatte, Research Assistant, Economics Unit was transferred to Talawakele in May.

2. Advisory and Extension Services

242 Letters were written to estates and smallholders

109 Advisory visits were made during the year

160 Local and foreign visitors and 301 smallholders visited the Centre

5 Field days/seminars/demonstrations were held for smallholders in Oorugaloya, Doragala, Moragalla, Wattappola and Handiyadeniya.

6 Seminars were conducted for the Asst. Superintendents and Field Staff of Madulkele, Melfort, Geragama, Alakolla, Rangala and Hatale Estates.

2 Seminars were held for TSHDA at Hantane Auditorium, one each for Tea Inspectors of Kandy region and for all Regional Managers, Asst. Regional Managers and Tea Inspectors.

2 RSC seminars were held at Hantane Auditorium organised by the RSC IV, Mid-country.

166 Soil samples were tested for pH

3. Hectarage as at 31st December, 1995

		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) – 1995

Month	*Harvested*	*Sold*	*Rate paid/kg Rs. cts.*	*Total Rs. cts.*
January	4456	4421	8.44	37313.24
February	2490	2476	8.86	21937.36
March	3955	3922	9.09	35650.98
April	3842	3790	8.28	31380.20
May	5607	5545	7.93	43971.85
June	4140	4106	7.10	29152.60
July	4146	4126	6.96	28716.96
August	3486	3465	7.92	27442.80
September	3311	3273	9.28	30373.44
October	5391	5361	11.53	61812.33
November	4958	4931	12.16	59960.96
December	3774	3775	9.95	37561.25
Total	49,566	49,191		444,226.19

5. Income

No. of cuttings sold	–	556,000
Income from sale of cuttings	–	Rs. 111,210.00
No. of VP plants sold	–	103,424
Income from sale of plants	–	Rs. 299,253.70
Amount (kg) of crop harvested	–	49,191
Income from green leaf sold	–	Rs. 444,226.19
Average price fetched per (kg) green leaf	–	Rs. 8.93
Guest House occupation charge	–	Rs. 27,425.00
Electricity charges	–	Rs. 1,656.34
Soil testing (pH) charges	–	Rs. 6,620.00
Miscellaneous	–	Rs. 31,659.00
Total income	–	Rs. 926,053.20

Other Activities

The Officer-in-Charge and Advisory Officer participated in 9 seminars on "Supply of quality leaf to factories" organised by the Tea Small Holding Development Authority at Aladeniya, Yahalatenna, Mahauva, Ancumbura, Edengrove, Kurugama, Menikdiwele, Nawalapitiya and Gampola.

The Officer–in–Charge participated in a Workshop on "Soil and water resource Management of tea" held at the Institute of Fundamental Studies, Kandy.

The Officer–in–Charge participated in a seminar on "Organic Agriculture" held in Kandy, organised by the Lanka Organic Agriculture Movement.

DENIYAYA ADVISORY AND EXTENSION CENTRE–DIYADAWA

Officer–in–Charge – J. C. K. Rajasinghe

1. General

Mr J. C. K. Rajasinghe assumed duties as Actg. OIC w.e.f. 1st February, 1995.

Mr D. W. Vithana was transferred to the Low-country Station w.e.f. 17th April.

The following visitors visited the Centre:

1. Dr Y. Takeda and Mr Yoshidome from the National Research Institute of Vegetables, Ornamental Plants and Tes Kagoshime Prefecture, Japan.

2. Dr R. L. de Silva, Consultant, Maturata Plantations Ltd.

3. Prof. K. A. D. W. Senaratne and Dr M. G. V. Wickremasinghe, University of Ruhunu, Matara.

2. Advisory and Extension Services

43	Letters were written on Advisory matters
50	Advisory visits were made
939	Visitors including smallholders visited the Centre. (Tea Inspectors – 1, Students – 1, Agriculture teachers – 1, Private estate owners – 1)
17	Training programmes were conducted.
14	Seminars were held (smallholders – 9, RSC – 1)
32	Video films were shown
99	Soil samples were tested for pH

3. Hectarage as at 31st December, 1995

	ha
Tea	6.41
Coconut	0.13
Grafting Experiment	0.04
Buildings	1.44
Guatemala area	0.70
Nursery	0.70
Experiment	1.12
Others	2.73
	13.27

4. Crop

Green leaf harvested (kg) – 1995

Month	*Harvested*	*Rate paid/kg (Rs. cts.)*	*Total Income (Rs. cts.)*
January	1674	9/95.2	16659.65
February	1174	10/47	12291.78
March	961	10/47.8	10069.36
April	1238	10/73.2	13286.22
May	1223	10/92.4	13360.05
June	1278	10/45.1	13356.38
July	1584	9/85.6	15611.90
August	1519	10/48	15919.12
September	1732	12/00	20784.00
October	1833	10/80.4	25302.73
November	2046	15/62.9	31976.93
December	1849	14/26	26366.74
Total	18111		214984.85

5. Income

No. of cuttings sold	–	51475
Income from sale of cuttings	–	Rs. 10295.00
No. of plants sold	–	17600
Income from sale of plants (with loading charges)	–	Rs. 58100.00
Amount (kg) of crop harvested	–	18111
Income from sale of crop	–	Rs. 214984.85
Average price fetched per kg green leaf	–	Rs. 11.87
Miscellaneous income (GH charges, testing soil pH, etc.)	–	Rs. 16596.00
Total Income	–	Rs. 299975.85

6. Experiments

6.1. LVP–43 This experiment has been terminated. However this area is to be pruned in April 1996 for issuing cuttings to estates and smallholders.

6.2. Intercropping experiment

This experiment has been terminated.

6.3. Clonal Grafting Experiment

This experiment has been terminated.

6.4. Aislaby Selections

This experiment is in plucking. Plucking weights of individual selections are being recorded weekly.

UVA ADVISORY AND EXTENSION CENTRE – PASSARA

Officer–in–Charge – M. B. A. Perera

1. Advisory and Extension Services

242 Advisory letters were sent out
63 Advisory visits were made
24 Seminars/Workshops were held
01 Special seminar was held on "The Use of Medicinal Herbs in Tea" for the tea planters in Uva
253 Visitors including foreign visitors visited the Centre
742 Soil samples were tested for soil pH
593 Soil samples were tested for their organic carbon content

2. Hectarage as at 31st December, 1995 (approx.)

		ha
Mature tea in plucking	–	4.85
Mother bushes	–	1.15
Buildings & Roads	–	0.50
Grass, scrub area	–	6.85
Total		13.35

3. Crop

Green leaf harvested (kg) – 1995

Month	*Harvested*	*Sold*	*Rate paid/kg* Rs. cts.	*Total Income* Rs. cts.
January	3167	3108	9.11	28,313.88
February	3404	3406	9.74	33,174.44
March	4271	4270	9.35	39,924.50
April	4713	4717	9.21	43,443.57
May	4555	4547	7.77	35,330.19
June	3227	3222	7.66	24,680.52
July	1681	1679	8.01	13,448.79
August	2471	2469	9.62	23,751.78
September	4769	4772	9.97	47,576.84
October	3242	3256	10.76	35,034.56
November	4654	4654	11.68	54,358.72
December	3070	3065	9.13	27,983.45
Total	43224	43165		407,021.24

A yield of 2005 kg ha^{-1} was obtained. The Centre recorded a yield of over 2000 kg ha^{-1} for the second consecutive year while the estimated yield for the year was 1432 kg ha^{-1}.

5. Income

No. of cuttings sold	–	106,100
Income from sale of V. P. cuttings	–	Rs. 26,525.00
No. of VP plants sold	–	5,103
Income from sale of V. P. plants	–	Rs. 19,136.25
Amount (kg) of crop harvested	–	43,165
Income from green leaf sold	–	Rs. 407,021.24
Average price fetched per kg green leaf	–	Rs. 9.33
Soil analytical charges (pH & carbon)	–	Rs. 7,620.00
Guest House accommodation charges	–	Rs. 6,525.00
Other income (sale of publications, sale of coffee seeds, old newspapers, *Grevillea* plants, etc.)	–	Rs. 1,783.00
Total Income	–	Rs. 538,610.49

The nursery was maintained only to establish plants of the TRI 4000 series clones. These plants were sold to selected tea smallholders.

5. Labour Force

No. on permanent check roll	–	10
No. on casual check roll	–	13
Out–turn–Permanent	–	62%
Out–turn–Casual	–	60%

6. Clonal Observation Trials

Two clonal observation trials, UVP 8 and UVP 9 are in progress at the centre.

7. Special Uva problems

In a number of estates defoliation and die back was observed in the clone TRI 2023. In some instances this clone had a very poor recovery after pruning. Those symptoms were noticed mainly in fields with depleted soil conditions and where the required amount of fertilizer was not regularly applied.

SOUTHERN PROVINCE ADVISORY AND EXTENSION CENTRE – TALGAMPOLA

Officer–in–Charge – K. D. Dahanayake

1. Advisory and Extension Services

46 Advisory letters were written
56 Advisory visits were made including visits to smallholders
417 Visitors visited the Centre
20 Training programmes were held for Superintendents, Asst. Superintendents, Field staff and smallholders
26 Seminars/Field days were held
6 Soil samples were tested for pH

2. Hectarage as at 31st December, 1995

		ha
Mature tea	–	9.5
Mother Bushes	–	0.5
Seed Gardens	–	1.5
Immature area (infills)	–	2.5
Nursery	–	0.7
Guatemala area	–	2.5
Paddy, Coconut, etc.	–	2.0
Main road, field, roads and buildings	–	9.8
Balance area	–	6.0
Total	–	35.0

3. Improvements to the Centre

The two newly constructed Bungalows were assigned to two Officers.

4. Crop

Green leaf harvested (kg) – 1995

Month	*Harvested*	*Sold*	*Rate paid/kg* Rs. cts.	*Total Income* Rs. cts.
January	6169	6169	11/32	69833.08
February	5320	5320	11/60.8	61754.56
March	1987	1987	11/30	22453.10
April	4531	4531	10/83.8	49106.98
May	6350	6350	11/61.8	73774.30
June	6919	6919	11/18.4	77382.10
July	7139	7139	11/22.3	80121.00
August	7876	7876	12/09	95220.84
September	7717	7717	13/30.2	102651.53
October	10587	10587	13/52.9	143231.52
November	9667	9667	16/81.2	162521.60
December	7622	7622	14/63.7	111563.21
Total	81884	81884		1049613.82

5. Income

No. of cuttings sold	–	28625
Income from sale of cuttings	–	Rs. 5725.00
No. of V. P. plants sold	–	18360
Income from sale of VP plants	–	Rs. 55080.00
Amount (kg) of crop harvested	–	81884
Income from green leaf sold	–	Rs. 1049613.82
Miscellaneous	–	Rs. 11114.00
Total Income	–	Rs. 1121532.82

6. Labour Force

Number on check-roll	–	61
Out-turn (average)	–	50

7. 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 Polyclonal experiment
11 Two pruning observation trials
12 Multi-cuttings Vs single-cuttings – observation block

WEATHER TABLES

METEOROLOGICAL OBSERVATIONS – 1995

TRI – ST. COOMBS, TALAWAKELE (Lat. 6° 55' N, Long. 80° 40' E, 1382 m amsl)

Month	*Mean Temperature (°C)*		*Soil at 20cm under grass*		*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	11.8	25.4	21.0	21.9	65.8	89.4	2027	6.1	126.0	10	84.22
February	11.3	25.9	20.7	22.0	66.4	73.6	2312	5.9	101.0	8	82.68
March	10.7	27.0	20.8	22.4	50.0	72.4	2623	7.2	74.6	5	112.50
April	14.0	26.1	21.9	22.9	69.1	83.8	609	6.1	196.9	21	73.02
May	15.8	24.4	22.1	22.5	74.5	89.2	1078	4.8	253.9	18	61.48
June	16.6	22.3	21.6	21.8	84.7	92.8	970	1.6	367.9	26	43.90
July	15.6	22.1	20.9	21.2	81.7	93.3	1133	3.2	184.2	22	64.50
August	14.5	22.4	21.2	21.5	75.8	94.6	2548	3.4	252.6	23	38.46
September	14.7	22.8	21.2	21.4	75.1	85.0	2684	3.7	216.9	16	53.48
October	14.3	NA	21.3	21.6	69.1	82.7	2152	4.9	344.4	17	55.18
November	13.6	NA	21.5	21.9	68.6	78.7	3979	5.3	236.2	15	62.18
December	12.2	NA	21.0	21.6	59.4	69.5	2802	6.6	27.0	9	79.20

LOW–COUNTRY STATION, RESEARCH, ADVISORY AND EXTENSION CENTRE, RATNAPURA

(Lat 6°41N, Long, 80°E – 40°E, 29 m amsl)

Month	*Mean Temperature (°C)*		*Relative Humidity (%)*		*Mean Sunshine (h day^{-1})*	*Total Rainfall (mm)*	*Difference from 30 yrs.*	*Wet Days*	*Difference from 30 day*	*Evaporation (mm)*
	Min. Dry	*Max. Dry*	*08.30h*	*15.30h*						
January	22.5	33.8	87	62	4.7	230.7	+ 119.6	11	+ 2	2.93
February	21.7	34.0	85	59	Not recorded	196.2	+ 59.2	10	+ 1	3.59
March	22.5	35.6	84	58	Not recorded	185.4	- 26.8	6	- 8	4.69
April	23.4	34.3	86	77	4.0	422.9	+ 84.0	27	+ 7	3.25
May	24.4	32.4	85	74	4.0	698.4	+ 255.5	27	+ 7	3.74
June	24.1	31.2	80	78	2.1	686.5	+ 274.3	29	+ 8	2.70
July	23.8	31.7	81	67	4.0	210.2	- 82.6	14	- 6	3.09
August	23.6	31.3	83	74	3.2	393.3	+ 88.2	22	+ 2	2.40
September	23.6	31.6	84	76	3.7	407.2	- 14.2	20	No difference	3.14
October	23.4	32.3	85	76	3.0	474.3	+ 37.5	23	+ 2	2.98
November	22.9	32.2	86	70	4.0	258.9	- 112.5	13	- 5	3.15
December	22.5	33.0	86	63	5.1	46.3	- 189.0	06	- 8	3.13
Total	–	–	–	–	–	4209.3	–	208	–	–
Mean	23.2	32.8	84	70	3.8	–	–	–	–	3.23

MID–COUNTRY RESEARCH, ADVISORY AND EXTENSION STATION – KANDY

(Elevation 762 m amsl)

Month	*Mean Temperature (°C)*		*Relative Humidity (%)*		*Mean Sunshine (h day-1)*	*Total Rainfall (mm)*	*Wet Days*	*Total Evaporation (mm)*
	Min. Dry	*Max. Dry*	*08.30h*	*15.30h*				
January	16.5	28.2	97.0	93.8	5.66	204.0	12	64.5
February	18.7	28.1	94.4	91.6	6.43	99.5	11	71.9
March	19.6	28.9	93.4	88.5	8.40	95.8	06	121.6
April	20.5	29.7	97.6	92.9	5.95	251.7	16	62.9
May	21.2	27.4	96.5	96.1	3.69	429.1	17	81.5
June	21.2	24.4	96.5	96.5	4.49	192.3	24	58.8
July	20.7	26.2	95.9	95.8	4.82	80.2	15	100.3
August	20.4	26.4	90.5	95.9	5.07	122.8	18	84.8
September	20.4	26.4	96.6	96.0	6.02	160.2	14	71.8
October	20.0	27.8	97.6	94.8	5.22	404.5	18	57.5
November	19.6	25.2	90.1	84.4	4.88	240.3	13	79.4
December	18.8	25.7	84.6	83.7	5.88	51.2	11	57.1

DENIYAYA ADVISORY AND EXTENSION CENTRE – DIYADAWA
(Elevation 250 m amsl)

Month	*Mean Temperature (°C)*				*Relative Humidity (%)*		*Sunshine (h day⁻¹)*	*Total Wind (km)*	*Total Rainfall (km)*
			Soil at 30 cm						
	Min.	*Max.*	*830 h*	*1530 h*	*830 h*	*1530 h*			
January	21.00	30.82	27.5	27.9	86.1	72.3	5.66	691	498.4
February	20.91	31.83	26.7	27.0	76.8	66.7	6.41	1032	72.0
March	20.78	33.35	27.7	29.2	77.9	67.8	6.47	928	127.9
April	20.20	29.30	27.8	28.4	70.7	69.7	6.32	775	394.1
May	20.00	39.30	27.8	28.4	76.7	68.7	3.98	1539	624.9
June	20.70	32.80	28.0	28.6	82.0	66.8	3.24	2201	612.4
July	22.51	29.62	26.1	27.4	81.8	72.6	4.48	3370	140.8
August	22.30	29.41	26.5	29.0	75.9	67.7	3.96	2480	338.2
September	22.73	29.15	26.5	26.9	91.7	84.5	6.22	2184	249.3
October	22.46	31.03	27.0	27.4	78.2	74.9	5.59	1420	557.7
November	18.70	24.07	26.8	27.2	78.0	70.8	4.78	1078	236.7
December	21.47	31.0	27.0	27.5	84.4	70.6	6.38	663	161.7

UVA ADVISORY AND EXTENSION CENTRE – PASSARA

(Lat. 6° 56' N, Long. 18° 07E, 1120 m amsl)

Month	*Mean Temperature (°C)*		*Relative Humidity (%)*		*Mean Sunshine (h day⁻¹)*	*Total Wind (km)*	*Total Rainfall (mm)*	*Total Evaporation (mm)*
	Mini. Dry	*Max. Dry*	*830h*	*1530h*				
January	16.7	24.3	92	92	5.6	1993	276.1	73.64
February	16.5	24.2	91	90	5.6	1351	143.7	66.55
March	17.4	26.5	78	70	6.2	1352	249.8	115.32
April	18.7	26.7	87	88	5.9	1103	325.8	75.22
May	19.1	26.7	91	92	5.3	1186	256.8	89.70
June	14.7	27.9	88	88	5.6	1479	35.5	100.28
July	16.3	27.2	86	87	5.5	995	71.1	91.48
August	18.2	26.6	88	88	5.7	981	190.8	79.33
September	18.1	26.9	91	90	5.3	1168	90.3	85.15
October	18.1	26.0	90	92	4.0	1081	270.2	55.01
November	17.4	25.2	91	94	3.3	1314	172.2	51.68
December	15.8	23.6	92	93	3.4	2858	153.2	59.02
Total							2235.5	942.38
Mean	17.2	25.9	88	89	5.1			

SOUTHERN PROVINCE EXTENSION CENTRE, TALGAMPOLA – KOTTAWA
(Elevation 30 m amsl)

Month	*Mean Temperature (°C)*		*Relative Humidity (%) 0830h*	*Mean Sunshine (h day⁻¹)*	*Total Rainfall (mm)*	*Wet Days*
	Min. Dry		*Max. Dry*			
January	19.7	31.0	94	6.0	67.9	04
February	–	–	–	6.8	–	–
March	–	–	–	9.2	28.0	03
April	–	–	–	–	389.2	13
May	–	–	–	–	397.0	22
June	–	29.7	94	–	448.7	13
July	–	30.2	84	6.8	46.1	06
August	–	29.7	88	–	226.2	11
September	–	29.7	89	6.0	117.0	09
October	–	30.0	90	–	317.2	18
November	–	29.9	91	–	243.4	09
December	–	30.5	86	6.4	48	02