

THE
TEA RESEARCH INSTITUTE
OF
CEYLON

Report for the Year 1968

Part II



Published by
THE TEA RESEARCH INSTITUTE OF CEYLON
ST COOMBS, TALAWAKELE, CEYLON

1969

The Tea Research Institute of Ceylon, Talawakele

The laboratories and headquarters of the Institute are situated at St Coombs Talawakele. Correspondence, enquiries, specimens, soil samples and other consignments should be addressed to

The Director
Tea Research Institute of Ceylon
St Coombs
Talawakele

Telegraphic Address : RESEARCH, TALAWAKELE

Railway Station : TALAWAKELE

Telephones : Talawakele 44 } Open at all hours; extensions to the Director's office,
Tillicoultry 35 } all Divisions and Senior Staff bungalows
Radella 36 } Director's office during office hours only
Radella 32 } Chief Administrative Officer during office hours only

Forwarding Agents : Messrs M. Y. Hemachandra & Co. (Transporters) Ltd., Talawakele, Maskeliya, Norwood and Colombo.

It is particularly requested that letters should *not* be addressed to officers by name. Consignments sent by rail should be forwarded to the Railway Station, Talawakele, c/o the Forwarding Agents. *Carriage must be pre-paid.*

Accommodation : The Guest House at St Coombs is open to persons visiting the TRI and St Coombs Estate on business. Prior permission for accommodation must be obtained in writing from the Director, Tea Research Institute of Ceylon, St Coombs, Talawakele. Unless sufficient notice is given, accommodation cannot always be guaranteed. A list of rules and charges is available on request.

The TRI Low-Country Station, Ratnapura

Low-country estates in the Sabaragamuwa, Southern and Western Provinces should address their correspondence, enquiries, plant specimens and soil samples to

The Advisory Officer
TRI Low-Country Station
St Joachim
Ratnapura

Telegraphic Address : RESEARCH, RATNAPURA
Railway Station : RATNAPURA
Telephones : Ratnapura 428 — Extension to Assistant Director's bungalow
Ratnapura 359 — Extension to Superintendent's bungalow

The TRI Mid-Country Station, Kandy

Mid-country estates in the Central Province should address their advisory enquiries and plant specimens to

The Advisory Officer
TRI Mid-Country Station
Hantane Estate
Kandy

Telegraphic Address : RESEARCH, KANDY
Railway Station : KANDY
Telephone : Kandy 7169

The TRI Uva Station, Debedde

Estates in the Uva Province should address their advisory enquiries, plant specimens and soil samples to

The Uva Scientific Officer
TRI Uva Station
Gonakelle Estate
Debedde

Telegraphic Address : RESEARCH, DEBEDDE
Railway Station : BADULLA
Telephone : Passara 546

Until further notice, soil samples for pH determinations and eelworm counts should be addressed to the Director, Tea Research Institute of Ceylon, St Coombs, Talawakele.

Visitors—Visitors to the Institute's headquarters and laboratories at Talawakele, the Low-Country Station at Ratnapura, The Uva Station at Debedde, The Mid-Country Station at Kandy, St Coombs Estate and St Joachim Estate are welcome on any day, provided they make a prior appointment with the officer they wish to meet.

Subscriptions

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THE
TEA RESEARCH INSTITUTE
OF
CEYLON

Report for the Year 1968

Part II

Edited by

L. H. FERNANDO, BSc, PhD (Lond)

and

R. L. De SILVA, BSc (Cey), PhD (Lond), DIC



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THE TEA RESEARCH INSTITUTE OF CEYLON
ST COOMBS, TALAWAKELE, CEYLON

1969

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The Tea Research Institute of Ceylon

The Board as at 31st December 1968

Chairman : *Vacant*

Ex-officio Members

The Director of Agriculture :

Mr M. S. Perera

The Honourable the Minister of Finance :

represented by Mr G. D. Loos

The Chairman, Planters' Association of Ceylon :

Mr B. Warusavitarnne

The Chairman, Agency Section, Planters' Association of Ceylon :

Mr S. K. D. Jayamanne

The Chairman, Low-Country Products Association of Ceylon :

Mr T. C. A. de Soysa

The Tea Controller :

Mr C. P. Chanmugam

The Director, Tea Research Institute of Ceylon :

Dr L. H. Fernando

Nominated Members

Appointed by the Planters' Association of Ceylon :

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Mr G. B. Middleton

Mr J. R. Somerville

Appointed by the Agency Section, Planters' Association of Ceylon :

Mr P. J. C. Durrant

Mr J. F. A. P. Peries

Mr M. B. Horsfall

Appointed by the Low-Country Products Association of Ceylon :

Mr S. Pathmanathan

Mr J. L. D. Peiris

Mr G. Hettiarachchi

Appointed by the Honourable the Minister of Agriculture to represent the smallholders :

Mr D. E. Hettiarachchi

Mr M. Rajendram, MBE

Appointed by the Honourable the Minister of Agriculture to represent the House of Representatives :

Mr D. J. Ranaweera, MP

Secretary : Mr P. Kanapathipillai

TEA RESEARCH INSTITUTE OF CEYLON

† THE STAFF

(On 31st December 1968)

DIRECTORATE

Director L. H. Fernando, BSc, PhD (Lond)

RESEARCH DIVISIONS

Agricultural Chemistry

Agricultural Chemist ... V. P. Bhavanandan, BSc (Cey), PhD (Edin), ARIC
Research Officer ... W. M. W. B. Manipura, BSc (Cey), PhD (Cantab)
Research Assistants ... *S. Sandanam, BSc (Cey)
... *S. Sivasubramaniam, BSc (Cey)
Technical Assistants ... V. Fernando
... S. G. Jayasuriya
... T. C. Z. Jayman
... T. Kularatna, BSc (Cey)
... C. C. Rajasingham
... A. Somaratne, BSc (Cey)
... S. Sunderalingam, BSc (Poona)
... A. B. D. Wickremaratne, BSc (Vidyodaya, Cey)

Biochemistry

Biochemist ... R. L. Wickremasinghe, BSc (Cey), BSc (Lond), PhD (Sheff), FRIC
Research Officer ... R. R. Selvendran, BSc (Cey), PhD (Cantab)
Research Assistant ... *G. R. Roberts, BSc (Cey), ARIC
Technical Assistants ... U. L. L. de Silva, BSc (Lond)
... W. A. B. de Silva, BSc (Cey)
... B. P. M. Perera
... K. P. W. C. Perera, BSc (Cey)
... K. Sivapalan, BSc (Cey), MSc (IARI, New Delhi)

Entomology

Entomologist ... W. Danthanarayana, BSc (Cey), PhD (Lond), DIC
Research Assistant ... D. J. W. Ranaweera
Technical Assistants ... K. D. Bandularatne, BSc (Cey)
... S. N. Fernando, BSc (Cey)
... A. Kathiravetpillai, BSc (Cey)
... C. Shanmugam

Nematology

Nematologist ... P. Sivapalan, BSc (Cey), PhD (Rutgers)
Technical Assistants ... A. R. M. Hassim
... P. A. John
... T. Manivasagar
... S. Samarajeewa
... V. Shivanandarajah, BSc (Cey)

Plant Pathology

Plant Pathologist ... N. Shanmuganathan, BSc (Cey), PhD (Lond)
Research Officer ... R. L. de Silva, BSc (Cey), PhD (Lond), DIC
Technical Assistants ... *P. V. Arulpragasam, BSc (Madras)
... R. N. Bopearatchy, BSc (Cey)
... S. R. A. Fernando, BSc (Cey)
... S. Murugiah
... T. V. Saravanapavan, BSc (Cey)

Plant Physiology

Plant Physiologist ... *U. Pethiyagoda, BSc (Cey), PhD (Lond), DIC
Research Officer ... V. S. Kulasegaram, BSc (Cey), PhD (Lond), MI Biol
Research Assistants ... *S. Kandiah, BSc (Cey)
... *S. Nagarajah, BSc (Cey), MS (Calif)
... *A. R. Sebastiampillai, BSc (Cey)

† When more than one officer is listed under a designation, the names appear in alphabetical order

* Working Overseas

Technical Assistants	...	A. S. B. Gomez, BSc (Cey) D. Janakiram, BSc (Madras), MSc (IARI, New Delhi) S. Krishnapillai, BSc (Cey) H. R. Solomon H. B. Wijetunga S. Wimaladharm
<i>Statistics</i>		
Statistician	...	P. Kanapathipillai, BSc (Lond), FSS
Technical Assistant	...	K. Seevaratnam
<i>Technology</i>		
Technologist	...	D. Kirtisinghe, BSc (Cey), PhD (Lond), DIC, AMIChemE, C Eng
Development Engineer	...	W. Joseph, BSc Eng (Cey)
Research Assistants	...	*N. M. Abdul Gaffar, BSc (Cey)
Technical Assistants	...	*W. C. A. de Silva, BSc (Cey) W. A. C. de Silva S. Jayaratnam, BSc (Cey) S. Samarasingham A. Thevathasan, BSc (Cey)
Electrical Foreman	...	W. R. Solomon
Electrician	...	K. A. Bowie
Mechanics	...	D. A. S. Opatha K. S. Vadivelu

ST COOMBS

Agriculturist	...	L. A. Seevaratnam, BSc (Dunelm)
Head Factory Officer	...	V. A. Fernandez
Acting Head Clerk	...	H. N. de Silva
Field Officer	...	W. Ariyapala
Apothecary	...	S. P. de Silva
Clerk of Works	...	R. A. Daniel
Works Clerk	...	K. H. T. Dassanayake

OUTSTATION SERVICES*Low-Country Service**The Low-Country Station, Ratnapura*

Biochemist	...	R. L. Wickremasinghe, BSc (Cey), BSc (Lond), PhD (Sheff), FRIC
Research Officer	...	D. T. Wettasinghe, BSc (Cey), PhD (Reading)
Advisory Officer	...	J. V. Sabanayagam, BSA (Toronto), MSc (Guelph)
Development Engineer	...	W. Joseph, BSc Eng (Cey)
Technical Assistants	...	E. J. B. de Silva, BSc (Cey) U. L. L. de Silva, BSc (Lond) W. A. B. de Silva, BSc (Cey) C. Kandappah, BSc (Cey) A. A. C. Karunaratne, BSc (Cey) D. D. Kroon K. P. W. C. Perera, BSc (Cey) N. S. Rajendram, BSc (Madras) *T. F. Saldin, BSc (Cey) H. H. Samarakoon U. P. de S. Waidyanatha, MSc (Cey) N. Yogaratnam, BSc (Alahabad)
Administrative Officer	...	C. Kirthiratne, FCCS
Accounts Clerk	...	T. R. B. Sally
Stenographer	...	S. K. P. Tambimuttu
Electrician	...	B. T. Ranasinghe
Works Clerk	...	T. D. V. Cooray

ST JOACHIM

Superintendent	...	G. S. Muttettuwegama
Head Factory Officer	...	M. S. W. Wijeratne
Head Clerk	...	G. L. A. Thomas
Field Officer	...	D. D. Pathinayake

* Working Overseas

REPORT OF THE DIRECTOR

L. H. Fernando, BSc, PhD

STAFF

Dr E. M. Chenery resigned from the post of Director, Tea Research Institute of Ceylon, in July 1968, and was succeeded by Dr L. H. Fernando. Mr J. A. H. Tolhurst, Adviser in Agricultural Chemistry and Agronomy and also Deputy Director, resigned in June 1968. Other senior staff changes were the retirement of Mr A. C. Perera, Chief Administrative Officer, the resignation of Dr A. S. L. Tirimanna (Biochemist) and Mr C. H. Wickremasinghe (Tea Taster), and the promotion of Dr V. S. Kulasegaram and Dr W. M. W. B. Mani-pura to Senior Scientific Staff Grade. Dr R. L. Wickremasinghe, Biochemist, moved to the Low-Country Station, Ratnapura. Dr U. Pethiyagoda was on study leave in the UK and Dr Shanmuganathan in Canada. Dr N. Shanmuganathan and Dr R. L. de Silva were invited to present papers at the First International Congress of Plant Pathology and Dr W. Danthanarayana at the 13th International Congress of Entomology in Moscow ; they were unable to attend but their papers were presented.

Efforts that were made to recruit staff for research proved unsuccessful, and vacant posts in Technology, Entomology and Nematology remained unfilled. This was a serious set back to the conduct of research. The complete list of staff changes is given in *Appendix 5*.

STATIONS

St Coombs secured 397,894 lb of made tea from 243 acres ; the yield of 1813 lb per acre was the highest ever recorded in the history of St Coombs. This is indeed an achievement, when it is compared with the yield of 480 lb per acre in 1928, the year the Tea Research Institute purchased St Coombs. The nett sale average of Rs 2.29 in 1968, was above the average of Rs 1.93 for high-grown teas, and the profit on St Coombs was Rs 282,115.

St Joachim produced 276,665 lb made tea from 260 acres, a mean yield of 1102 lb per acre. The loss incurred on the working of St Joachim over the last three years, consequent on one-third of the acreage being uprooted for replanting, has now been reduced to Rs 26,152 in 1968. The nett sale average of Rs 1.73 for St Joachim teas was above the average of Rs 1.63 for low-grown teas.

The TRI Substation at Kottawa, Talgampola, in the Galle District is now 75 acres in extent, with 35 acres planted in clonal tea. The proceeds from the sale of green leaf covered the full working expenses of this station, including the cost of experiments. A high standard was maintained in the management and development of this station.

A firm decision was taken to purchase 203 acres of tea, patna and scrub land from Agratenne Division of Ury Group, Passara, for the establishment of a research station in lower Uva. Progress was made in the development of this station and the first experiments have already been set down.

The Hantane Investment Company transferred 56 acres of land to the Tea Research Institute in August 1968 for the TRI Mid-Country Station. Substantial progress was made in the development of the Station and in the implementation of an experimental programme.

RESEARCH

No significant differences in yield were generally found when urea was compared against sulphate of ammonia, even with the usual method of broadcasting the fertilizer on the surface of moist soil. Loss of nitrogen from urea and precautions that should be taken to minimize these losses were studied and recommendations were made. In a wide range of fertilizer experiments on TRI Stations and commercial estates, responses to nitrogen were evident, but yield increases with the application of phosphate and potash were disappointing. On the basis of these results, a range of 80 to 200 lb N, 20 lb P_2O_5 , 40 to 80 lb K_2O per acre per year is recommended for seedling tea; and 240 to 360 lb N, 30 lb P_2O_5 and 90 to 120 lb K_2O for VP tea. In young tea, striking responses to nitrogen, phosphate and potash have been obtained. T200 continues to be recommended at $\frac{1}{2}$ oz per plant in the first year and $\frac{3}{4}$ oz in the second year, these applications being made six times per year. When tea is brought into plucking, a fertilizer such as T700 may be used at about 200 lb N per acre per year until pruning is first done.

Zinc sulphate applications up to 20 lb per acre per year have increased yields. Liming has not shown any influence on yield, but has raised the pH of the soil, and is accordingly beneficial where high levels of sulphate of ammonia have increased the acidity of the soil.

Mulching has been found effective, particularly in young tea. The materials used were guatemala, dadap and paddy husk in quantities approaching 20 tons per acre per year. The removal of shade has generally increased the yield of both seedling and clonal tea, but experiments are being continued to determine the consequences of shade removal.

Studies on the physiology of growth and of the various cultural operations that influence growth and yield were continued. Nutrient deficiency symptoms were induced and corrected using sand culture techniques in the glass house. Studies on growth and dormancy were pursued. Plant hormones were used to break dormancy and improve growth of tea shoots, and also to increase the number and growth of shoots following pruning.

Gramoxone at $\frac{1}{2}$ pint in 50 to 60 gallons water applied once in two months has been widely used on estates to control weeds in tea. Some weeds are not

adequately controlled in this way and higher rates and frequencies of application of Gramoxone were found necessary. As this increased costs, other chemicals were tried either as a substitute or a supplement to Gramoxone. Among these diuron at $\frac{1}{2}$ lb per acre was found to control weeds effectively over a period of two months. Alternate round of Gramoxone and diuron are accordingly recommended for trial on estates.

Clones continue to be tested at all TRI Stations. Evaluations of yield, quality, tolerance to pests, diseases and drought have been published in *The Tea Quarterly*. In addition to the usual method of selecting promising bushes in seedling fields, new clones have also been derived by selection in open-pollinated and hand-pollinated progenies. Attempts were also made to obtain desirable characteristics by the use of irradiated cuttings and seed.

Emphasis is now placed on the selection of suitable land for replanting of tea. It is recommended that shallow, eroded soils with underlying rock close to the surface should always be avoided. On suitable soils, rehabilitation with Guatemala Grass is not always necessary. Where no rehabilitation is done, adequate measures are necessary for soil and water conservation, and the growing of a suitable legume between tea rows is advisable. The incorporation of organic matter and top soil in planting holes which should be two ft deep is strongly recommended.

Eelworm damage is not necessarily confined to tea at the higher elevations; more recently poor clonal tea in the mid- and low-country have been found to be affected by the meadow eelworm, *Pratylenchus loosi*. Factors associated with the incidence of eelworm appear to be high nitrogen and a low uptake of potash. Variations in soil moisture have been found to affect the results of soil sampling for eelworm, and an attempt is being made to determine the right time for sampling in each district.

Experiments comparing the use of a winch against uprooting by hand indicate that although initially the eelworm build-up was lower where winching is done, eventually there was no appreciable difference in the two methods either in respect of eelworm build-up and pathogenicity or in the subsequent growth of tea. These results indicate that winching alone is not sufficient, unless it is followed by deep forking and exhaustive removal of tea roots.

The search for eelworm-tolerant clones continues. Of six clones (TRI 2025, 2142, DT1, Mooloya 116, 208 and 241) tested for yield and eelworm tolerance, TRI 2025 appeared to be the best, followed closely by Mooloya 241.

Fundamental aspects of research on *Poria hypolateritia* and other root diseases of tea indicate that only a small quantity of inoculum is required to infect young tea plants. An attempt is being made to determine whether the quantity of inoculum required varies with the age of the tea bush. It has been found that *P.hypolateritia* can survive as a saprophyte in tea root segments in fallow soil for as long as four years. Methyl bromide has given excellent

control of *P. hypolateritia* in large tea stumps, when applied at the rate of one to two lb per 100 sq. ft of infested soil. This finding suggests that *Poria* patches can now be fumigated successfully without digging out the infected stumps. Studies of the effects of soil fumigation with methyl bromide on soil microflora and on the growth of tea and Guatemala Grass continue. Methyl bromide was found to be effective in the control of Charcoal Stump Rot of Tea (*Ustilina deusta*), and *Rosellinia arcuata*.

In the control of Collar and Branch Canker (*Phomopsis theae*) none of the fungicides tested gave satisfactory control of the disease ; even Santar A failed to live up to an earlier expectation. Information on the selection of clones for replanting areas prone to attack by *P. theae* was published in the December 1968 issue of *The Tea Quarterly*.

Studies continue on the epidemiology of Blister Blight (*Exobasidium vexans*) and loss of crop.

Heptachlor is the only alternative to dieldrin that can be recommended at present in the control of Shot-hole Borer. Heptachlor is effective for a maximum period of 15 months. For this reason, and because the peak of shot-hole borer build-up was about 18 months after pruning, heptachlor is most effective as a mid-cycle application.

Morestan and Kelthane are the best acaricides in the control of Red Spider and Scarlet Mites.

A bacterium and a fungus pathogenic to Tea Tortrix were isolated from field populations. These organisms are now being identified. It is found that these reach a peak in the south-west monsoon period and perhaps for this reason tortrix numbers are less during this period. DDT is the best tortrix killer available at present for use in tea, and a single application of DDT was effective for a period of 2½ months. Moreover, DDT applications did not have any adverse effects on the build-up of the tortrix parasite. Spraying insecticides on the frame, drenching the soil, shoot or root or foliar applications of systemic insecticides were not effective in the control of live wood termites. The only method of control available so far was the protection of the frame from the time of planting by annual applications of heptachlor against Shot-hole Borer.

Qualitative and quantitative chemical analyses of different types of tea showed the dissimilarities between green, black and instant teas. Analyses of different parts of the tea bush showed a progressive decrease in polyphenols and amino-acids from the bud to the seventh leaf.

Quantitative determinations of protein provided evidence that there were changes in these compounds during the different stages of manufacture, particularly fermentation. A comparison of the volatile compounds of black tea from St Coombs and St Joachim revealed that linalool and its derivatives, geraniol and cis-jesnone were present in relatively higher concentration in the former than in the latter. Artificial addition of the amino-acid, L-leucine, to tea flush (St Coombs), improved the valuations of the black tea prepared therefrom. Manganese too had a beneficial effect on the valuations, but was detrimental above a certain optimal level. Studies on the metabolism of phosphate have given interesting results.

The study of variations in the microbial populations on tea flush confirmed last year's observation that these change with season. An investigation of peroxidases indicated that these enzymes undergo changes during manufacture.

The process for up-grading St Joachim tea was adopted to orthodox manufacture methods, and more work is in progress on this project. Research in Technology centred round the application of fluidized bed techniques to the drying of tea. This project suffered an unfortunate set back when Axia Fans, who were collaborating with the Institute on this project, changed hands. Experiments with the manufacture of Instant Tea were also carried out in collaboration with the Biochemist. The freeze-dried samples of instant tea represented a very considerable improvement on the teas produced earlier by spray-drying techniques.

The experimental shipment of tea in polythene liners were not as favourably reported on as those in conventional chests on arrival in the UK. CTC teas were manufactured at St Joachim during the early part of the year. These samples found favour with buyers from the UK. A project to manufacture green tea on an experimental basis was also initiated.

Special attention has been paid to the design, analyses and interpretation of the field, laboratory and factory experiments by the Statistician. The complexity and magnitude of the work involved has increased so much that it is intended to programme and process the data of some of the standard designs on a computer, the computer time being hired for this purpose.

LIBRARY AND PUBLICATIONS

Dr E. M. Chenery ceased to function as Senior Editor of the Institute's publications, on his departure from Ceylon on 11th July. Dr L. H. Fernando took over the duties of the Senior Editor, after the departure of Dr Chenery. Dr R. L. de Silva continued to function as Co-editor and continued to overlook the administration of the Library during the year.

Library

In October, the library was moved into the building previously occupied by the Administrative Division. The library is now situated in close proximity to the research staff who have ready access to the reference library and the reading room.

A revision of the mailing list for the publications of the Institute was undertaken towards the end of the year, but will only be fully implemented in 1969.

Publications

Parts I and II of the Annual Report continue to be published as Sessional Papers in Sinhalese, English and Tamil. The sale of the TRI Monograph No. 6 on "Insect and mite pests of tea in Ceylon and their control" were sufficient to cover the cost of printing.

In March, the scheduled number of *The Tea Quarterly* was not published, but a combined March/June number was published in July. The publication of *The Tea Quarterly* returned to normal with the September issue. For the first time in the 40 years history of the journal, summaries of all articles were published in the official language.

The complete list of publications issued by the TRI during the year is given in *Appendix 1* and the list of scientific papers from the TRI, published in international journals during the year is given in *Appendix 2*.

APPENDIX 1

PUBLICATIONS ISSUED BY THE TEA RESEARCH INSTITUTE OF
CEYLON IN 1968

- | | | |
|--|---|--|
| 1 — <i>The Tea Quarterly</i> | — | Volume 39 |
| Parts 1 & 2 | — | March/June 1968 |
| Part 3 | — | September 1968 |
| Part 4 | — | December 1968 |
| 2 — <i>The Tea Quarterly</i> | — | Index to Volume 38 |
| 3 — Annual Report for the year 1966 | — | Part 1 |
| 4 — Annual Report for the year 1967 | — | Part 2 |
| 5 — Sessional Paper No. 20 — Annual Report for the year 1966 | — | Part 1 — Published in Sinhala, Tamil and English |
| 6 — Sessional Paper No. 22 — Annual Report for the year 1967 | — | Part 2 — Published in Sinhala, Tamil and English |
| 7 — SHANMUGANATHAN, N. (1968). " <i>Root diseases of tea</i> ". Tea Res. Inst. Ceylon Advisory Pamphlet 2/66. 11 pp + 8 col. pl. | | |

APPENDIX 2

PAPERS FROM THE TEA RESEARCH INSTITUTE OF CEYLON PUBLISHED
IN INTERNATIONAL JOURNALS AND SYMPOSIA IN 1968

- BHAVANANDAN, V. P. & MEYER, K. (1968). Studies on keratosulfates. *J. biol. Chem.* **243**, 1052-1059.
- KERR, A. & DE SILVA, R. L. (1968). Epidemiology of tea Blister Blight (*Exobasidium vexans*). First International Congress of Plant Pathology, London.
- MACNEILL, B. H. & SABANAYAGAM, J. V. (1968). The induction of dodine tolerance in *Fusarium Oxysporum* f. *melonis*. A technique applicable to the study of bionomics of soil-borne fungal pathogens. *Canad. J. Microbiol.* **14**, 1262-1263.
- MORRIS, P. J., KIRTISINGHE, D. & STRICKLAND-CONSTABLE, R. F. (1968). Retardation of growth of salol crystals in the melt in capillary tubes. *J. Crystal Growth* **2**, 97-105.
- SELVENDRAN, R. R. & ISHERWOOD, F. A. (1968). Identification of guanine derivatives of D-xylose, D-mannose, D-glucose and D-galactose in mature strawberry leaves. *Biochem. J.* **105**, 723-727.
- SHANMUGANATHAN, N. (1968). Studies on the parasitism and control of tea root disease fungi in Ceylon. First International Congress of Plant Pathology, London.
- SIVAPALAN, P. (1968). Association of *Radopholus similis* with decline in young tea fields. *Plant Dis. Repr* **52**, 528.
- WETTASINGHE, D. T. (1968). A preliminary investigation on the effects of two plant factors on simazine toxicity. Ninth British Weed Control Conference, London.

APPENDIX 3

BUILDINGS COMPLETED DURING 1968

The Low-Country Station, Ratnapura

- 1 — Two junior staff houses
- 2 — Three minor staff quarters (one double unit and one single unit)

APPENDIX 4

VISITORS TO THE TEA RESEARCH INSTITUTE OF CEYLON IN 1968

- Mr C. G. Akhurst, Member of the World Bank Mission to Ceylon
 Mrs Jacqueline Amin, S/S Hope, USA
 Sir John Arbuthnot, Chairman, Estates & Agency Co. Ltd, England
 Mr D. Atmer, Berlin, Germany
 Mr O. P. Bagaria, Steelsworth (Private) Ltd, Assam, India
 Mr J. Bain, James Finlay & Co. Ltd, Calcutta, India
 Mr A. W. Banwell, Investment/Development, India
 Mr R. W. Bastian, Consultant, Asian Development Bank, FAO, Rome, Italy
 Mr K. Baloo, Pierce, Leslie & Co. Ltd, South India
 Dr D. S. Bhatia, Coca-Cola Export Corporation, New Delhi, India
 Mr S. K. Banerjee, James Finlay & Co. Ltd, Calcutta, India
 Mr C. M. Bates, Hentley-on-Thames, England
 Dr L. Bateman, Chairman, Malayan Rubber Fund Board, Kuala Lumpur, Malaysia
 Mr R. C. Billman, Monsanto Co., USA
 Mr W. D. Brind, Director, Commonwealth Bureau of Soils, Harpenden, England
 Dr A. K. Banerjee, Hoechst Pharmaceuticals Ltd, Bombay, India
 Mr Alors Benda, Embassy of Czechoslovakia, Colombo
 Dr K. Caesar, Germany
 Mr W. H. W. Coultas, Consultant, Asian Development Bank, India
 Mr D. G. Coursey, Tropical Products Institute, London, England
 Mrs A. Custot, General Delegate, Comite Francais du The, France
 Mr K. de Coureg, Leader of the Indian Tea Machinery Delegation to Ceylon
 Mr A. Dickson, Standard Tea Co. Ltd, London, England
 Dr G. G. Eichholz, Regional Adviser, International Atomic Energy Agency, Vienna
 Mr G. H. Ellis, Engineer, Axia Fans Ltd, Crawley, England
 Mr D. Elz, USA
 Dr K. Engelthaler, United Nation's Office in Ceylon
 Mr Natko Erber, Colombo, Ceylon
 Mr K. H. Ermish, Rhu-Stickstoff A-G, Bochum, Germany
 Mr A. Faure, Asst General Manager, Ste R. Twining & Co., France
 Mr W. R. Feaver, Cadbury Brothers Ltd, Bournville, England
 Mr H. Ferguson, James Finlay & Co. Ltd, Glasgow, Scotland
 Professor J. D. Ferwerda, Agricultural University, Wageningen, Holland
 Mr G. M. A. Fuller, Weybridge, England
- His Excellency the Governor-General of Ceylon (Mr W. Gopallawa, MBE) and his party:
 Mr A. B. Elkaduwa, Secretary to HE the Governor-General
 Major A. T. Nugawela, ADC to HE the Governor-General
 Mr F. C. Pietersz, Government Agent, Nuwara Eliya
 Mr H. Kobbekaduwa, Deldeniya, Menikdiwela
- Mr A. V. Ghate, Velsicol-Chemical Corporation, New Delhi, India
 Mr W. C. C. Gorst, George Williamsons Africa Ltd, Nairobi, Kenya
 Dr P. O'Hagen, Member of the World Bank Mission to Ceylon
 Mr R. C. Hampel, Plant Protection Ltd., England
 Mr A. S. M. Haq, Commercial Secretary, High Commission for Pakistan in Ceylon
 Mr C. J. W. Haines, Brooke Bond Liebig Ltd, London, England
 Miss E. Helton, AUX Provinces Gourmandes, Paris, France
 Dr R. F. Homer, National Research Development Corporation, England
 Dr P. Horst, Berlin, Germany
 Mr Isamu Itoh, Mitsui Norin KK, Tokyo, Japan
 Mr H. S. Jackson, Chairman, Matheson Bosanquet & Co Ltd, Coonoor, South India
 Mrs V. Jakovlic, Professor of the University of Rijeka, Yugoslavia
 Mr Jakovlic, Ingra, Yugoslavia
 The Hon. Major Montague Jayewickrema, MP, Minister of Public Works, Posts & Telecommunications, Ceylon
- Mr Bong H. Kay, Leader of the Asian Development Bank team to Ceylon
 Dr G. Kemmler, Bunteh Research Station, Hannover, Germany
 Mr Tony Key, Berks, UK
 Dr A. Kerr, Waite Agricultural Research Institute, South Australia
 Mr R. W. Kettlewell, Hunting Technical Services Ltd, England
 Dr R. Kincaid, Embassy of the United States of America, New Delhi, India
 Mr A. H. J. Kroon, Agronomist, FAO, Rome, Italy
 Mr B. Kumaran, Upper Waterfield, South India
 Mr D. W. Lewis, University of Oxford, England
 Dr & Mrs D. M. Mackay, East Pakistan
 Mr Lindsay Mackie, London, England
 Mr C. J. L. Madden, Director, Rowe, White & Co., London, England
 Dr Z. Mathioudakis, Greece
 Mr J. Maurice, George Williamson & Co. Ltd, London, England
 Mr L. R. McCutchen, Dow Chemical N.V. Kuala Lumpur, Malaysia
 Mr D. E. Minshull, Trade Development Officer, Ceylon Tea Centre, London, England
 Mr B. M. Mukerjee, Member of the Indian Tea Machinery Delegation to Ceylon

Commander & Mrs G. R. Muir, James Finlay & Co. Ltd, Glasgow, Scotland
 Mr T. Murayama, Nippon Soda Co. Ltd, Tokyo, Japan
 Mr M. M. Muthiah, Chairman, Association of Planters of Madras State, India
 Mr G. S. Napier-Ford, Somerset, England
 Mr H. R. Neutatz, Berlin, Germany
 Dr Susumu Nishigaki, National Institute of Agricultural Sciences, Tokyo, Japan
 Mr B. K. G. Niyogi, Andrew Yule & Co. Ltd, Calcutta, India
 Mr A. N. Norris, Malayakum Plantations Ltd, South India
 Mr Jiro Otha, Mitsui Norin KK, Japan
 His Excellency the High Commissioner for Pakistan in Ceylon, Mr H. K. Panni
 Mr R. M. Patel, General Manager, Madhavani Sugar Works Ltd, Uganda
 Mr L. M. Patel, American Spring & Pressing Works, Pvt Ltd, Bombay, India
 Mr S. J. Perkins, FMC International, USA
 Dr H. C. Pereira, LA Division, FAO, Rome, Italy
 Mr A. L. Perera, Post-Master General of Ceylon
 Mr E. Ratcliff, Co-op Tea Society, Glasgow, Scotland
 Mr J. Reinfrank, Berlin, Germany
 Dr E. Rochecouste, DuPont Far East Inc., Australia
 Mr V. Romer, Frankfurt/Main, West Germany
 Mr J. Rünner, President, Comite Francais du The & Mrs Runner
 Mr Max I. Salhuteru, Government Estate Group, West Java, Bandung
 Mr M. M. A. R. Sameha, Trade Representative for the United Arab Republic in Colombo
 Mr E. Schroder, Berlin, Germany
 Mr N. H. Sethna & Mrs Sethna, Bombay Trading Corporation Ltd, South India
 Mr W. Y. Sharpe, Malayalam Plantations Ltd, South India
 Mr Rafael Sison, Project Economist, Asian Development Bank, Bangkok, Thailand
 Mr C. J. Strachan, General Manager, Anglo Ceylon & General Estates Co. Ltd, England
 Mr R. L. Stone-Wigg, The African Highlands Produce Co. Ltd, Kericho, Kenya
 Sir William & Lady Strath, Piccadilly, London
 Mr M. S. Sydney-Smith, Geneva, Switzerland

The Royal Tea Commission

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 Mr Andrew Wemyss, Sotick Tea Co. Kenya
 Mr J. H. Wertheim, O. H. Clapp & Co. Inc, USA
 Mr D. R. M. Whitaker, Velsicol International Corporation, Singapore
 Mr S. Klaus Wiedemann, Berlin, Germany
 Mr K. D. Wilde, Embassy of the Federal Republic of Germany in Ceylon
 Mr W. T. Williams, Mincing Lane, London, England
 Mr J. R. P. Williams, Rowe White & Co. Ltd, London, England
 Mr W. J. Woodman, Velsicol International, Singapore
 Mr David Wyndham-Lewis, London, England

APPENDIX 5

STAFF CHANGES—1968

Appointments

Directorate

Dr L. H. Fernando, Acting Director from 11.7.68
 Dr L. H. Fernando, Director from 1.10.68

Senior Staff

Dr P. Sivapalan, Head of the Nematology Division from 1.1.68
 Mr P. Kanapathipillai, Acting Chief Administrative Officer from 1.11.68

Intermediate Staff

Nil

Junior Staff

Mr R. I. Pereira, Accounting Assistant from 23.4.68
 Mr M. B. Palies, Senior Accounts Clerk from 9.5.68
 Mr S. Jayaratnam, Technical Assistant, Technology Division from 14.7.68
 Mr K. D. Bandularatne, Technical Assistant, Entomology Division from 1.8.68
 Mr R. N. Bopearatchy, Technical Assistant, Plant Pathology Division from 1.8.68
 Mr W. A. B. de Silva, Technical Assistant, Biochemistry Division from 1.8.68
 Mr V. Shivanandarajah, Technical Assistant, Nematology Division from 1.8.68
 Mr A. B. D. Wickremaratne, Technical Assistant, Agricultural Chemistry Division from 1.8.68
 Mr K. D. L. Nanayakkara, Accounts Clerk, Low-Country Station from 18.9.68
 Mr T. R. B. Sally, Chief Clerk, Low-Country Station from 1.11.68

Minor Staff

Mr K. C. W. M. A. Chandrasekera, Laboratory Attendant, Plant Pathology Division from 1.9.68

Resignations

Mr B. P. Jones, Stenographer/Typist/Clerk from 31.3.68
 Mr G. T. Karunasena, Laboratory Attendant, Plant Pathology Division from 31.3.68
 Mr W. R. F. Rodrigo, Technical Assistant, Plant Pathology Division from 28.5.68
 Mr M. Sikurajapathy, Technical Assistant, Agricultural Chemistry Division from 30.5.68
 Mr J. A. H. Tolhurst, Deputy Director and Adviser in Agricultural Chemistry and Agronomy from 6.6.68
 Mr H. B. Herath, Technical Assistant, Entomology Division from 15.6.68
 Dr E. M. Chenery, Director from 10.7.68
 Mr A. Nanayakkara, Technical Assistant, Plant Physiology Division from 31.8.68
 Mr K. C. W. M. A. Chandrasekera, Laboratory Attendant, Plant Pathology Division from 2.10.68
 Dr A. S. L. Tirimanna, Biochemist (Flavour Research) from 31.10.68
 Mr K. D. L. Nanayakkara, Accounts Clerk, Low-Country Station from 20.11.68
 Mr U. P. de S. Waidyanatha, Technical Assistant, Low-Country Station from 30.11.68

Retirements

Mr A. H. B. Dias, Accounting Assistant from 31.3.68
 Mr A. C. Perera, Chief Administrative Officer from 31.10.68

Termination of Services

Mr D. W. Wickremaratne, Accounts Clerk from 17.10.68

Overseas Training**Arrivals**

Mr J. V. Sabanayagam, Advisory Officer, Low-Country Station returned after post-graduate training from Canada on 6.6.68
 Dr N. Shanmuganathan, Plant Pathologist, returned after post-doctoral research from Canada on 2.10.68
 Mr K. Sivapalan, Technical Assistant, Biochemistry Division, returned after post-graduate training from India on 15.10.68
 Dr R. R. Selvendran, Research Officer, Biochemistry Division, returned after post-graduate training from the UK on 23.10.68

Departures

Dr U. Pethiyagoda, Plant Physiologist, was awarded a Nuffield Foundation Fellowship for post-doctoral research in the UK and left Ceylon on 5.3.68
 Mr R. K. Nathaniel, Advisory Officer, was awarded a Colombo Plan Scholarship for post-graduate training in Canada and left Ceylon on 23.8.68
 Mr N. M. Abdul Gaffar, Research Assistant, Technology Division, was awarded a Colombo Plan Scholarship for post-graduate training in the UK and left Ceylon on 26.9.68
 Mr S. Sandanam, Research Assistant, Agricultural Chemistry Division, was awarded a Colombo Plan Scholarship for post-graduate training in the UK and left Ceylon on 29.9.68

REPORT OF THE AGRICULTURAL CHEMISTRY DIVISION

Agricultural Chemist — V. P. Bhavanandan, BSc, PhD, ARIC

General

Mr J. A. H. Tolhurst left Ceylon in June after serving the Tea Research Institute for fifteen years as Agricultural Chemist. Mr S. Sandanam proceeded to the United Kingdom in September for his postgraduate training. Mr S. Sivasubramaniam continued his training at the Rothamsted Experimental Station. Mr M. Sikurajapathy, Technical Assistant, resigned from his post on 30th May and was replaced by Mr A. D. P. Wickremaratne on 1st August.

Laboratory Investigations

Chemical and physical analyses of soils

The aim of this investigation is to compare the chemical status of soils from the different tea districts of Ceylon. Soils from tea fields and undisturbed jungle soils from St Coombs, St Joachim, Hantane, Passara and Kottawa are being analysed for the following physical and chemical properties: texture, colour, pH, organic carbon, nitrogen, acid soluble K & P, cation exchange capacity, exchangeable cations (potassium, calcium, magnesium, sodium) and the more important trace elements. After reviewing the results of these analyses the survey will be extended to other districts, if this is considered worthwhile. It is hoped that the results of such a survey will help in advising estates regarding their fertilizer programmes and also in interpreting and comparing the results from the fertilizer extension experiments in different districts.

T. C. Z. Jayman

Correlation between leaf and soil manganese

The objective of this experiment is to find the best method for estimating plant-available manganese in the soil. Soils from fourteen plots of a shade experiment at the Mid-Country Station were analysed for total manganese and for extractable manganese using the following three extractants: Morgan's (pH 4.8), ammonium acetate (pH 7.0) and ammonium acetate-quinol. Leaves from the same plots were also analysed for total manganese. Statistical analysis of the results showed that the leaf manganese values could not be correlated with any of the four values obtained for the soils. The search for the correct extractant will be continued. The results from this experiment will be very useful in view of the finding that leaf manganese plays an important role in the development of flavour (Wickremasinghe, Perera and de Silva 1969).

T. C. Z. Jayman

Ammonium nitrogen vs nitrate nitrogen for tea in sand culture

In order to investigate whether tea prefers ammonium or nitrate nitrogen two sets of tea plants of clone DT 1 were established in sand culture. After the plants were growing actively, one set of plants was given a balanced nutrient solution containing sulphate of ammonia labelled with N^{15} as the only source of nitrogen. The second set of plants was also given the balance nutrient solution but containing potassium nitrate labelled with N^{15} as its only source of nitrogen. At the end of ten weeks, two plants from each set

were separately fractionated into the following components: ammonium amide; nitrate; caffeine; amino acids and protein (residue). The individual components were digested with sulphuric acid and hydrogen peroxide. After determination of total nitrogen, the digests were sent to the IAEA laboratories in Vienna for analysis of percentage excess N^{15} .

The results indicated that under the conditions of this experiment, young tea plants of clone DT 1 were able to assimilate both forms of nitrogen. It is intended to pursue these studies after some arrangements are made for the N^{15} analysis, and when more of the expensive N^{15} compounds can be purchased. It is necessary to carry out similar experiments in soils, firstly in pots and later in the field. The behaviour of the tea plants growing in soil might be different from those growing in sand culture because of the importance of pH for the growth of tea and the difficulty in controlling pH in sand-culture experiments.

T. Kularatna

pH and the growth of tea

It is well known that nitrification occurs readily in soils of high pH. It is, therefore, reasonable to expect that the ammonium content of soils with high pH will be low in comparison to that of the soils with low pH. This experiment is designed to find out whether there is a relation between the poor growth of tea plants in soils with high pH and the absence of ammonium nitrogen in these soils. Tea plants of clone TRI 2025 were planted in four sets of ten pots each, filled with treated soils, as follows:

- 1st set — Soil adjusted to pH 7.2 with Limbux
- 2nd set — Soil adjusted to pH 7.2 with Limbux, mixed with N-Serve* at 5 ppm and then fumigated with methyl bromide to minimize nitrification
- 3rd set — Soil adjusted to pH 7.2 with Limbux
- 4th set — Soil pH 5.2, mixed with N-Serve at 5ppm and fumigated with methyl bromide.

Some difficulties are being experienced in establishing the young plants in the pots. The growth is generally poor, most plants developed a scorch and a few died. The dead ones have been replaced and after they are well established, the 1st, 2nd and 4th sets will be given 10 g of T 200 fertilizer mixture per year in four applications every three months.

The third set will receive the corresponding quantity of T 200 without the ammonium sulphate in the same number of applications. The ammonium sulphate for this set will be given separately as a solution, in weekly applications. If the experiment is successful, the effect of high pH and rapid nitrification on the growth of tea plant can be compared with the effect of high pH alone, with nitrification inhibited. Further, from set 3 the effect of frequent applications of ammonium nitrogen to tea plants growing in soil of high pH can be assessed. An attempt is also being made to duplicate this experiment using soil with a naturally high pH (7.2). In this experiment aluminium sulphate will be used to decrease the pH of the soil required for the 4th treatment.

T. Kularatna

* N-Serve (2-chloro-6-trichloromethyl pyridine) is a compound marketed by the Dow Chemical Co., USA, and is known to inhibit nitrification when mixed with soil.

Studies on the enzyme urease

The enzyme urease hydrolyses urea applied to the soil to ammonium carbonate, thereby making the nitrogen available to plants. This enzyme has also been detected in certain plants. It was detected in the fleshy tea roots and in tea flush. On an average, the enzyme present in 100 g of flush released about 60 mg N as ammonia from urea, under optimal conditions. In addition to this enzymatic conversion of urea to ammonia, a high degree of non-enzymatic hydrolysis of urea was noticed in the boiled tea flush homogenates.

Urease in tea soils

The urease activity of the soil is important for the utilization of urea applied to the soil as fertilizer. This enzyme is usually present in large quantities in biologically active soils, because microorganisms hydrolyse urea enzymatically.

In experiments with St Coombs soils the following information was obtained :

1 — The urease activity of tea soils, as in other soils, is of two types :

- (a) extracellular activity, adsorbed on soil colloids and humified organic matter, and
- (b) activity caused by the metabolizing ureolytic microorganisms.

Both types are almost completely destroyed on autoclaving the soil; the second type can be selectively inhibited by the addition of toluene.

2 — The urease activity in the soil decreases with depth.

<i>eg</i>	Depth in inches	0-6	6-12	12-18	18-24
	Urease number*	39.6	23.7	14.8	13.9

3 — It appears that the application of urea to the soil increases the urease activity of the soil, as shown below:

Treatments (Soils from Experiment A4)	Urease Number (Average of 8 determinations over 2 months)
Urea	37.7
Calcium ammonium nitrate	28.6
Sulphate of ammonia	21.3

Urease and copper inhibition

In this experiment, the inhibition of urease activity in the soil by copper (as copper sulphate & Perenox) was investigated. It was found that large quantities of copper inhibited the activity of this enzyme, *eg* 500 ppm of copper added to the soil caused a 19% inhibition of the urease activity. The urease activity of the soils from the Plant Pathology Experiment P26 were examined

* The urease number gives the quantity of urease contained in 100 g soil, *eg* Urease number 1 corresponds to the quantity of enzyme in 100 g soil which hydrolyses 1 mg of nitrogen as ammonia from urea, under the specified conditions.

to investigate whether the Perenox used for blister blight control has any effect on the urease activity of the soil. The plots in this experiment received six doses of Perenox (0, $\frac{1}{2}$, 1, 2, 4 and 8 oz per acre) at weekly intervals for three years. There was no statistically significant difference in the urease activity between the six treatments.

Urease and soil fumigation with methyl bromide

It is known that fumigation of soil with methyl bromide destroys a wide variety of microorganisms normally present in the soil. Investigations showed that the urease activity of the soils fumigated with methyl bromide at 1 lb and 4 lb per 100 sq. ft decreased to 60% and 45% respectively, of the original value, one week after fumigation. It was further noted that even after 11 weeks of fumigation the urease activity did not reach the original value.

V. Fernando

Volatilization losses from urea applied to the soil

Some of the urea applied to the soil may be lost by volatilization of ammonia after the urea is converted to ammonium carbonate by the enzyme urease. The degree of loss will depend on the properties of the soil as well as on weather conditions. Some of the factors affecting these losses are pH, cation exchange capacity, moisture content, temperature, rainfall and sunshine patterns. Some preliminary studies carried out on this problem gave the following information :

- 1 — The percentage losses of nitrogen from urea, sulphate of ammonia and calcium ammonium nitrate broadcast on soil was measured in different locations at St Coombs. The figures are given below:

Treatment	Loss of nitrogen into the atmosphere (%)				
	Location No.	1	2	3	4
Urea		33.0	10.7	39.9	24.6
Ammonium sulphate		4.7	3.8	4.5	0.2
Calcium ammonium nitrate		1.8	3.7	2.9	0.4

- 2 — In most experiments, the losses from urea reached a maximum between the third and fourth days after application and was negligible after about three weeks. The results under very dry conditions may be different.
- 3 — The quantity of nitrogen lost was proportional to the rate of application of urea :

Dose of urea (lb N per acre)	Nitrogen lost as ammonia (%)
125	8.9
100	6.9
75	2.7
50	2.0

The figures are from only one experiment; the absolute values do not, therefore, mean much.

4 — Different methods of application of urea in the field were investigated in order to minimize volatilization losses. The following is the approximate order of efficacy of the methods tested, as compared with broadcasting:

- (a) Burying of urea to a depth of 3 in.; deep forking-in of urea; injection of urea solution to depths of $4\frac{1}{2}$ in. and 6 in.
- (b) Broadcast followed by spraying of water—simulated rainfall (see below).
- (c) Spraying of urea solution on soil.
- (d) Dibbling in of urea using hand forks.

In a typical simulated-rainfall experiment the figures given below were obtained.

Simulated rainfall (inches)	N lost as ammonia (%)
0.1	2.2
0.2	0.7
0.3	0.5
0.5	0.2

Field Experiments A7, A14 and A17 are being initiated to extend this investigation on the efficiency of the methods of application of urea on an estate scale.

V. Fernando

Studies on the leaching properties of urea

The movement of urea in soil in relation to ammonium and nitrate ions was studied using chromatographic columns packed with fresh soil from the field. The results indicated that urea was partly retarded in comparison to nitrate ions which emerged right away from the column. In comparison, however, ammonium ions were eluted only slowly and continuously. It is, therefore, possible that urea is held by some weak adsorption forces on to the soil colloids. An experiment is being planned to study the leaching of urea under field conditions.

V. Fernando

Fertilizer mixtures and nitrogen losses

The strong odour of ammonia which emanated from some of the fertilizer mixtures that were being handled by us prompted an investigation into the losses of nitrogen as ammonia from fertilizer mixtures. Some initial experiments indicate that fertilizer mixtures consisting of sulphate of ammonia and saphosphosphate slowly and uniformly lost nitrogen as ammonia. Over a period of 38 days a mixture of sulphate of ammonia and saphosphosphate lost 4.9% of its nitrogen as ammonia. Addition of muriate of potash to the above mixture did not prevent the loss of ammonia. Losses from mixtures where sulphate of ammonia was substituted by urea were negligible (less than 0.1%). Further investigation is necessary to determine the causes for these losses. It is possible that some substance in saphosphosphate may be responsible.

T. Kularatna

Yield potential of VP tea

The yield potential as well as the other characteristics of a plant are inherent in the plant and will depend on one or more factors. If in the case of VP tea it is possible to determine factors controlling its yield potential, then it would be easier to predict the yield that a particular clone is capable of giving than it is at present. The yielding capabilities of clones are now assessed by long-term (several cycle) and tedious field experiments.

It is reported (Chiranjeevi Rao, Krishnamurthy & Thuljaram Rao 1967), that the yield potential of sugar cane varieties can be correlated with the cation-exchange capacity of the sett roots. Investigations were initiated to determine whether such a relation existed in the case of VP tea. Young tea plants of clones of widely differing and known yield potentials were selected for this study. After the methods are worked out, the cation-exchange capacities of the feeder roots of these clones will be determined to see whether these values have any correlation with the yield characteristics of each clone.

S. Kulasegeram & A. D. P. Wickremaratne

Field Experiments and Trials

Experiment A11 was abandoned.

A1 — NPK at No. 3 Field, St Coombs — (1931)

Yield response for the first and second years of the 12th cycle are shown in Table 1.

TABLE 1 — *Yield response for the first and second years of the 12th year cycle*

	Treatments (lb per acre per annum)	First year (lb per acre per annum)	Second year (lb per acre per annum)
N	120	697	942
	180	688	1029
	240	728	1126
P ₂ O ₅	0	575	889
	30	798	1134
	60	740	1075
K ₂ O	0	382	542
	75	884	1273
	150	847	1283
LSD	<i>P</i> = 0. 05	85	112
	<i>P</i> = 0. 01	115	152
	<i>P</i> = 0.001	153	201

There was no significant response to nitrogen during the first year of the 12th cycle but in the second year, nitrogen gave a significant response. A highly significant response to 30 lb P₂O₅ was obtained for both first and second years but there was no further response to an additional 30 lb P₂O₅. Similarly, for K₂O the response to 75 lb was marked in the first and second years with no further increase in response to an additional 75 lb K₂O.

A2 — NPZn, lime at No. 9 Field, St Coombs — (1962)

Liming treatments were introduced into this experiment in the second cycle. Details of treatments in the second cycle were given in the Annual Report

for 1966. The summarized results for the first 24 months of the second cycle are given in Table 2. Results were analysed separately for replicate 1 and replicate 2 because the lime treatments given to each replicate varied.

TABLE 2 — *Yield response for the first 24 months of the second cycle*

	Treatments (lb per acre per annum)	Yield (lb per acre per annum)	
		Replicate 1	Replicate 2
		N	150 300 450
ZnSO ₄	0 10 20	2813 2828 3094	2759 2894 3172
LSD <i>P</i> = 0.05		168	177

There was no significant response to the phosphate and liming treatments. Response to both nitrogen and zinc sulphate was linear and significant. A detailed examination of soil pH was carried out at two depths in December 1968 and the results are presented in Table 3.

TABLE 3 — *Effects of nitrogen and liming treatments on soil pH at two depths*

Soil depth (inches)	Replicate—1 N (lb per acre per annum)			Replicate—2 N (lb per acre per annum)		
	150	300	450	150	300	450
0 — 6	4.23	3.86	3.79	4.37	4.06	3.98
LSD (<i>P</i> = 0.05)			0.11			0.13
6 — 12	4.22	3.93	3.87	4.43	4.17	4.07
LSD (<i>P</i> = 0.05)			0.08			0.14
	Lime (tons per acre)* 0 1			Lime (tons per acre)* 0 2		
0 — 6	3.88	4.04		3.96	4.31	
LSD (<i>P</i> = 0.05)		0.05			0.08	
6 — 12	3.95	4.07		4.07	4.38	
LSD (<i>P</i> = 0.05)		0.05			0.09	

*Only one application of lime was given at the beginning of the cycle.

There was a marked decrease in pH with increasing levels of nitrogen at the two soil depths examined. The application of one ton of lime had a small but a significant effect on soil pH at both depths. With two tons of lime per acre soil pH was raised markedly at both depths.

A8 — NPK on clone TRI 2024 at No. 8 Field, St Coombs — (1962)

After the first prune in September 1967, the plots were brought into plucking in March 1968. Levels of nutrients tested in the second cycle are the same as for the last year of first cycle. Yield data for the first year after pruning

were analysed and the results are presented in Table 4. As in the previous cycle, the results were summarized for the two groups of blocks separately. Group 1 gives markedly higher yields than Group 2.

TABLE 4 — *Yield response for the first year of second cycle*

Treatments (lb per acre per annum)	Group 1 Yield (lb per acre per annum)	Group 2 Yield (lb per acre per annum)
N		
100	1251	953
200	1413	1221
300	1406	1089
P ₂ O ₅		
0	1387	1141
50	1320	1148
100	1361	975
K ₂ O		
0	1364	1052
62.5	1394	1061
125	1312	1150
Mean for control plots	638	448
LSD (<i>P</i> = 0.05)	58	165

Response to fertilizer levels was generally small during the first year of the second cycle. In Group 1 where the yield levels are high, there was a significant response up to 200 lb N but no further increase in yield with 300 lb N. Similar trends were also evident for nitrogen in Group 2. There were no consistent trends in the response to phosphate and potash in either group.

A10 — *N, K on clone E 727 at Walaha, Tangakelle Group, Lindula — (1965)*

After the pruning in June 1967, the plots were brought into plucking in November 1967. Out of the 54 plots laid out originally 36 plots were selected for the fertilizer trial. This design is of the split-plot type, nitrogen being applied to the main plots and levels of potash to the subplots; there are four replicates.

Nutrient levels tested are:

N (lb per acre per annum)	200	300	400
K ₂ O (lb per acre per annum)	0	75	150

The first treatments were given in May 1968 and no yield analysis will be made at this early stage of the experiment.

A12 — *NPK at No. 3 Field St Coombs — (1966)*

The plots were pruned in July 1968. A complete statistical analysis of the results was carried out for the yield totals of the first cycle (27 months only). The summarized results are presented in Table 5.

TABLE 5 — *Yield totals for 27 months of the first cycle*

Nitrogen (lb per acre per annum)	Yield (lb per acre)	K ₂ O (lb per acre per annum)	Yield (lb per acre)
90	2323	0	3582
180	3231	75	3708
270	3955	150	3867
360	4393	—	—
450	4693	—	—
LSD (<i>P</i> = 0.05)	517		224

There was a marked response to levels of nitrogen though the yield increments due to nitrogen beyond 270 lb N tended to be small. Both the linear and quadratic effects of N were, therefore, very highly significant. No response to phosphorus has yet been observed in this experiment but a significant response to potassium was obtained at the 5% level of probability.

W. B. Manipura, A. D. P. Wickremaratne & S. G. Jayasuriya

MA1 — *Nitrogen, potassium and shade on seedling tea at Hantane Estate, Kandy — (1966)*

This experiment is described in the Report on the Mid-Country Station (see page 148).

Field experiments with urea

A4 — *Type of nitrogen at No. 9 Field — (1961)*

In this new cycle the treatments, viz sulphate of ammonia, urea and calcium ammonium nitrate at two levels of N (150 and 300 lb per acre), remain unchanged. The tea was tipped and brought into plucking on 21st January 1968. In the first year (eight plucking months) of this cycle there was no statistically significant difference in yield either for the types or for the levels of nitrogen.

S. Sundaralingam

A5 — *Frequency of application of nitrogen at No. 13 Field — (1963)*

In this second experimental cycle, sulphate of ammonia was replaced by urea. The tea was tipped and brought into plucking on 11th February 1968. The levels of nitrogen (120 and 240 lb per acre) were maintained throughout, but the frequency (2,3 and 4 applications per year) was reintroduced only from September of this year. For the period ending August 1968, there was no significant difference in yield for the levels of nitrogen.

S. Sundaralingam

A7 — *Nitrogen distribution at No. 13 Field — (1963)*

Again, in the new cycle urea was substituted for sulphate of ammonia. The tea was tipped and brought into plucking on 11th February 1968. From December a new treatment, namely methods of application, was introduced in this experiment to study the effect of forking in of urea. The present treatments, therefore, consist of

- a) — two levels of urea (75 and 225 lb N per acre)
- b) — two methods of distribution of urea (alternate and double row)
- c) — two methods of applications of urea (broadcast and forking in) replicated four times in randomized blocks.

The results upto the end of November, ie before the introduction of the new factor, were statistically analysed. The difference in yield between the two levels of nitrogen is significant at the 1% level of probability. As in previous years, there was no significant difference in yield between the two methods of distribution of nitrogen.

S. Sundaralingam

A14 — 3 levels of nitrogen (urea), 3 levels of potassium, 3 frequencies of application and 3 methods of application of urea on VP tea at Tangakelle Group, Lindula — (1967)

The 81 treatment combinations were allocated to the plots and the pre-treatment yield data analysed to check for inherent variations. The treatments will start early in 1969.

M. Sikurajapathy & C. C. Rajasingham

1968 Experiments

A17 — 3 levels of urea and 3 methods of application on VP tea at No. 8 & No. 16 Fields — 3 × 3 randomized block design replicated 3 times — (1968)

Thirty plots were laid out in three different clonal areas and pre-treatment yields are being recorded. Treatments will start early in 1969.

S. Sundaralingam

A22 — Damage to tea leaves resulting from foliar applications of urea — (1968)

In order to find the optimum concentration of urea solution that can be sprayed on tea foliage without damaging the bush, a few observation trials were carried out.

It was found that urea solutions upto 3% concentration at the rate of about 100 ml per bush sprayed with a knapsack sprayer did not cause visible damage to the bush. A 4% urea solution at the above rate caused some slight scorch on the foliage; the scorch was reduced considerably when a spreader like Teepol was added to the solution before spraying. Solutions of 5 and 10 % concentrations were found to induce scorch the latter, rather severely. An experiment is being planned to compare the efficacy, with regard to crop increase, of knapsack spraying and mistblowing of urea solutions on mature tea.

S. Sundaralingam

Experiments on spacing and bringing into bearing

A9 — Clonal spacing at Nos 2 and 7 Fields, St Coombs — (1964)

This experiment continues to get uniform fertilizer treatment in order to evaluate the residual effects of the NPK mixture (T 200) applied during the first 15 months from planting. Table 6 shows the yield trends for the 4th year from planting, ending in July 1968. Figures under 'Initial N treatment' refer to nitrogen equivalent of the initial 15-month-treatment; all plots have since received 240 lb N per acre per annum. Residual effects of the initial fertilizer levels were still evident.

TABLE 6 — Residual effect of varying levels of T 200 in the first 15 months from planting — 4th year yields — A9 — St Coombs

Initial N treatment (lb / acre)	Present N treatment (lb / acre)	Yields (lb / acre)
16.6	240	1672
83.3	240	1832
150.0	240	1979
LSD ($P = 0.05$)		159

Table 7 shows the effect of clone and spacing treatments tested in this experiment.

TABLE 7 — Yield from clones spaced differently for the 4th year

Clone	Yield (lb per acre per annum)
TRI 2024	2088
DT 1	1854
TRI 777	1541
Spacing	
14	1893
28	1799
42	1791
LSD ($P = 0.05$)	159
LSD ($P = 0.01$)	214

Spacing indicated in the Table are distances between plants in the row, rows being four ft apart. Clonal differences are still marked but the yield differences resulting from varying the spacing were not significant.

A15 — *Bringing-into-bearing and spacing of VP tea at No. 3 Field, St Coombs — (1967)*

The methods of bringing-into-bearing being tested in this experiment are:

- 1 — Two bendings followed by cutting across at 14 in. and tipped at 18 to 21 in. and brought into plucking,
- 2 — Cut at six in., then at 14 in. and tipped at 18 to 21 in. and brought into plucking,
- 3 — Cutting at six in. followed by bending of the axillary branches. New shoots are cut at 14 in. and tipped at 18 to 21 in. and brought into plucking.

These treatments are studied in relation to three clones, DT 1, TRI 2142 and TRI 2025, and three spacing *viz* 10½, 21 and 42 inches within the row, the rows being four ft apart.

The initial bending and cut-across treatments were given in December 1967. There were many casualties during the drought in early 1968. Analysis of variance was carried out on the percentage deaths (data transformed before analysis) and the summarized results are shown in Table 8.

TABLE 8 — *Effect of spacing and bringing-into-bearing treatments on percentage deaths of different clones during the drought in early 1968*

Clone	% deaths	Trnasformed data
DT 1	9.5	17.92
TRI 2142	1.7	7.37
TRI 2025	8.9	17.40
Spacing (inches)		
10½	6.3	14.54
21	5.7	13.79
42	6.1	14.34
Method of bringing-into-bearing		
Bent only	1.1	6.06
Cut only	10.9	19.24
Cut and bent	8.9	17.38
LSD ($P = 0.05$)	—	2.10
($P = 0.01$)	—	2.83
($P = 0.001$)	—	3.76

Clones DT 1 and TRI 2025 were adversely affected by the drought, this effect being mainly because of the poor conditions of the nursery plants of these two clones. When the plants were cut at six in. there were only a few leaves remaining on the plant. The two cutting treatments, therefore, resulted in a greater number of casualties than those from the bending treatment. Spacing had no significant effect on percentage deaths. This experiment will be brought into plucking in July 1969.

W. B. Manipura, S. Sandanam & S. G. Jayasuriya

Shade experiments

A13 — 3 levels N on 3 clones with 3 levels of shade at No. 3 Field — (1966)

The experiment was planted out in July 1968. The three levels of shade are: no shade, *Acacia pruinosa* spaced 24 ft × 24 ft, and 24 ft × 12 ft apart. Three clones, TRI 2142, TRI 2025 and TC 9, and three levels of N are allocated to the subplots within the shade treatments; there are three replicates. Uniform fertilizer (T 200) will be given for the first two years. At the end of this period the nitrogen treatments will be applied.

UA2 — 3 levels of shade, 3 methods of bringing-into-bearing on 5 clones at the Agratenne Substation — (1966)

The plots were demarcated and tea was planted in November 1968. No results are available.

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Rehabilitation experiments

A16 — Rehabilitation Experiment Nos 11 and 13 Fields — (1967)

A second set of blocks of old tea was uprooted and planted in Guatemala grass in August 1968. It is proposed to plant VP tea in all blocks in July 1969.

1968 Experiments

A18 — Guatemala grass (*Tripsacum laxum*), Mana grass (*Cymbopogon confertiflorus*) and *Crotolaria anagyroides* each at 3 levels of nitrogen as soil rehabilitation crops at No. 5 Field — 4 replicates of 9 treatments in randomized blocks — (1968)

The three rehabilitation crops were planted in an old-tea area which was uprooted in July 1968. The growth of the three crops are being studied at 3 levels of N. The results are not yet available.

A19 — Rehabilitation vs none at No. 3 Field — Paired plots — (1968)

Fifteen pairs of plots were marked out in two adjoining areas; 15 plots, on land rehabilitated with Guatemala grass for two years, and the other 15 plots on land where the old tea was uprooted in April 1968, with no subsequent rehabilitation. The plots which were not rehabilitated, were fumigated with methyl bromide at the rate of $\frac{1}{2}$ lb per 100 sq. ft. All plots were planted with clone TC 9 in June 1968. Apart from the excellent weed control obtained in the fumigated plots till the end of the year, no differences in the growth of tea can still be observed visually between the two treatments. Soil samples were taken in July 1968 at a depth of 0 to 6 in. and chemical analyses were carried out. The results obtained are summarized in Table 9.

TABLE 9 — *Soil nutrient status — 0 to 6 in. depth*

Treatment	Ammonium nitrogen (ppm)	Nitrate nitrogen (ppm)	Total nitrogen (%)	Available phosphorus (ppm)	Exchangeable potassium (% m eq)	Carbon (%)	pH
2 years rehabilitation	24.2	1.29	0.27	13.3	0.59	3.03	5.2
No rehabilitation (Fumigated)	31.3 **	0.98 NS	0.24 *	9.9 NS	0.37 ***	2.66 *	5.0 **

NS — not significant

* — significant at $P < 0.05$ ** — significant at $P < 0.01$ *** — significant at $P < 0.001$

Plots which were not rehabilitated but fumigated with methyl bromide gave a higher content of ammonium nitrogen than plots rehabilitated for two years. Increase in the ammonium nitrogen content after fumigation has been reported previously (Shanmuganathan & Fernando 1967). Percentage total nitrogen, percentage organic carbon, exchangeable K, and pH were slightly higher in the rehabilitated plots than in the fumigated plots. Further studies on soil physical structure, chemical characteristics and growth of plants are planned.

W. B. Manipura, S. G. Jayasuriya & A. Somaratne

Young tea experiments

Experiments AYT12, AYT14, AYT15, AYT16, AYT19 and AYT20 have been concluded. AYT21 was abandoned. AYT22 and AYT23 are reported as A20 and A21 respectively.

A20 — *Mulching on young tea at No. 3 Field — (1967)*

This experiment compares mulching with Guatemala loppings once a year and twice a year at the rate of 16 tons fresh material per acre each time with no mulching. The effect of mulching on growth, soil moisture content, soil nutrient content and weed growth are being studied. Growth of the young tea was assessed at the end of one year by cutting the plants across at nine inches. Summarized results for the leaf and stem weights and for total dry weight per plant are shown in Table 10.

TABLE 10 — *Effect of mulching with Guatemala grass on the growth of young tea*

Treatment	Leaf dry wt (g per plant)	Stem dry wt (g per plant)	Total dry wt (g per plant)
Mulched once a year	43.6	27.2	70.8
Mulched twice a year	42.3	24.9	67.1
Control	35.6	20.4	56.0
LSD ($P = 0.05$)	6.3	4.3	10.5

Leaf dry weight, stem dry weight and total dry weight per plant were significantly increased by mulching once a year when compared with no mulching, but mulching twice a year did not result in any further increase in

growth. Mulching also resulted in slightly higher moisture content of the soil mostly at 0 to 6 in. depth. Chemical analysis of soil carried out at the end of the first year did not show marked differences in available nitrogen, total nitrogen, available phosphorus and exchangeable potassium between the treatments tested. Preliminary studies on the effect of mulching on surface runoff, infiltration and soil erosion are being made in similar experiments. The results are not yet available. (Refer under AYT22 in previous Annual Reports).

A21 — Sulphate of ammonia, calcium ammonium nitrate and urea on 3 clones — (1967)

Sulphate of ammonia, calcium ammonium nitrate and urea were tested as a source of nitrogen for young plants on three clones TC 9, DT 1 and TRI 2027. Surface application of these fertilizers was also compared with dibbling and no dibbling as sub-treatments. The quantity of fertilizer applied was equivalent to 90 lb nitrogen per acre per annum on the basis of 5000 plants per acre. Fertilizer was always applied in wet weather. At the end of first year plants were uprooted and the dry weight of leaf, stem and roots were taken separately. The summarized results for the effect of the type of nitrogen on growth are shown in Table 11.

TABLE 11 — *Effect of the type of nitrogen on the growth of young tea*

Treatment	Leaf dry wt (g per plant)	Stem dry wt (g per plant)	Root dry wt (g per plant)
Sulphate of ammonia	50.2	61.2	21.1
Calcium ammonium nitrate	43.7	61.7	20.5
Urea	49.7	61.8	21.6
No nitrogen	26.4	41.4	15.6
LSD ($P = 0.05$)	9.8	11.8	5.2

All three types of nitrogen gave similar and significant increases in leaf dry weight per plant and stem dry weight per plant when compared with the control. Increase in root dry weight per plant failed to reach significance at the 5% level of probability. There were no significant differences in leaf, stem and root dry weights between types of nitrogen and between dibbling and no dibbling. There was no interaction between clones and type of nitrogen with respect to any of the yield components. (Refer under AYT23 in previous Annual Reports).

W. B. Manipura, A. Somaratne & S. G. Jayasuriya

Chemical control of weeds

Experiments W1, W2, W6, W7, W9 and W10 have been concluded.

MW1 — This experiment is described in the Report on the Mid-Country Station.

1968 Experiments

W11 — *Levels of surfactant on the herbicidal activity of diuron* — Randomized block design with 3 replicates — (1968)

Four levels of Surfactant N (supplied by the Shell Co. of Ceylon Ltd), viz 0, $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$ and $3\frac{1}{2}$ pints in 50 gallons of spray volume per acre were tested at two levels of diuron (one lb and two lb ai per acre). The most common weeds observed in the experimental plots were *Crassocephalus crepidioides*, *Digitaria* pps., *Drymaria cordata*, *Polygonum* spp., *Crepis javanica* and *Cyanotes villosa*.

Appreciable leaf scorch symptoms were observed only one week after spraying. Leaf scorch symptoms were assessed visually at weekly intervals up to the fifth week after spraying. No marked effect of the levels of surfactant was observed at either levels of diuron; the two lb level of diuron was slightly superior to the one lb level.

W12 — Amitrole T and Gramoxone on *Panicum repens* — Randomized block design with 4 replicates — (1968)

The following treatments were being compared :

- 1 — 2 lb per acre Amitrole T
- 2 — $\frac{3}{4}$ lb per acre Amitrole T followed by $\frac{1}{2}$ pint Gramoxone per acre two weeks later
- 3 — $\frac{1}{2}$ pint Gramoxone per acre only.

This experiment is laid out in an area with a uniform stand of *Panicum repens* (Couch). Amitrole T is a mixture of amino triazole and ammonium thiocyanate. Leaf and stem chlorosis were observed on the second day after spraying Amitrole T and these symptoms continued down the stem changing its colour from yellowish white to light pink. Gramoxone alone scorched the leaves and stems severely, and there was good weed control up to the fourth week. Rapid regeneration and new growth was observed thereafter. Amitrole and Gramoxone in combination gave good control up to the sixth week and regrowth was noted thereafter but not to the same extent as in the plots treated only with Gramoxone. Amitrole T at two lb gave good control up to the seventh week, after which there was a very slow regeneration and a gradual disappearance of chlorotic symptoms. Control with any of the treatments tested, was in no instance complete.

W13 — Gramoxone and diuron separately and in combination on weeds in VP tea areas — Randomized block design with 4 replicates — (1968)

Two levels of Gramoxone ($\frac{1}{2}$ and 1 pint per acre) and two levels of diuron (1 and 2 lb per acre) were tested separately and in combination, to test the efficacy of mixtures of herbicides for better weed control. The weed control was estimated visually at monthly intervals for four months after spraying and the summarized results are presented in Table 12.

TABLE 12 — Effect of Gramoxone and diuron separately and in combination, on weed growth in VP tea areas

Treatment		1st month	2nd month	3rd month	4th month
Gramoxone (pints)	Diuron (lb)				
—	1	++	+++	+++	++
—	2	+	+++	++++	+++
$\frac{1}{2}$	—	+	+++	++	+
1	—	++	+++	++	+
$\frac{1}{2}$	1	+++	++++	++++	+++
$\frac{1}{2}$	2	+	+++	++	++
1	1	+	++++	++++	++
1	2	+++	++++	+++	+++

++++ Very good control
 +++ Good control
 ++ Very satisfactory control
 + Satisfactory control

The higher level of diuron was slightly more effective than the lower level with respect to weed control, but it was also noticed that in some instances, slight chlorotic symptoms appeared in tea plants at the higher level of diuron. There was no marked difference between the control obtained with the two levels of Gramoxone. When applied alone, Gramoxone gave poor control after the second month compared with diuron. All mixtures of Gramoxone and diuron had a marked residual effect and the combination of one lb diuron and half pint Gramoxone gave good control up to the fourth month. It was not possible to draw definite conclusions from these preliminary observations, because of the wide variation in weed growth observed initially between plots.

W14 — *Diuron, Simazine and Gramoxone on weeds in VP tea areas — 6 x 6 latin square — (1968)*

The plots used previously for Experiment W1 were pruned in July and a new set of treatments was assigned. The present experiment is designed to control weeds with two levels of diuron, two levels of Simazine and one level of Gramoxone and to determine the effect of these treatments on the yield of tea. The first applications of the treatments were given late in the year and the results are not yet available.

W. B. Manipura & A. Somaratne

Extension Experiments

Yield expressed as pounds dry weight per acre per annum and the period for which the yield has been summarized are quoted separately for each experiment. Fertilizer levels are quoted as pounds per acre per annum for nitrogen (N) and for potash (K₂O). In experiments comparing levels of Limbux only one application at the rates 0, 1 and 2 tons per acre has been given, at the beginning of each experiment. All results should be taken as indicative of trends observed, and no conclusion should be drawn at this stage.

Experiments XA11 and XA12 have been abandoned.

XA1 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels on seedling tea at Tangakelle Group, Lindula — (1965)*

Table 13 shows the response to the three levels of nitrogen.

TABLE 13 — *Yield response for the period 21.9.67 to 30.11.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
120	1866
240	2129
360	2314
LSD ($P = 0.05$)	283

There is a response to levels of nitrogen. The use of different types of nitrogen did not give any significant differences in yield.

XA2 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels on seedling tea at Mayfield Estate, Kotigala — (1965)*

Table 14 shows the response to the levels and types of nitrogen.

TABLE 14 — Yield response for the period 19.6.67 to 20.5.68

Type of nitrogen treatments	Yield (lb per acre per annum)
Sulphate of ammonia	2523
Calcium ammonium nitrate	2245
Urea	2245
Levels of nitrogen (lb per acre per year)	
120	1867
240	2498
360	2647
LSD ($P = 0.05$)	114

Yield differences are significant for levels of N as well as for types of N.

XA3 — Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels on seedling tea at Hauteville Estate, Agrapatana — (1965)

Yield data for the period 7.10.67 to 8.10.68 were statistically analysed but there were no significant differences in yield resulting from the use of different levels of nitrogen (120, 240 and 360 lb) or types of nitrogen.

XA4 — Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash on seedling tea at Diyagama East, Agrapatana — (1965)

Table 15 shows the yield response to the three levels of nitrogen.

TABLE 15 — Yield response for the period 4.6.66 to 3.7.68

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
120	3105
240	3197
360	3357
LSD ($P = 0.05$)	130

There is a significant response to levels of nitrogen, but the yield differences resulting from the use of different types of nitrogen and different levels of potash were not significant.

XA5 — Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels on VP tea at Ederapolla Group, Bulathkohupitiya — (1965)

Table 16 shows the yield response to the three types of nitrogen.

TABLE 16 — Yield response for the period 14.12.66 to 23.7.68

Type of nitrogen	Yield (lb per acre per annum)
Sulphate of ammonia	3192
Calcium ammonium nitrate	3033
Urea	3233
LSD ($P = 0.05$)	138

Yield differences were significant for the three types of nitrogen but not for the levels of nitrogen.

XA6 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash on seedling tea at Blairlmond Estate, Udapussellawa* — (1965)

Yield data were summarized for the period 14.11.67 to 14.11.68 and statistically analysed. None of the treatments gave significant yield differences at the 5% level of probability.

XA7 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of Limbux on seedling tea at Kirkoswald Group, Bogawantalawa* — (1966)

Table 17 shows the yield response to the three levels of nitrogen.

TABLE 17 — *Yield response for the period 17.8.66 to 13.7.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
120	1921
240	2223
360	2439
LSD ($P = 0.05$)	214

There is a significant response to the three levels of nitrogen but not to the other treatments.

XA8 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash at Brunswick Group, Maskeliya* — (1966)

Table 18 shows the yield response to the types and levels of nitrogen.

TABLE 18 — *Yield response for the period 18.8.66 to 9.6.68*

Type of nitrogen treatments	Yield (lb per acre per annum)
Sulphate of ammonia	2724
Calcium ammonium nitrate	2565
Urea	2503
Levels of nitrogen (lb per acre per annum)	
120	2161
240	2635
360	2996
LSD ($P = 0.05$)	105

Sulphate of ammonia gave a significantly greater response than either of the other two types of nitrogenous fertilizer. There was no significant response to levels of potash. There was a highly significant linear response to levels of nitrogen.

XA9 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of Limbux at Holyrood Estate, Tala-wakele — (1966)*

Yield data were summarized for the period 17.8.67 to 17.8.68 (first year after pruning). None of the treatment effects reached significance at the 5% level of probability.

XA10 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash at Clarendon Estate, Nanu Oya — (1966)*

Yield data were summarized for the period 28.5.67 to 5.6.68. Statistical analysis of the results was carried out and none of the treatments gave a significant response.

XA13 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash at Ottery Estate, Dick-o-ya — (1966)*

The yield response to the levels of nitrogen are given in Table 19.

TABLE 19 — *Yield response for the period 23.12.66 to 6.7.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
90	2130
180	2242
270	2417
LSD ($P = 0.05$)	134

There is a significant linear response to the levels of nitrogen but not to other treatments.

XA14 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash at Dickoya Estate, Dick-o-ya — (1966)*

The yield responses to the levels of nitrogen are given in Table 20.

TABLE 20 — *Yield response for the period 8.10.67 to 17.10.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
90	1320
180	1565
270	1724
LSD ($P = 0.05$)	70

The yield response to levels of nitrogen is significantly linear. There was no significant response to the types of nitrogen or to the different levels of potash.

XA15 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of potash at Kotiyagala Estate, Bogawantalawa — (1966)*

The yield responses to the levels of nitrogen are given in Table 21.

TABLE 21 — *Yield response for the period 5.1.67 to 22.7.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
90	1830
180	2048
270	2301
LSD ($P = 0.05$)	262

The response to levels of nitrogen is significantly linear. There was no significant response to the levels of potash and no significant yield differences resulted from the use of different types of nitrogen.

XA16 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of Limbux at Oonagaloya Estate, Kotmale — (1966)*

The yield responses to the levels of nitrogen are given in Table 22.

TABLE 22 — *Yield response for the period 4.6.67 to 28.6.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
90	1856
180	1954
270	2100
LSD ($P = 0.05$)	65

There was a significant response to the different levels of nitrogen but not for the other treatments.

XA17 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with three levels of Limbux at Diyagama East Estate, Agrapatana — (1966)*

The yield response to the different types and levels of nitrogen are given in Table 23.

TABLE 23 — *Yield response for the period 3.4.67 to 23.5.68*

Type of nitrogen treatments	Yield (lb per acre per annum)
Sulphate of ammonia	2458
Calcium ammonium nitrate	2615
Urea	2617
Levels of nitrogen (lb per acre per annum)	
90	2334
180	2511
270	2844
LSD ($P = 0.05$)	131

There was a significant linear response to the different levels of nitrogen. Yield differences between types of nitrogen were significant at the 5% level of probability. There was no significant response to the different levels of Limbux.

XA18 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels in combination with 3 levels of Limbux at Gonapitiya Estate, Kandapola* — (1966)

The yield response to the different levels of nitrogen are shown in Table 24.

TABLE 24 — *Yield response for the period 27.5.67 to 29.6.68*

Nitrogen treatments (lb per acre per annum)	Yield (lb per acre per annum)
90	2701
180	2893
270	3059
LSD ($P = 0.05$)	248

There was a significant linear response to the different levels of nitrogen but no other treatment effects were significant.

S. Sandanam, W. B. Manipura & C. C. Rajasingham

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We wish to thank the Superintendents and other staff on estates where our experiments are located, for their kind co-operation and help. The assistance of the Statistician and his Assistant in statistical designs and analyses is gratefully acknowledged. Our thanks are also due to Dr R. L. Wickremasinghe for the use of the Biochemistry laboratory facilities; to Dr U. Pethiyagoda and Mr S. Krishnapillai for their co-operation and help in sand culture work and to Drs P. B. Vose and H. Broeshart of the IAEA Research Laboratories in Vienna for the N^{15} analysis.

Visits, Lectures and Symposia

Lecture

Dr V. P. Bhavanandan addressed the members of the Chemical Society of Ceylon, on the subject "The Chemistry of the mucopolysaccharides" in June.

Symposium

Dr V. P. Bhavanandan and Dr W. B. Manipura participated in a symposium on 'Drought' held at Badulla for the Uva Planters' Association.

Publications

BHAVANANDAN, V. P. & MEYER, K. (1968). Studies on Keratosulfates. *J. Biol. Chem.* **243**, 1052-1059.

References

CHIRANJEEVI, RAO, K., KRISHNAMURTHY, T. N. & THULJARAM RAO, J. (1967). Cation-Exchange capacity of roots and yield potential of sugar cane. *Plant and soil*, **27**, 314-318.

SHANMUGANATHAN, N. & FERNANDO, S. R. A. (1967). Some observations on *Poria* control by soil fumigation with methyl bromide. *Tea Q.* **38**, 311-319.

WICKREMESINGHE, R. L., PERERA, B. P. M. & DE SILVA, U. L. L. studies on the quality and flavour of tea—4—Observations on the biosynthesis of volatile compounds, (1969). *Tea Q.* **40**, 26-30.

REPORT OF THE PLANT PHYSIOLOGY DIVISION

Research Officer — S. Kulasegaram, BSc, PhD, MIBiol

General

The year under review was marked by the absence of four members of the Division including Dr U. Pethiyagoda, the Plant Physiologist, who left for the UK in March for one year on a post-doctoral fellowship, awarded by the Nuffield Foundation. Dr S. Kulasegaram was in charge of the functioning of the Division during the absence of the Plant Physiologist. Messrs A. R. Sebastiampillai, S. Kandiah and S. Nagarajah continued their post-graduate studies abroad. Mr A. Nanayakkara resigned from his post of technical assistant in August.

Laboratory Investigations

Growth of tea in sand culture

Induced nutrient deficiencies

Nutrient deficiency symptoms for nitrogen, potassium, calcium, magnesium and sulphur were induced in clone CY9. A description of the foliar deficiency symptoms in respect of the above elements was given in the Annual Report for 1967. In view of the apparently unusual response of clone CY 9 to magnesium deficiency, four clones, TRI 2024, TRI 2027, DT 1 and TC 9, were grown in sand culture using nutrient solution lacking in each of the five major nutrients mentioned above, to test the possibility of clones differing in their expression of nutrient deficiency symptoms. All clones under investigation behaved in a manner similar to clone CY 9. Magnesium deficiency induced a faint interveinal chlorosis, the affected leaves being shed shortly afterwards.

Clone TRI 2024 was exceptional in its reaction to potassium deficiency. The plants showed progressive yellowing of the leaves along the margins before the characteristic foliar scorch symptoms of potassium deficiency developed.

Foliar deficiency symptoms were successfully corrected by introducing the deficient element concerned in the nutrient solution. Plants under the corrective treatments showed no further progression of the symptoms in the affected parts and produced normal new leaves.

Interaction between aluminium and certain other minor elements

Three experiments designed to study the interaction between aluminium and iron, manganese and fluorine respectively on the growth of clone TRI 2025 have been described in the Annual Report for 1967. All plants in the three experiments were pruned in March 1968 at a height of one ft and the tops weighed. No significant differences in top weights were noted in respect of the levels of aluminium, iron or fluorine. No differences were evident in the appearance and growth of the plants treated with these elements. There was a significant reduction in top weights in the treatments receiving no manganese. This was evidently due to severe deformity, scorch and premature shedding of leaves, symptoms characteristic of manganese deficiency. The plants recovered well from the prune but have since declined in growth. An interesting observation was that even the plants that were grown without manganese recovered well but developed foliar symptoms of deficiency quite soon.

The levels of supply of iron, fluorine and manganese have since been increased tenfold *ie* to 0, 10, 20 and 40 ppm. Plants receiving high levels of fluorine as sodium fluoride showed severe scorch of foliage and most of the plants have progressively died. Further experiments are planned to test whether the toxicity resulted from the high levels of sodium (introduced from other salts as well) or from the fluorine.

Effect of aluminum on growth

Two experiments were initiated to study the effect of different levels of aluminium on the growth of young seedlings from open-pollinated seeds of clone TRI 2024. In one experiment, aluminium (as aluminium sulphate) was supplied twice a week to these plants at 0, 2, 4 and 8 ppm. On other days of the week the plants were given Hewitt's solution at half strength. In the other experiment aluminium at 0, 10, 20 and 40 ppm was included in the nutrient solution and given daily to these plants. The experiments are in progress.

Comparison between nitrate and ammonium as forms of nitrogen for tea plants

The experiment was to determine the optimum manner of supplying nitrogen to tea plants in sand culture—whether as nitrate or ammonium or as a mixture of the two forms. Young plants of clone DT 1 were supplied the different nutrient solutions after an initial stabilising period of two months. Each plant received a constant volume of nutrient solution containing an equivalent of 100 ppm of nitrogen. Between the extreme treatments which consisted of nitrate or ammonium as the only source of supply of nitrogen, were nine mixtures of ammonium and nitrate, separated by steps of ten ppm. As the nitrate nitrogen content rose by ten ppm, the ammonium dropped by an equal amount so that the total nitrogen level remained at 100 ppm. The eleven treatments were replicated five times.

Plants receiving nitrogen mainly or only as ammonium produced darker green leaves than those receiving a greater proportion of their nitrogen as nitrate. The former, however, subsequently developed a characteristic chlorosis of their leaves which were also crinkled and recurved along the stem axis. These plants were also much smaller in size, the best growth apparently being shown by plants in the median treatment region. Plants receiving large proportions of nitrate also showed a characteristic scorching of leaves. Growth assessments and analyses are due to be carried out shortly.

S. Krishnapillai

Field Experiments and Trials

The following experiments have been concluded :

PH1, PH4, PH6, PH9, PH19, PH21, PH22, PH23, PH27 and XPH8.

PH3 — Growth Analysis — (1963)

Two further assessments were recorded during the year. While statistical analysis awaits the completion of further assessments, the following general trends have emerged :

- 1 — Bending, cut-across pruning and plucking have all reduced plant weight relative to the untouched free-growing treatment. This is also generally true for the weights of the component plant parts—stem, leaf and root.

- 2 — There are indications that with the passage of time, the initial setback to growth is gradually overcome and the gap narrow. The greatest initial reduction arose from the formative cut-across prune. Bending and plucking have exerted relatively mild effects.
- 3 — While in the first four years the free-growing treatment was the superior one, it is likely that as maximum plant size is approached, the bushes in plucking may overtake them in dry matter production. There is a suggestion that this reversal has occurred or is imminent in clone TRI 777 whose final size is smaller than the other clone in the experiment, TRI 2142.

The tea is to be pruned shortly.

PH5 — Mulching — (1965)

The experiment has now progressed for a further period since commencement and the analysis of the yields recorded during the period under review is presented in Table 1.

TABLE 1 — *Effects of different types of mulch and levels of nitrogen on yield—Mulch applied monthly to provide 6.2 tons fresh matter per acre per annum—Nitrogen at four-monthly doses to provide 45, 135 and 225 lb per acre per annum*

Mulch treatments	Yield (lb fresh weight per plot for 151 plucks from 31.12.65 to 31.12.68)
All leaf swept away	214.90
Mana	235.99
<i>Grevillea robusta</i>	262.27
Tea	272.99
Dadap	276.40
LSD ($P = 0.05$)	16.84
($P = 0.01$)	22.82
($P = 0.001$)	30.56
Mean yield for all mulched treatments	262.41
Yield for swept control	214.90
LSD ($P = 0.001$)	41.31

Nitrogen treatments (lb N per acre per annum)	Yield (lb fresh weight per plot for 151 plucks from 31.12.65 to 31.12.68)
45	218.20
135	250.57
225	289.95
LSD ($P = 0.001$)	23.67

As reported previously, nitrogen as well as the mulch treatments have had significant promotive effects on yield. There was no significant interaction between mulch treatments and levels of nitrogen. The beneficial effects of the additions of the different types of mulch followed the same pattern as reported earlier. The three other types of mulch were all superior to Mana and did not differ significantly among themselves. The yields obtained for 57 plucking rounds from the supplementary plots in the experiment involving the additions of tea leaf droppings confirm the beneficial effects of tea leaves as mulch.

PH12 — *Hakea saligna* as a shelter-belt plant — (1965)

The experiment continues.

PH13 — *Rested tea bushes as shelter belts* — (1965)

The absence of a consistent relationship between plot positions, relative to the rested rows, may arise from their unsatisfactory alignment with respect to wind direction. This trial is to be concluded shortly.

PH14 — *Total available carbohydrate (TAC) levels and recovery from pruning* — (1965)**PH15** — *Quantities of total available carbohydrates (TAC) and recovery from pruning* — (1965)

No further studies were undertaken on experiments **PH14** and **PH15** during the year.

PH20 — *Plucking frequencies and yield* — (1967)

The mean yield obtained since commencement of the experiment are given in Table 3.

TABLE 2 — *Mean yield obtained from different plucking frequencies and combinations, on seedling tea—Yields of green leaf per plot are for 12 months of plucking—Figures for made tea per acre per annum are approximate figures based on an assessed bush density of 300 per acre and an out-turn of 21% made tea*

Treatment	Length of plucking round (days)	No. of plucking rounds	Yield (lb green leaf per plot)	Yield per pluck (lb)	Calculated made tea per acre per annum (lb)
	7 (fish leaf)	52	405.3	7.79	1277
	3	121	392.5	3.24	1236
	5	73	388.6	5.32	1224
	Alternating 4 & 10	52	377.4	7.26	1189
	9	40	369.9	9.25	1165
	7 (single leaf)	52	363.0	6.98	1143
	Alternating 6 & 8	52	323.1	6.21	1018
	10	36	313.2	8.70	987
	14	26	290.4	11.17	915
LSD for total yields					
			$P = 0.05$	29.8	
			$P = 0.01$	39.9	
			$P = 0.001$	52.4	

Of the frequencies involving normal plucking there was no significant difference between three, five, alternating four and ten, nine and seven-day rounds. These proved to be significantly superior to the rest. Fish leaf plucking on a seven-day round gave the highest yields and was significantly different from the longer plucking rounds of nine, seven, alternating six and eight, ten and 14 but not significantly different from the shorter rounds of three, five, and alternating four and ten. This experiment has been concluded.

PH24 — *Gibberellic acid applications on young nursery plants* — (1967)

Gibberellic acid as a 200 ppm aqueous solution was applied as a drenching spray to six and ten-week old cuttings of TRI 2025 and TC 9. The two clones were chosen for their contrasting vigour in the nursery. The times of application were selected to roughly coincide with stages of root initiation and active growth respectively. Batches of ten treated plants are to be sampled at six, 13, 20 and 27 weeks from planting, along with unsprayed controls.

D. Janakiram

PH25 — *Growth retardants on tea* — (1967)

No further studies on this subject were undertaken.

PH26 — *Studies on banji* — (1967)

Studies on this subject were continued and the observations made and results obtained have been given in a paper "Studies on the dormancy of tea shoots : 1. Hormonal stimulation of the growth of dormant buds" which has been submitted for publication in *The Tea Quarterly*.

Preliminary grafting experiments showed that the technique of reciprocal grafting of active and dormant shoots on young plants in one state or another of growth in relation to the conditions of the terminal buds may be used in studying the source and nature of the factor governing dormancy or growth. Although it takes a minimum period of about eight weeks in a mist chamber, for the graft union to become effective, by which time the dormant bud in the ungrafted plant may have become active, it is felt that by using grafted controls it would be possible to overcome this difficulty. A start has also been made in the experimental control of growth or dormancy by using the split-root technique. It is also hoped to study the levels of other important endogenous growth regulators and inhibitors in dormant buds, in buds resuming growth and in active buds, which may help in understanding the nature of dormancy in tea.

PH28 — *Pruning of clonal tea at Welimada Group, Welimada* — (1967)

Visual observations made on recovery did not appear to have shown differences between any of the treatments tested.

H. B. Wijetunge & S. Wimaladharm

PH29 — *Growth factors and recovery from pruning in clone TRI 2025* — (1967)

In a preliminary experiment on the above subject, some growth factors such as sucrose, gibberellic acid (GA3), indolyl-3-acetic acid (IAA), all at 800 ppm and kinetin at 50 ppm and some combinations of these were applied on to the pruned frames three times on alternate days.

All treatments applied increased the total number of buds developing and the number of buds developing per unit area of the pruned frame compared with the control in the following decreasing order of efficacy at the concentrations employed: kinetin (K) + gibberellic acid (GA_3), indolyl-3-acetic acid (IAA) + GA_3 , K, IAA, GA_3 , and sucrose. Although the total length of shoots was increased by GA_3 , sucrose and K + GA_3 , only in GA_3 treated plants was the mean length of shoots greater than that of the control. IAA followed by GA_3 produced a greater number of measurable shoots (> 0.5 cm) at eight weeks from pruning.

It appears that by the appropriate choice of growth factors at the correct concentrations better recovery and frame development may be obtained. It is hoped to follow this line of work.

CLONAL TESTING

No additional clones were selected and/or tested apart from the testing of the performance of the already selected clones which are in the clonal testing experiments at the different locations. The ranking of the clones in the respective experiments has been made on the basis of total yields obtained over the periods indicated for each experiment. No direct comparison of the yields obtained at the different locations can be made as the experiments have progressed through different stages in the cycle and the completed cycle yields are not available for comparison. Information on the length of time covered from prune and the length of time each experiment has been in plucking is also given in the Tables 3 to 8 along with the calculated mean yields as made tea per acre, obtained to-date for the different clonal trials.

The clones in each table have been arbitrarily grouped into three yield categories similar to that presented in the report for 1967, *ie* over 2500 lb, between 2500 and 1500 and below 1500 lb made tea per acre per annum. It will be noted that fewer clones have been included in the higher yield categories in the second cycle compared with that of the previous year. This is because of a variation in the method of computation of the yields obtained into made tea per acre per annum. Earlier, the yields were calculated for 52 weekly plucks which covered a year. It was felt that while this may be satisfactory for the calculation of the first cycle yields it would not give a realistic estimate of yield in relation to time for subsequent cycles as it does not take into account the non-productive period of recovery following pruning and, therefore, gave disproportionately high yields. The yield classification of clones has now been made on yield calculated for a period of 12 months following pruning, and not for 12 months following first pluck after pruning.

VP1 — *Clonal testing at St Coombs* — (1961)

MVP1 — *Clonal testing at the Mid-Country Station* — (1961)

UVP1 — *Clonal testing at the Uva Station* — (1961)

LVP1 — *Clonal testing at the Kottawa Substation* — (1961)

VP1, **MVP1** and **UVP1** are at various stages in the second cycle, while **LVP1** is in the third cycle but has not completed a year from pruning, and has, therefore, been omitted from Table 3.

TABLE 3 — Rank of clones on the basis of yields obtained for the periods indicated in experiments **VP1**, **MVP1** and **UVP1** — Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb — Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb — Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb

SECOND CYCLE

	VP1	MVP1	UVP1
	KEN 16/3	TRI 2023	TRI 2023
	TRI 2025	TRI 2026	TRI 2027
	MT/BG	TRI 2025	TRI 2025
	CY 9	KEN 16/3	T 5/3
	TRI 2027	DG 39	TRI 2026
	N	TRI 2151	KEN 16/3
	TRI 2023	N	UH 9/3
	TK48	MT/BG	N
	TRI 2024	GMT 9	GMT 9
	DT1	MT 18	BG 18
	TRI 2026	TRI 2027	CY 9
	GMT9	T 5/3	NL 4/2
	Seed	T 5/35	DT 1
	CV 5/B1	TRI 2024	DG 39
	K 150	PA 22	TK 48
	TRI 777	EN 31	MT/BG
	UH 9/3	NL 3/1	CV 4/B1
	K 136	DT 1	TRI 2151
	PA 22	TK 48	EN 31
	MT-18	K 136	CV 5/B1
	T 5/3	CY 9	K 150
	PO 26	QT 1/5	QT 1/5
	DG 39	PO 26	TRI 2024
	NL 3/1	NL 4/2	PO 26
	KEN 15/7	TRI 777	T 5/35
	TRI 2151	KEN 15/7	PA 22
	CR 4	K 150	K 136
	T 5/35	Seed	TRI 777
	QT 1/5	CV 5/B1	NL 3/1
	EN 31	CR 4	KEN 15/7
	CV 4/B1	UH 9/3	Seed
	NL 4/2	CV 4/B1	CR 4
No. of months from prune	22	24	36
No. of months in plucking	12	19	28
Calculated mean yield (made tea per acre) for the period indicated	1845 ± 104	4066 ± 225	4830 ± 137
Yields as made tea per acre per annum	1845	2568	2070

VP2 — Clonal testing at St Coombs—(1962)

MVP2 — Clonal testing at the Mid-Country Station—(1962)

UVP2 — Clonal testing at the Uva Station—(1962)

LVP2 — Clonal testing at the Kottawa Substation—(1962)

VP2, **MVP2**, **UVP2** and **LVP2** are all in their second cycle. The clones in **VP2** have not been ranked in Table 4 because they have still not completed a year from pruning.

TABLE 4 — Rank of clones on the basis of yields obtained for the periods indicated in experiments MVP2, UVP2 and LVP2 = Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb—Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb—Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb

2nd CYCLE			
	MVP2	UVP2	LVP2
	KP 204	KP 204	TRI 2022
	TRI 2016	MG	TRI 2024
	CH 13	TRI 2024	KP 204
	TRI 2022	TRI 2039	TRI 2043
	NK 4/B29	TRI 2016	MPA 1
	MPA 1	TRI 2022	NK 4/B29
	TRI 2039	H 13/4	TRI 2039
	TRI 2043	NK 4/B29	NAY 3
	NAY 3	CH 13	MG
	MG 3/B1	NAY 3	TRI 2016
	D	TRI 2043	CH 13
	MG	MG 3/B1	MG 3/B1
	TRI 2024	MPA 1	H 13/4
	TRI 2020	D	TRI 2020
	OT 5/8	TRI 2020	D
	H 6 A1	H 6 A1	H 6 A1
No. of months from pruning	12	26	30
No. of months in plucking	8	19	26
Calculated mean yield (made tea per acre) for the period indicated	733 ± 50	2909 ± 114	9256 ± 763
Yield as made tea per acre per annum	—	1837	4272

VP3 — Clonal testing at St Coombs—(1963)

MVP3 — Clonal testing at the Mid-Country Station—(1963)

UVP3 — Clonal testing at the Uva Station—(1963)

LVP3 — *Clonal testing at the Kottawa Substation—(1963)*

VP3 and MVP3 have completed 36 months of plucking in the first cycle while UVP3 has completed 19 months of plucking in the first cycle LVP3 has completed the first cycle and is now 18 months from pruning in the second cycle

TABLE 5 — *Rank of clones on the basis of yields obtained for the periods indicated in experiments VP3, MVP3, UVP3 and LVP3—Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb—Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb—Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb*

	1ST CYCLE		2ND CYCLE	
	VP3	MVP3	UVP3	LVP3
	B 275	TRI 2021	B 275	TRI 2045
	TGK 2	DG 7	TRI 2021	TRI 2021
	W/2-145	TRI 2024	TRI 2024	DG 3
	DG	<i>W3</i>	<i>DG 3</i>	DG 7
	<i>E7/27</i>	<i>DG 3</i>	<i>DG 7</i>	TRI 2024
	<i>W3</i>	<i>W/2-145</i>	TRI 2046	B 275
	TRI 2046	<i>E 7/27</i>	<i>E 7/27</i>	<i>E 7/27</i>
	TRI 2021	TRI 2046	<i>W/2-145</i>	<i>W/2-145</i>
	DG 3	<i>DG</i>	<i>DG 43</i>	DG 43
	DG 7	TGK 2	TGK 2	DG
	<i>ML 7</i>	TRI 2045	<i>W 3</i>	TRI 2046
	TRI 2024	<i>ML 7</i>	<i>DG</i>	TGK 2
			TRI 2045	W 3
			<i>ML 7</i>	<i>ML 7</i>
No. of months from prune	—	—	—	18
No. of months in plucking	36	36	19	15
Calculated mean yield (made tea per acre) for the period indicated	6089 ± 463	1158 ± 36	2058 ± 94	5718 ± 342
Yields as made tea per acre per annum	2030	386	1300	4574

VP4 — *Clonal testing at St. Coombs—(1964)*MVP4 — *Clonal testing at the Mid-Country Station—(1964)*

UVP4 — *Clonal testing at the Uva Station—(1964)*

LVP4 — *Clonal testing at the Kottawa Substation—(1964)*

TABLE 6 — *Rank of clones on the basis of yields obtained for the periods indicated in experiments VP4, MVP4, UVP4 and LVP4—Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb—Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb—Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb*

	1ST CYCLE			
	VP4	MVP4	UVP4	LVP4
	MO 241	PGG 2	PLLG 2	CW12
	DW 12	MO 116	TRI 1114	HI/58
	QT 4/4	DW 12	DW 12	TRI 2024
	MO 146	LANS. SEED	TRI 2024	TRI 1526
	MO 208	TRI 2024	QT 4/4	TRI 1530
	TRI 1114	H 1/58	MO 116	LANS. SEED
	TRI 2142	TRI 1114	MO 208	DW 12
	PLLG 2	QT 4/4	CW 21	QT 4/4
	MO 116	PLLG 2	CAR 7/10	ILLUK. SEED
	<i>MO 114</i>	ILLUK. SEED	TRI 2142	PLLG 2
	<i>TRI 1530</i>	MO 208	LANS. SEED	CAR 7/10
	<i>TRI 1526</i>	MO 241	ILLUK. SEED	MO 146
	<i>LANS. SEED</i>	CAR 7/10		MO 116
	<i>CAR 7/10</i>	MO 146		TRI 1114
	<i>TRI 2024</i>	TRI 1530		MO 208
	<i>ILLUK. SEED</i>	MO 114		MO 114
No. of months from prune	—	—	—	—
No. of months in plucking	24	24	18	24
Calculated mean yield (made tea per acre) for the period indicated	3054 ± 211	1719 ± 54	1860 ± 44	5743 ± 419
Yield as made tea per acre per annum	1527	860	1240	2872

VP5 — *Clonal testing at St Coombs—(1965)*

MVP5 — *Clonal testing at the Mid-Country Station—(1965)*

LVP5 — *Clonal testing at the Kottawa Substation—(1965)*

TABLE 7 — Rank of clones on the basis of yields obtained for the periods indicated in experiments VP5, MVP5 and LVP5—Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb—Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb—Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb

	1ST CYCLE		
	VP5	MV4	LVP5
	TC 9	TRI 2024	TRI 2024
	DK 1	LD 999	TRI 25
	DK 8	DK 17	PK 4
	TRI 2024	DA 1408	S 106
	DA 1408	CC 34	LD 999
	K 145		K 145
	DK 17		<i>DIV 23</i>
	DT 95		CC 34
	QT 3/3		
	TRI 2045		
No. of months from prune	—	—	—
No. of months in plucking	12	6	24
Calculated mean yield (made tea per acre) for the period indicated	853 ± 93	231 ± 20	2054 ± 81
Yield as made tea per acre per annum	853	—	1027

LVP10 — Clonal testing at the Kottawa Substation—(1965)

TABLE 8 — Rank of clones on the basis of yields obtained for the periods indicated in experiment LVP10—Clones shown in heavy type gave a mean calculated yield per acre per annum of more than 2500 lb—Clones shown in plain type gave a mean calculated yield per acre per annum of between 1500 and 2500 lb—Clones shown in italics gave a mean calculated yield per acre per annum of less than 1500 lb

	1ST CYCLE
	LVP10
	TRI 2023
	T 62/1
	T 62/5
	T 62/7
	T 62/9
No. of months from prune	—
No. of months in plucking	24
Calculated mean yield (made tea per acre) for the period indicated	9593 ± 745
Yield as made tea per acre per annum	4797

VP17 — Clonal testing—(1966)

This experiment was brought into plucking on 29.4.68 and is still in the first year of plucking but yields obtained so far indicate that clones SM 404, C 34, YF 6/1, PK 2 and TRI 62/9 are doing well.

MVP6 — Clonal testing at the Mid-Country Station—(1966)

This experiment was brought into plucking in November 1968.

VP21 — Clonal testing—(1967)

The plants were given a light cut-across in September 1968, tipped and brought into plucking in February 1969.

MVP7 — Clonal testing at the Mid-Country Station—(1967)

This experiment has completed one year's growth.

No definite conclusions can as yet be made from these experiments on the value of shade, in general for clonal tea. This appears to be a problem which may be usefully studied at a more fundamental level. Close examination of the Tables 3 to 8 indicate that there is a general similarity in the ranking of the clones as reported previously although certain clones have shifted positions. These confirm the suggestion that clones may have regional climatic preferences.

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Height of plucking table and yield

Observation made in VP1 on the growth of shoots and the increase in the height of the plucking table following pruning and tipping done uniformly on all clones indicated that there was a correlation between the rate of development of the plucking table and yields, provided the clones are plucked on their respective merits and no attempt is made to maintain a level table over the entire clonal area. An estimate of this relationship was obtained by calculating the correlation coefficient between the mean heights of the plucking table and the yields recorded over this period (84 plucks) following pruning. A high correlation ($r = +0.76$) was obtained which was highly significant (P at $0.001 = 0.55$). Table 9 gives the mean heights of the plucking table in inches along with the respective yields obtained over this period as lb made tea per acre.

TABLE 9 — *Mean height of clones in VP1 arranged in ascending order and their respective yields as lb made tea per acre over the same period (3.6.67 to 3.2.69)*

Clones	Mean height (in.)	Total yield (lb made tea per acre)
CV 4 B1	28.86	1241
NL 4/2	30.02	1081
TRI 2151	31.22	1791
NL 3/1	31.52	2856
TRI 777	31.77	3873
T 5/35	32.17	2030
K 136	33.52	3803
QT 1/5	33.68	2035
UH 9/3	34.04	3624
PO 26	34.25	3202
CR 4	34.29	2143
T 5/3	34.41	3172
MT 18	34.45	3650
K 150	34.45	4056
N	34.45	4477
GMT 9	34.49	3888
TRI 2026	34.67	4043
DG 39	34.98	3321
PA 22	35.22	3437
EN 31	35.30	1606
TRI 2027	35.43	4645
KEN 16/3	35.51	4958
CV 5 B1	36.00	4376
KEN 15/7	36.08	2953
MT/BG	36.14	4810
Seedling	36.59	4060
TK 48	36.65	4720
TRI 2024	36.69	4449
DT 1	36.99	4551
TRI 2023	36.99	4738
TRI 2025	37.26	5048
CY 9	37.56	4709

Correlation coefficient $r = 0.76^{***}$ (P at $0.001 = 0.55$)

In view of the high correlation obtained, regular height measurements of the plucking table along with their respective yields are being recorded in VP2 and MVP3 which have recently been pruned, to determine how long it takes before a significant correlation will be recorded.

VP18 — Nursery growth characters and yield—(1967)

In this trial 15 clones differing in their yields were selected from VP1 and attempts were made to correlate several plant characters in the nursery at three stages (5½, 8½ and 12 months) from planting with their respective yields. Table 10 gives the correlation coefficients obtained, for some plant characters with mean first cycle yields.

TABLE 10 — Some plant characters and their correlation coefficients with yield

Plant character	Correlation coefficients		
	Stage of growth (months)		
	5½	8½	12
Mean height	0.407	0.547*	0.525*
Mean appendage number	0.480	0.418	0.355
Mean leaf area	0.336	0.587*	0.499
Mean total dry weight	0.585*	0.597*	0.661*
Mean top dry weight	0.445	0.578*	0.661*
Mean root dry weight	0.671*	0.572*	0.600*

LSD ($P = 0.05$)

* significant at 5% level

It will be noted from the above that vigour of the plant in the nursery, as indicated by some of the characters listed above, at 8½ and 12 months would appear to give a better indication of their subsequent performance in the field than vigour determined at an earlier period in the nursery. If this relationship can be shown to hold true for a larger number of clones, it may help in the testing of clones subsequent to their selection, by reducing the period required to assess the performance of a clone so that at least the poorer clones can be discarded at the nursery stage. It is hoped to pursue this work.

A. Nanayakkara

VP19 — Flush characteristics of clones—(1967)

Preliminary studies are in progress on the analysis of the components of the flush in the different clones in VP1, VP2 and VP3. Analysis in VP2 was interrupted as pruning became due. It is hoped to resume once the bushes are brought into plucking.

D. Janakiram

VP20 — Reaction of clones to drought—(1967)

This experiment was carried out but there did not appear to be a correlation between the degree of drought tolerance and the soil moisture levels associated with temporary and permanent wilting points, the percentage moisture in the tissues at each of these stages and speed of recovery on resumption of watering, respectively. Wide differences were observed in plants within the clones. It was observed that within any one clone, plants which were growing actively wilted earlier than plants which were in the dormant state, on suspension of watering. To avoid any such differences it appears that a larger number of plants will have to be raised and carefully selected according to their condition of growth to obtain meaningful results. It was also

noted that larger pots than the ones used in the experiment should be employed so that there is sufficient soil for a reliable sampling to be carried out without damaging the roots of the plants. This would also permit gradual moisture depletion in the soil by the plants and may augment clonal differences. With the use of small pots soil moisture depletion was rapid so that clonal differences were not noticeable. In view of the above considerations it appears that repetition may give useful results.

H. B. Wijetunge

VP22 — *Panasand and Panacide for the control of mosses*—Randomized block design with type of chemical and time of application split on clones—2 replicates—(1968)

Two commercial formulations Panasand and Panacide which were claimed to control algae and moss development on soil in nurseries were used. Panasand was used at the rate of one part in 150 parts in the top quarter inch of the soil in the polythene sleeve and the Panacide was watered on the soil at the rate of 20 ml Panacide 40% solution in 100 gallons of water. Each of the chemicals was also used at half the above strengths. The treatments also included two times of application, one immediately after planting and the other after about four months. The clones used were DT 1 and TRI 2025.

Observations made on moss growth showed that both chemicals at the strengths used were effective in controlling moss growth for a period of about six months. Statistical analysis carried out on the effect of the chemicals on the growth of the plants after seven months from planting did not show any effect except for a slight decrease in root growth with Panasand when compared with the control. No significant difference in growth was observed for the two times of application.

D. Janakiram

VP23 — *The influence of nodal position of a cutting on its rooting*—4 replicates of 10 treatments in randomized blocks—(1968)

In taking single-node cuttings for propagation, it is customary to discard the more tender and the more mature portions of the shoot. In a vigorous and succulent clone, this practice still furnishes a reasonable number of cuttings per shoot. In less vigorous clones, whose shoots mature into the redwood stage at a smaller distance behind the apex, acceptable cuttings are limited in number.

This experiment re-examines the relationship between the maturity of a cutting (as indicated by its nodal position) and its rooting. The three clones selected, TRI 2025, TRI 777 and DT 1 vary in the succulence and vigour of their shoots. Ten consecutive nodal cuttings (after the top two leaves and the bud were discarded) were propagated from each shoot. The lower nodes in the slower-growing clones extended deep into the redwood portion of the shoot.

The experiment is in progress.

D. Janakiram

PLANT BREEDING

VP10 — *Selections from open-pollinated clonal seedlings*—(1962)

The plants have just been brought into plucking and observations are being made so that the better performers can be propagated for testing on a larger scale.

VP11 — *Selections from hand-pollinated seedlings—(1963)*

The plants are in a similar stage as those of **VP10**. Yield records are being maintained.

VP12 — *Selections from bi-clonal progeny—(1964)*

Plucking continued and the yields recorded are presented below in Table 11.

TABLE 11 — *Mean yields as lb made tea per acre over 52 plucks (21.1.68 to 13.1.69)*

Population	Yield
TRI 2023	2297
TRI 2024	2260
TRI 2026	2227
Lansdowne Seed	1354
(M: TRI 2026 × F: TRI 2023) Rambukkande Seed	1324
(M: TRI 2023 × F: TRI 2026) Lansdowne Seed	1116
(M: TRI 2023 × F: TRI 2026) TRI 2024 (open pollinated)	935
LSD $P = 0.05$	373
0.01	505
0.001	676

It will be clear from the above that the parent clones have continued to perform better than any of the seedling populations. The seedling populations show high variability and it appears that further selections should be made from these in order to estimate the maximum potential of the cross.

VP13 — *Seedling progeny from eight commercial seed gardens—(1965)*

No yield records have been maintained previously. It was decided that some estimate of yields may be important and records are now being kept.

VP14 — *Hand-pollinated seedlings—(1965)*
Observations are being continued**VP15** — *Field selections at No. 11 and No. 14 Fields, St Coombs—(1964)*
Yield records are being maintained*Irradiation studies*

The exposure of living cells to certain types of radiations can induce changes in the genetic material which in turn cause changes in the expression of various plant characters. Such changes are called mutations and are generally permanent and heritable. Mutations could be of beneficial or of harmful types. Propagating material (seeds or cuttings) may be exposed to radiation and subsequently grown and observed for any chance beneficial mutations. Because mutations are relatively rare events and because the nature of the change is beyond the control of the experimenter, it is necessary to screen the plants from a large number of irradiated seeds or cuttings.

Cuttings and seeds were exposed to radiation in the installation at the Central Agricultural Research Institute, Peradeniya. The ionizing radiation in the unit is obtained from a weak radioactive source of Cobalt⁶⁰, emitting gamma rays at 1.2 kilorads per hour. The material is placed in an eight-inch-cube chamber and different doses are obtained by varying the time of exposure. Doses ranging from 2.5 to 50 kilorads for cuttings and 25 to 60 kilorads for

seeds were tested and the treated material planted out. The desirable dose for cuttings appears to be below 15 kilorads as those treated with higher doses have shown a very high percentage of mortality. With the dose range used for seeds, none of them germinated. This work is being continued.

Controlled hand-pollination studies

In contrast to some work reported earlier it was found that self-pollination gave as large a percentage of fruit set as that obtained by cross-pollination. The reasons underlying the apparently conflicting results merit investigation. The seeds obtained from these pollinations are being tested for viability in germination tests.

Studies on floral development and effect of climatic conditions on flowering and fruit-set

One hundred floral buds on each of five different clonal seed bearers were labelled every month, and their development closely followed through different stages in relation to flowering and natural fruit set. It is hoped to correlate such data obtained with prevailing weather conditions as well. The observations on the natural pattern of flowering and fruit-set should prove helpful in planning future breeding work.

D. Janakiram

CENTRAL NURSERY

The Central VP Nursery which was under the charge of this Division was handed over to the Agriculturist in July 1968. All requirements of VP tea plants for the respective divisions will now be met by the Agriculturist.

EXTENSION EXPERIMENTS

Details of these experiments and some of the results obtained earlier has been presented in the Annual Report for 1967.

XPH1 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Liddesdale Group, Halgranoya — (1965)*

This tea was pruned in January 1968. Yields have not been recorded for a sufficiently long period in the new cycle for analysis and are, therefore, not presented.

XPH2 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Rothschild Estate, Pussellawa — (1965)*

This tea was pruned in June 1967 and the yields of the new cycle have been analysed and reported on below.

XPH3 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Mayfield Estate, Kotagala — (1965)*

The tea was pruned in December 1967 and is in the same stage of progress as XPH1. The results are, therefore, not presented.

XPH4 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Hauteville Estate, Agrapatana — (1965)*

Yields have been recorded for a further period and the results reported on below.

XPH5 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Blairlmond Estate, Udapussellawa — (1966)*

Yields have been recorded for a further period and the results are reported on below.

XPH9 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Brunswick Group, Maskeliya — (1966)*

The tea was pruned in January. The analysed yield figures are presented below.

XPH10 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Morar Estate, Bogawantalawa — (1966)*

Forty eight post-treatment plucks have been recorded and analysed, and the results are presented below.

XPH12 — *Nitrogen at 4 levels with shade vs no shade as the main treatments at Oonoogaloya Estate, Kotmale — (1966)*

Forty six post-treatment plucks have been recorded and analysed and the results are presented below.

XPH6 — *Shade vs no shade at Rothschild Estate, Pussellawa — (1966)*

XPH7 — *Shade vs no shade at Bogawana Group, Bogawantalawa — (1966)*

XPH11 — *Shade vs no shade at New Peacock Group, Pussellawa — (1966)*

The results of experiments **XPH6**, **XPH7** and **XPH11** have still to be processed.

The experimental plucking continued and the yields have been analysed for the number of plucks indicated against each experiment and are presented in Tables 12 and 13.

In all the experiments the difference between shade vs no shade was in favour of the removal of shade. Nitrogen has had a significant promotive effect on yield at all locations. In **XPH2**, N_2 gave a significantly higher yield than those of the other levels of nitrogen amongst which no difference was evident. There was no significant difference between the two higher nitrogen levels (240 and 360 lb per acre per annum) in experiment **XPH4**. In **XPH5** there was no difference between the higher rates of nitrogen application, *ie* 200, 300 and 400 lb. A barely significant increase in yield of the third over the second nitrogen level was obtained ($P < 0.05$) at Brunswick (**XPH9**) and Morar (**XPH10**) while at Oonoogaloya (**XPH12**) the difference was significant at the 1% level of probability. It would be interesting to see whether the difference between second and third nitrogen levels and in the other experiments also would become significant with time as no significant difference was obtained in the analysis reported previously. It is also of interest to note that reasonable yields were obtained at the zero level of nitrogen suggesting high residual effects of earlier applications. The period over which this will be effective will be of importance. The percentage increases in yield obtained with increasing levels of nitrogen both in the presence and absence of shade trees are presented in Table 14.

It was reported earlier (Report for 1967) that although there was a tendency for the response to nitrogen to be slightly better in the absence of shade trees in all the experiments, the difference was not significant in any of them. Analyses carried out after the experiment had progressed for a further period

showed that in the experiments at Hauteville (XPH4) and Oonoogaloya (XPH12) there was a significant interaction between shade and level of nitrogen ($P < 0.05$) indicating a greater response to nitrogen in the absence of shade. Whether this would be true for the other experiments as well in course of time, will be watched with interest.

In experiments XPH1, XPH2, XPH3, XPH4, XPH9, XPH10 and XPH12 the levels of nitrogen are 0, 120, 240 and 360 lb per acre per annum. In XPH5 the levels of nitrogen are 100, 200, 300 and 400 lb per acre per annum.

TABLE 12 — *Effect of nitrogen levels and shade trees on yield—All figures are calculated as made tea per acre per year on an absolute bush stand*

Experiment	Location	No. of plucks	Shade				No shade			
			N0	N1	N2	N3	N0	N1	N2	N3
XPH2	Rothschild	56	1850	1639	1895	1643	1743	1848	1960	1847
XPH4	Hauteville	64	1614	1872	1943	2140	1644	1825	2245	2344
XPH5	Blairlomond	92	2367	2681	2628	2666	2839	2860	2861	2957
XPH9	Brunswick	43	1720	1896	1957	2075	1776	2039	2102	2307
XPH10	Morar	48	1770	1819	2138	2198	1955	2182	2292	2417
XPH12	Oonoogaloya	46	2347	1681	1843	1990	1280	1780	2089	2249

TABLE 13 — *Effect of nitrogen and shade trees on yields at the different experimental sites (mean yields as lb made tea per acre per annum) on an absolute stand*

(a) Nitrogen effects		L S D						
		N0	N1	N2	N2	$P = 0.05$	$P = 0.01$	$P = 0.001$
XPH2	Rothschild	1796	1744	1927	1745	132	—	—
XPH4	Hauteville	1629	1849	2125	2242	148	203	277
XPH5	Blairlomond	2604	2770	2745	2812	122	—	—
*XPH9	Brunswick	1748	1963	2029	2191	161	221	301
*XPH10	Morar	1862	2015	2215	2308	92	126	172
*XPH12	Oonoogaloya	1311	1730	1966	2119	106	145	198

(b) Shade tree effects		Shade	No shade	Level of significance
XPH2	Rothschild	1757	1849	5%
XPH4	Hauteville	1892	2030	5%
XPH5	Blairlomond	2586	2879	0.1%
XPH9	Brunswick	1912	2054	5%
XPH10	Morar	1988	2212	0.1%
XPH12	Oonoogaloya	1714	1849	0.1%

TABLE 14 — *Percentage increase in yields with increasing levels of nitrogen*

		Shade trees present				Shade trees removed			
		No	N1	N2	N3	No	N1	N2	N3
XPH2	Rothschild	100	89	102	89	100	106	112	106
XPH4	Hauteville	100	116	120	133	100	111	137	143
XPH5	Blairlomond	100	113	111	113	100	101	101	104
XPH9	Brunswick	100	110	114	121	100	115	118	130
XPH10	Morar	100	103	121	124	100	112	117	124
XPH12	Oonoogaloya	100	125	137	148	100	140	163	176

Acknowledgements

The gift of samples of Gibberellic acid and Phyomone by Chemical Industries (Colombo) Ltd, is gratefully acknowledged. Our thanks are due to Managers, Superintendents, Assistants and others on estates for their interest and co-operation in the conduct of the extension experiments, and the Statistics Department for the analysis of the results.

Visits, Lectures and Symposia

Dr V. S. Kulasegaram participated in a symposium on 'Drought' conducted by the Institute at Badulla in November for the Uva Planters' Association.

REPORT OF THE PLANT PATHOLOGY DIVISION

Plant Pathologist — N. Shanmuganathan, BSc, PhD

General

The Head of the Division returned to Ceylon on 2nd October having worked overseas for a year. Dr R. L. de Silva acted for him in his absence. Mr P. V. Arulpragasam continued his post-graduate studies at Wye College, Kent, England. Mr W. R. F. Rodrigo left the service of the Institute on 30th June after spending six useful and productive years. He was replaced by Mr R. N. Bopearatchy who assumed duties on 1st August. Mr G. T. Karunasena, Laboratory Assistant, resigned his post and left the Institute on 31st March. Mr A. Chandrasekera, who succeeded him, also left the Institute on 30th September. Dr R. L. de Silva continued to function as the Co-Editor of the Institute's publications during the year. He was also in charge of the administration of the Institute's library.

Laboratory Investigations

Fungicides for Phomopsis theae

Using standard techniques, 11 fungicides were tested in the laboratory for their efficacy in controlling spore germination and mycelial growth of *P. theae*; the most effective were Du Pont 1991, Verdasan, Antimucin and Actidione. This work is being continued.

N. Shanmuganathan & R. N. Bopearatchy

Fungicides for Monacrosporium ambrosium

Work on this subject is presently in abeyance.

Field Experiments and Trials

The following experiments have been concluded :

P11, P23, P24, P25, P28, P31, P52, P53, P54, P57, P58, P59, P62, P63, P64, P65, P66, P67, P70, P71, P72, P73, P74, P78, P79, P80 and P82

Red Root Disease (*Poria hypolateritia*)

P10 — Survival of *P. hypolateritia* in soil at different depths — (1964)

The details of this experiment have been described in the Report for 1965. When root segments were retrieved after three years' burial, 76.6% of them still contained the pathogen in a viable state, but only 25.0% of these were able to infect young tea plants. The depth of burial had no significant effect on viability or infectivity. Full results are shown in Table 1.

TABLE 1 — *Viability and infectivity of root segments retrieved after three years' burial in fallow soil*

Diameter of root segment (cm)	Viability (%)	Infectivity (%)
1	46.9	0
2	80.0	33.3
3	93.8	14.3
4	87.1	30.7

After four years' burial only 46.6% of the root segments retrieved contained viable *P. hypolateritia* mycelium. The results of inoculations with these root segments are not yet available.

P11 — *Resistance of clones to P. hypolateritia* — (1964)

Further observations have shown that none of the clones tested in this experiment (see Annual Report for 1964) is immune to the disease, although clone DUN 7 showed high resistance. This experiment is concluded.

P13 — *Selection of bushes resistant to P. hypolateritia at Mattakelle Estate, Talawakele* — (1964)

It was possible to raise plants from only eight of the ten clones selected on the field. Plants raised from these eight clones were planted in pots and inoculated with *P. hypolateritia*. Observations to date show that two of these clones are susceptible to the disease. The experiment is continuing.

P31 — *Control of P. hypolateritia in tea stumps using methyl bromide* — (1966)

Details of the experiment are given in the Annual Reports for 1966 and 1967. The efficacy of the treatments was finally assessed by planting one-year-old tea plants in the plots. A year after planting the number of stumps that were infective in each plot was recorded. Results showed that all the control plots and two others that received the half pound treatment had infected stumps, while the remaining plots had none. It is concluded that for complete control of *P. hypolateritia* within large tea stumps, the soil should be fumigated with at least one pound of methyl bromide per 100 sq ft.

P45 — *Resistance of clones to P. hypolateritia* — (1966)

Results of this experiment in which 19 clones are being tested for resistance to the disease are not yet available.

P53 — *Selection of bushes resistant to P. hypolateritia at Le Vallon Group, Pupuressa* — (1966)

All the six clones tested in this experiment have been found to be susceptible to the disease. The experiment is concluded.

P55 — *Studies on inoculum potential—Quantity of inoculum and age of host plants on the infection of tea by P. hypolateritia* — (1967)

The experiment is continuing.

P56 — *Soil fumigation with methyl bromide on soil nitrogen, soil microflora, and the growth of tea and Guatemala Grass* — (1967)

This experiment is continuing.

P69 — *Resistance of clones to P. hypolateritia* — (1967)

The plants in this experiment (see Annual Report for 1967) have been inoculated, but results are not yet available.

1968 Experiments

P75 — Control of *P. hypolateritia* by soil treatment with chloropicrin—3 replicates of 3 treatments + control — (1968)

In this experiment, two rates of chloropicrin, viz 10 ml per sq. ft (3.7 lb per 100 sq. ft) and 20 ml per sq. ft (7.4 lb per 100 sq. ft) were compared with the standard rate of methyl bromide (0.5 lb per 100 sq. ft) for efficacy against *P. hypolateritia*. The chloropicrin was applied to the soil nine inches below the surface using injector guns, and plots were covered with polythene sheeting after application. The efficacy of the treatments was assessed by burying infected root segments in the plots before fumigation and retrieving them and determining their viability seven weeks after fumigation. The results showed that all three treatments were fully effective in controlling *P. hypolateritia*. It is intended to test lower rates of application of chloropicrin in 1969.

P76 — Studies on inoculum potential—Determination of the smallest effective inoculum for infection of young tea plants by *P. hypolateritia* — (1968)

To determine the effective inoculum potential of one-year-old plants, potted plants of clone TRI 2024 have been inoculated with inocula of different volumes. Twelve different volumes have been used by selecting root segments of varying diameters and lengths (cf P46, Annual Report for 1966). The experiment is progressing.

S. R. A. Fernando & N. Shanmuganathan

Root diseases of tea

P57 — 3 doses of methyl bromide for the control of *Ustilina deusta*, *Rosellinia arcuata*, *Fomes lignosus* and *Fomes noxius* — (1967)

All three doses of methyl bromide tested in this experiment, viz, $\frac{1}{4}$, $\frac{1}{2}$, 1 lb per 100 sq. ft, gave 100% control of *U. deusta* down to a depth of two ft, but only the half and one lb treatments were fully effective against *R. arcuata*. The latter observation confirms earlier results (cf P44, Annual Report for 1966). The efficacy of the treatments against *F. lignosus* and *F. noxius* could not be assessed accurately because many of the control inocula were also found to have lost their viability after recovery from the soil. The experiment will be repeated with the *Fomes* spp. in 1969.

S. R. A. Fernando & N. Shanmuganathan

Blister Blight (*Exobasidium vexans*)

P14 — Epidemiology of Blister Blight — (1962)

An experiment was carried out to determine whether the spores caught in the Hirst trap came mainly from the unsprayed area immediately surrounding it or whether they came from further away. Two traps were run, one each, in the centre of two adjoining unsprayed areas. The tea in one of these areas was progressively pruned starting from the centre, and the catches in the two traps compared.

Results showed that there were no significant differences in the number of spores caught by the two traps even after a ring of 18 bushes had been pruned around one trap, implying that the majority of the spores caught in the traps did not come from the immediate vicinity.

N. Shanmuganathan & T. V. Saravanapavan

P26 — *Loss of crop caused by Blister Blight on unshaded seedling tea* — (1966)

This experiment began its third year of plucking in April, and in June the tea was four years old from pruning. It was decided to extend the pruning cycle for a fifth year in order to assess crop loss caused by Blister Blight with increasing age from pruning. Pruning is due in 1969. A reappraisal of the results will be undertaken at the completion of the pruning cycle.

R. L. de Silva & S. Murugiah

P30 — *Loss of crop caused by Blister Blight on unshaded VP tea (Clone TRI 2024)* — (1966)

This experiment began its second year of plucking in July. It was found that infection levels are higher on VP tea than on seedling tea sprayed with the same dose of fungicide. This is probably because VP tea has more plucking points and the area to be covered by the fungicide is, therefore, greater than it would be with seedling tea. An appraisal for crop loss will be made at the end of the pruning cycle, which will be 1970.

R. L. de Silva, T. V. Saravanapavan & S. Murugiah

P58 — *Nickel and copper fungicide mixture for the control of Blister Blight on VP tea* — (1967)

The differences between treatments failed to reach significance and the experiment was abandoned. This experiment will be repeated as soon as it can be fitted into the experimental programme on Blister Blight. Some of the treatments are included in Experiment P77.

P59 — *Blister on tea flush* — (1967)

Assessments of Blister Blight were made on factory leaf (units of two leaves and a bud). It was found that when conditions were conducive for infection, latent blisters appeared as translucent spots on five to ten % of the shoots but no sporulating blisters were found on flush units of two leaves and a bud. In the case of single-leaf soft banji, however, 20 to 40 % of the shoots often had sporulating blisters. This is understandable because the leaves on a banji shoot are much older than those on flush shoots. Earlier observations that blisters that do not reach sporulating age on flush, cannot affect the made tea are confirmed. This experiment is concluded.

R. L. de Silva

P60 — *2 levels of nitrogen, 4 levels of infection of Blister Blight and 3 levels of shade on yield of 2 clones (TRI 2025 and TRI 2023)* — (1967)

This experiment was planted out in 1967 and, in the year under review, shade trees were planted on all the plots, there being nine dadap (*Erythrina lithosperma*) trees per plot. Pre-treatment records will be taken when the plants have reached full bearing and the shade on the low-shade and no-shade plots will then be removed for treatments to commence. This would probably be in 1971.

R. L. de Silva, T. V. Saravanapavan & S. Murugiah

P61 — *Protection of tea against Blister Blight by disease forecasting* — (1967)

This experiment was continued on No. 14 Field at St Coombs. Spraying was done according to the forecast of the infection in this field. According to this scheme when predicted infection is high, nickel chloride is sprayed; when

it is moderate, copper formulations are used, and when it is low, no spraying is done. According to this scheme the following spraying rounds were applied during the year under review:

Nickel chloride	—	9 rounds
Copper formulations	—	4 rounds

The experiment is continuing.

R. L. de Silva, W. R. F. Rodrigo & T. V. Saravanapavan

1968 Experiment

P77 — *Fungicides for the control of Blister Blight on VP tea—Randomized blocks — (1968)*

Two new fungicides were tested for their efficacy in controlling Blister Blight. The first was a formulation of copper oxychloride and nickel chloride and the second was Du Pont 1991, reported to have systemic properties. Although the latter should be applied to the roots, in this experiment it was sprayed on the leaves together with the surfactant supplied by the manufacturers, in two volumes of water. The test fungicides were compared with the performance of nickel chloride, nickel sulphate hexahydrate, and a standard cuprous oxide formulation. Results are not yet available.

R. L. de Silva, T. V. Saravanapavan & S. Murugiah

Collar and Branch Canker in young tea (*Phomopsis theae*)

UP7 — *Resistance of clones to P. theae at Nayabedde Estate, Bandarawela — (1964)*

One assessment for canker incidence was carried out during the year on the clones under test (see Annual Report for 1965). The three clones that suffered most from *P. theae* cankers were TRI 2024, UH 9/3 and NL 3/1. The experiment is continuing.

UP8 — *Resistance of clones to P. theae at Glen Devon Estate, Halgranoya — (1965)*

The 20 clones in this experiment (see Annual Report for 1965) were examined for cankers in March, and only clone KEN 16/3 had cankers on 15 bushes. The experiment is continuing.

P18 — *Clonal resistance, pathogenecity of isolates of P. theae and effect of age of bushes on disease development — (1964)*

The yearly inoculations in this experiment, the details of which are given in the Annual Reports for 1965 and 1966, could not be carried out in 1968. The last series of inoculations will be carried out in 1969.

P62 — *3 fungicides for the control of P. theae on Clone TRI 2024 at St Leonards Estate, Halgranoya — (1967)*

The three fungicides tested in this experiment were Santar A (yellow mercuric oxide), Fomac (pentachloronitrobenzene) and Bordeaux mixture (4:4:50). Statistical analysis of the final results showed that the application of Santar A and Bordeaux mixture caused a significant reduction in the number of collar cankers as compared to the control, but none of the three fungicides had any significant effect on branch cankers. Fomac was also found to be phytotoxic. The experiment is concluded.

P63 — 3 fungicides for the control of *P. theae* on clone TRI 2024 at Liddesdale Group, Halgranoya — (1967)

The three fungicides tested were the same as in **P62**. Analysis of the final results showed that there were no significant differences between the treatments and the control in regard to canker incidence. The experiment is concluded.

P64 — 3 fungicides for the control of *P. theae* on clone KP9 at Concordia Group, Kandapola — (1967)

The same three fungicides were tested as in **P62**. Final results showed that none of the fungicides was effective in controlling collar or branch canker. The experiment is concluded.

P65 — 3 fungicides for the control of *P. theae* on clones TRI 2025 and N3 at Craig Estate, Bandarawela — (1967)

The fungicides tested were the same as in **P62**. In this experiment, the application of Santar A resulted in a significant reduction in the number of collar cankers compared with the control, but it had no effect on branch cankers. Both Fomac and Bordeaux mixture were, however, ineffective against collar as well as branch cankers. The experiment is concluded.

P66 — Soil covers on soil moisture and incidence of Collar and Branch Canker Disease at St Leonards Estate, Halgranoya — (1967)

Details of this experiment are given in the Annual Report for 1967. Final results showed that plots covered with polythene had significantly less cankers than those left uncovered (control) or thatched with Mana grass (Table 2). There were also fewer deaths resulting from attacks by *P. theae* in the polythene covered plots compared with the other two treatments but the difference was not significant statistically.

TABLE 2 — Incidence of *P. theae* on plots covered variously

Cover	Mean No. of cankers (transformed data)	No. of dead plants
Polythene	1.80	3
Mana grass	2.61	15
Uncovered	2.49	19
LSD ($P = 0.05$)	0.67	NS

Soil moisture determinations on the plots carried out weekly for two months proved inconclusive probably because of large errors in sampling. The experiment is concluded.

N. Shanmuganathan & W. R. F. Rodrigo

1968 Experiments

P70 — 3 fungicides for the control of *P. theae* on clone DG 39 at Delmar Estate, Halgranoya—5 replicates of 3 treatments + control in randomized blocks — (1968)

The three fungicides tested in this experiment were Antimucin (a phenyl mercury compound), Santar A and Kanderdood (a mercury-based paint). The rates and methods of application were as follows:

- Antimucin — One fluid ounce per gallon of water; sprayed on the collar and frame
- Santar A — One kg in 2½ gallons of water; sprayed on the collar and frame
- Kankerdood — Applied as a paint with a brush to the collar and lower parts of the frame.

All treatments were applied once each month from June to October. Final results were recorded in December, and statistical analysis revealed that none of the treatments was effective in reducing canker incidence, although Antimucin appeared promising (Table 3).

TABLE 3 — Control of *P. theae* with three fungicides

Fungicide	No. of cankers (transformed data)
Antimucin	1.31
Santar A	1.46
Kankerdood	2.65
Control	1.87
LSD ($P = 0.05$)	0.67

P71 — 3 fungicides for the control of *P. theae* on clones TRI 2022 and TRI 2027 at Craig Estate, Bandarawela — 6 replicates of 3 treatments + control in randomized blocks — (1968)

The three fungicides used and the rates and methods of application were the same as in P70. The treatments were applied once each month from June to November. Statistical analysis of the final results recorded in December showed that while Antimucin was effective in reducing canker incidence significantly, both Santar A and Kankerdood were ineffective (Table 4).

TABLE 4 — Control of *P. theae* with three fungicides

Fungicide	No. of cankers (transformed data)
Antimucin	1.82
Santar A	4.23
Kankerdood	3.45
Control	3.03
LSD ($P = 0.05$)	1.17

P72 — 3 fungicides for the control of *P. theae* on clone TRI 2026 at Liddesdale Group, Halgranoya — 5 replicates of 3 treatments + control in randomized blocks — (1968)

The details of this experiment are identical to those of P70. None of the treatments gave significant control of the disease in this experiment.

P73 — 3 fungicides for the control of *P. theae* on Clone DG 39 at Gordon Estate, Uda Pussellawa — 5 replicates of 3 treatments + control in randomized blocks — (1968)

The details of this experiment are identical to those of P70. None of the treatments gave significant control of the disease in this experiment.

P74 — 3 fungicides for the control of *P. theae* on clone *St John's 76* at *Park Group, Kandapola* — 4 replicates of 3 treatments + control in randomized blocks — (1968)

The three fungicides tested in this experiment were Santar A, Fycol (oil-based copper fungicide + nickel chloride) and Verdasan (phenyl mercuric acetate). Fycol and Verdasan were applied as a spray to the collar and frame at the rate of three oz per gallon and four oz per gallon respectively. Santar A was applied as in **P70**. None of the three fungicides tested was effective in reducing canker incidence significantly in this experiment.

S. R. A. Fernando & N. Shanmuganathan

P82 — *Depth of root penetration on the incidence of P. theae* — Paired bushes, one of each pair being infected and the other healthy — (1968)

This experiment has been concluded and the results published (de Silva & Fernando 1968).

R. L. de Silva & S. R. A. Fernando

Root disease and shade trees

P32 — *Killing Grevillea robusta trees by Phortox treatment and by ring-barking* — (1966)

Details of this experiment are given in the Annual Report for 1966. The following observations were made during the year :

- Treatment 1 — Phortox 5%—Eight trees were completely dead in this treatment, while four were in various stages of defoliation. The remaining 13 trees did not show any obvious signs of death.
- 2 — Phortox 2.5%—Only two trees in this treatment died during the year, while another two were heavily defoliated. The remaining 21 trees showed no apparent signs of death.
- 3 — Ring-barking—23 trees in this treatment died during the year and the remaining four were defoliating.

Up to the end of 1968, 12 estimations of root reserves had been carried out, and results indicated that a significant reduction in reserves had occurred only in the ring-barked trees as compared with the controls. All dead trees have been inoculated with *U. deusta*, but results are not yet available. The experiment is continuing.

N. Shanmuganathan, P. V. Arulpragasam & T. V. Saravanapavan

P20 — *Incidence of root diseases in tea following removal of shade trees by various methods* — (1965)

G. robusta trees on various fields of *St Coombs Estate* were felled (a) after ring-barking and complete defoliation, and (b) without ring-barking. No cases of tea root diseases were detected arising from the ring-barked trees during the year, while four patches of *U. deusta* were detected in the stumps of trees which had been felled without ring barking. Records continue to be maintained.

R. L. de Silva & L. A. Seevaratnam

Oilspot Disease**P21 — Rate of spread of Oilspot Disease at Pedro Group, Nuwara Eliya — (1964)**

No assessments were made during the year, but the experiment will be retained for future assessments.

R. L. de Silva & P. V. Arulpragasam

Phloem Necrosis Virus Disease**P23 — Search for indicator clones at Eskdale Estate, Kandapola — (1960)**

Ten low-jat clones which were planted in 1960 have so far shown no symptoms of the disease. The experiment has been in progress for eight years. Even if any of these clones develop symptoms in the future, they would be of little use as indicators. The experiment is, therefore, concluded.

P24 — Seed transmission — (1960)

One seedling out of 25 from diseased bushes planted in 1958 showed symptoms of the disease after nine years. The experiment is now concluded.

P27 — Tolerance of clones to Phloem Necrosis Virus Disease at Pedro Group, Nuwara Eliya — (1966)

One hundred and forty six clones were planted in November 1966 and are under observation for symptoms of the disease. The details of the clones are given in the Annual Report for 1966. The plants are due to be tipped in early 1969. The experiment is continuing.

R. L. de Silva

Stem Cankers on low-grown clonal tea**LP3 — Rate of spread of cankers at Millakande Estate, Bulathsinhala — (1964)**

No assessments of cankers were carried out during the year but the experiment will be retained for future investigation.

R. L. de Silva

Mechanical Harvesting of tea**P28 — Hand, machine and shear plucking on tea yield and quality — (1966)****P29 — Hand, machine and shear plucking on tea yield and quality — (1966)****P67 — Hand, machine and shear plucking on yields and manufacturing properties of low jat seedling tea at Pedro Group, Nuwara Eliya — (1967)**

Experiments P28, P29 and P67 have been concluded and have been reported in the Report of the Technology Division for 1967 under experiment numbers T18, T19 and T26.

R. L. de Silva, S. Murugiah and the Technology Division

Asphyxiation of tea roots**P52 — Depth of planting holes on growth — (1966)**

This experiment has been concluded and the results published (de Silva & Seevaratnam 1968).

R. L. de Silva & L. A. Seevaratnam

Miscellaneous**P68 — Methyl bromide for the control of Couch Grass — (1967)**

It was found that methyl bromide at the dose of two lb per 100 sq. ft of ground controlled a heavy stand of Couch Grass extremely well. No new Couch Grass has been observed on the area for almost two years. It is possible, however, that lower doses may be effective although this was not tested. It is also possible that on other types of soil the dose of two lb may not be sufficient. This experiment is concluded.

R. L. de Silva & L. A. Seevaratnam

P78 — Porosity of soil mixtures adjusted by the use of coarse sand on the growth of young VP tea plants in polythene sleeves — 20 replicates of 4 treatments in randomized blocks — (1968)

The four treatments were subsoil and coarse sand mixed in the proportions 1:1, 1:2, 1:3 and 1:4. It was found that root growth was best where the highest proportion of sand was used. The roots tended to grow into the body of the soil rather than remain in-between the polythene sleeve and the soil, when the proportion of coarse sand used was greater. This experiment has been reported on earlier (de Silva & Seevaratnam 1968) and is now concluded.

P79 — Porosity of soil mixtures adjusted by the use of compost on the growth of young VP tea plants in polythene sleeves-20 replicates of 4 treatments in randomized blocks — (1968)

The treatments were similar to those used in experiment P87, except that compost was used instead of sand. Again, it was found that root growth was best when subsoil and compost were mixed in the proportion of 1:4. The results of this experiment have been published (de Silva & Seevaratnam 1968) and is now concluded.

P80 — Effect of aeration on the growth of vegetatively-propagated nursery plants growing in polythene sleeves in clayey soil — 20 replicates of 4 treatments in randomized blocks — (1968)

The plants of Clone DT 1 selected for this experiment were exhibiting poor growth in clayey soil. There were three treatments as follows :

- 1 — Bags were picked up and pressed in from the sides in order to break up the clay and improve soil aeration.
- 2 — Using a round iron rod 7 mm in diameter and pointed at one end, the soil in each bag was stilled six times from above so that the rod penetrated to the bottom of the soil, thereby, improving the drainage of water from the soil.

It was found that the treatments 1 and 2 resulted in greatly enhanced root growth whereas the growth in the untreated controls continued to remain poor. The results have been published (de Silva & Seevaratnam 1968) and the experiment is now concluded.

R. L. de Silva & L. A. Seevaratnam

P81 — Forking the soil on the growth of Clone TRI 2142 planted in heavy soil — 14 paired plots — (1968)

In this experiment the effect of forking the soil to a depth of 18 inches is being compared with no forking. The growth of the tea is assessed visually.

The plots are arranged in pairs, one of each pair being forked and the other left unforked. The plots were forked once in late 1968. The results are not yet available.

R. L. de Silva & R. N. Boppearatchy

New observations and records

Charcoal Stump Rot of Eucalyptus robusta

Ustulina deusta was recorded, apparently for the first time in Ceylon, on *Eucalyptus robusta* stumps at St. Coombs. *E. robusta* is the most common species of gum planted on tea estates in Ceylon. The disease was observed on the stumps and roots of three-year-old trees felled without prior ring-barking. Fructifications, which were abundant on the stumps, were similar to those found on tea stumps affected by Charcoal Stump Rot.

Leaf Spot of Crotalaria anagyroides

An unidentified fungus was found to attack young plants of *C. anagyroides* at St. Coombs. The fungus forms grey to black, sharply defined, irregular spots on the leaves and lesions on the stem. The spores of this species are similar to those of *Pestalotia theae* found on tea. The same fungus was also found on diseased *C. anagyroides* plants sent to the Institute from an estate in the Kandy District. The disease is under investigation.

Acknowledgements

The co-operation of the Agency Houses, Managers and Assistants of estates in the conduct of the experimental programme, and the co-operation and assistance of the staff of the Division are gratefully acknowledged. Thanks are also due to commercial firms that supplied free samples of fungicides for experimentation.

Visits, Lecturers & Symposia etc

Lectures

KERR, A. & DE SILVA, R. L. — "Epidemiology of tea Blister Blight (*Exobasidium vexans*)". Paper read at Symposium on "The Epidemiology of Leaf Diseases in the Humid Tropics" organized by the First International Congress of Plant Pathology in London in July.

PERIES, O. S. & DE SILVA, R. L. — "Problems of crop disease control with chemicals". Paper read at the Symposium on "Crop Protection" organized by the Ceylon Association for the Advancement of Science held in Colombo in December.

SHANMUGANATHAN, N. — "Studies on the parasitism and control of tea root disease fungi in Ceylon". Paper read at the Symposium on "Root Diseases of Plantation Crops" organized by the First International Congress of Plant Pathology in London in July.

SHANMUGANATHAN, N. & FERNANDO, S. R. A. — "Effects of soil fumigation with methyl bromide on root diseases of tea and the nitrogen status of tea soils". Paper read at the 24th Annual Sessions of the Ceylon Association for the Advancement of Science held in Colombo in December.

Dr N. Shanmuganathan and Dr R. L. de Silva wish to thank Dr A. Kerr for reading their papers at the First International Congress of Plant Pathology held in London in July, which they were unable to attend.

Symposia

Dr N. Shanmuganathan and Dr R. L. de Silva participated in the Symposium on Drought held at Badulla in October for the Uva Planters' Association.

Publications

- DE SILVA, R. L. (1968). Agricultural Research. Vidumina of 19th June 1968 (In Sinhala).
- DE SILVA, R. L. (1968). Tea. In a Supplement on Agriculture and Industry. *The Times of Ceylon* of 30th November 1968, 32 pp.
- DE SILVA, R. L. & FERNANDO, S. R. A. (1968). The influence of shallow topsoil on the incidence of Collar and Branch Canker Disease of tea (*Phomopsis theae* Petch). *Tea Q.* 39, 87-91.
- DE SILVA, R. L. & SARAVANAPAVAN, T. V. (1968). Tea Cider : A potential winner. *Tea Q.* 39, 37-41.
- DE SILVA, R. L. & SEEVARATNAM, L. A. (1968). The importance of soil air for tea root growth. *Tea Q.* 39, 42-49.
- SHANMUGANATHAN, N. & DE SILVA, R. L. (1968). Susceptibility of tea clones to Collar and Branch Canker Disease of tea (*Phomopsis theae* Petch). *Tea Q.* 39, 92-93.
- SHANMUGANATHAN, N. (1968). Root diseases of tea and their control. *Tea Res. Inst. Ceylon, Advisory Pamphlet 2/66*. 12 pp. + 9 col. pl.

REPORT OF THE NEMATOLOGY DIVISION

Nematologist — P. Sivapalan, BSc, PhD

General

The vacancy created by Mr. H. B. Herath's transfer to the Entomology Division in October 1967, was filled by the appointment of Mr V. Shivanandarajah in August 1968. As the Division was short of staff the services of Mr P. A. John, who was due to retire in October 1968, were extended by one year.

Laboratory Investigations

Methodology

Earlier findings indicated that storage of soil samples in the laboratory, resulted in a build up of eelworm numbers within samples. Further investigations have shown that this observed increase was due to an increased activation of worms that resulted in a higher percentage recovery than the usual 20 per cent. As the recovery technique depends on the activity of the worms, temporary storage at a slightly higher temperature than that in the field, results in an increased activity and consequently, a larger percentage is recovered. This technique of "storing and recovery", has proved useful to detect the existence of eelworm in areas where the population level has dropped below the threshold value, of the "normal detection level," as for instance, following a period of rehabilitation under Guatemala grass.

P. A. John

Biochemical investigations

Laboratory investigations into the biochemical aspects of resistance of tea clones to eelworm pathogenicity, have indicated that there is a significant reduction in the amino acid theanine (an amino acid specific to tea) in roots infested with eelworms. No such obvious reduction in this amino acid was observed in clones tolerant or resistant to eelworms. When investigating the free amino acid pattern within nematode tissues, glutamine and glutamic acid, were found to be the most predominant and these two amino acids also happen to be the major derivatives of theanine. The latter appears to play a significant role in the metabolism of this eelworm.

As these are interesting observations, further investigations are being carried out.

V. Shivanandarajah

Field Experiments and Trials

The following experiments have been completed and the results have been published in the Annual Report for 1967, Part 2, pp 79-87: N7, N12, N14, N15, N16, N21, N23, LN2, MN1 and UN1.

N1 — *Resistance and tolerance of clones to Pratylenchus loosi* — (1962)

Thirty six clones were screened for resistance and tolerance in 1968 but the assessments have not been completed, and the results cannot, therefore, be quoted yet.

N3 — *Field performance of clones tolerant to P. loosi* — (1964)

The results of yield analysis are presented in Tables 1 and 2.

TABLE 1 — *Field performance of clones tolerant to P. loosi*

Clone	Estates*	Mean yield (lb green leaf per plot)		Mooloya
		St Coombs	Derryclare	
M241		103.9	88.6	63.5
M116		59.7	108.1	55.7
2142		61.4	75.0	94.9
2025		125.8	125.7	94.4
M208		58.9	86.9	53.9
DT1		88.6	93.7	56.3
LSD	$P = 0.05$	23.6	33.5	4.6
	$P = 0.01$	32.6		6.3
	$P = 0.001$	45.0		8.7

*The plots at Chapelton Estate were pruned in May 1968. An analysis on yield could not, therefore, be worked out.

As seen from Table 1, a highly significant difference in yield was observed between clones at St Coombs and at Mooloya. A combined statistical analysis of yield patterns, indicated a highly significant difference between locations and a highly significant treatment x location interaction, indicating that the clones behaved differently at the different test locations (*vide* Table 2).

TABLE 2 — *Locational performance of clones tolerant to P. loosi*

Estates	Mean Yield (lb green leaf per plot)
Derryclare	96.32
St Coombs	83.04
Mooloya	69.78
LSD ($P = 0.05$)	9.17
($P = 0.01$)	12.21
($P = 0.001$)	15.93
Clones	
TRI 2025	115.28
M 241	85.33
DT1	79.53
TRI 2142	77.09
M 116	74.48
M 208	66.54
LSD ($P = 0.05$)	12.96
($P = 0.01$)	17.27

All the clones yielded best at Derryclare Estate and least at Mooloya Estate. TRI 2025 yielded best at all locations, yielding, on an average, a little over 2000 lb made tea per acre per year, in the third year of plucking of the first cycle. This yield was found to be (highly) significantly greater than all the other test clones. TRI 2025 was followed by M 241 yielding, on an average, a little over 1500 lb made tea per acre per year. All the other test clones were found to yield less than 1500 lb, with M 208 yielding the least (1200 lb).

The results of assessments of eelworm numbers are presented in Tables 3 and 4.

TABLE 3 — *Build-up of soil populations of P. loosi among the test clones—Analysis done for individual estates*

Clone	Estates			
	St Coombs	Derryclare	Chapelton	Mooloya
M 241	0.845	1.490	1.817	0.525
M 116	0.762	1.540	1.620	1.605
2142	0.880	1.072	1.745	0.600
2025	1.097	1.460	1.778	0.885
M 208	0.270	1.240	1.427	1.275
DT 1	0.735	1.475	1.640	0.975
LSD ($P = 0.05$)	0.965	0.567	0.542	0.690
	(NS)	(NS)	(NS)	

As seen from Table 3, no significant difference in the build-up of the eelworm population in soil was observed in respect of the different test clones, other than at Mooloya Estate, where a significant difference was observed between the clones M 241 and 208. From a combined statistical analysis, however, it could be concluded that there is no significant difference between the test clones, in respect of eelworm multiplication. (*vide* Table 4).

TABLE 4 — *Build-up of soil populations of P. loosi among the test clones—combined analysis for all estates*

Estates	Mean population count per 100g soil
Mooloya	1.67
Derryclare	1.37
Chapelton	0.97
St Coombs	0.76
LSD ($P = 0.05$)	0.28
($P = 0.01$)	0.37
($P = 0.001$)	0.47
Clones	
M 116	1.38
TRI 2025	1.30
DT 1	1.20
M 241	1.16
TRI 2142	1.07
M 208	1.05
LSD ($P = 0.05$)	(NS)

A highly significant locational variation was, however, observed in respect of eelworm multiplication. This could be due to variations in soil conditions, which in turn have a direct influence on the rate of eelworm multiplication. According to the observations, the soil conditions at Mooloya seem to be the most favourable, and that at St Coombs the least favourable for rapid eelworm build-up. (The poor performance of the test clones at Mooloya, could probably result from this rapid build-up of eelworms.) The plots at St Coombs and Mooloya are due for pruning in 1970. The plots at Derryclare Estate were pruned in January 1969. Assessments will be continued for the second cycle.

S. Samarajewa & P. A. John

N8 — *The effect of two methods of uprooting on (a) survival of P. loosi during the rehabilitation period and (b) the increase of P. loosi following replanting* — (1965)

The results of assessments are presented in Table 5.

TABLE 5 — *Means of assessments of shoot and root growth of replanted tea and mean counts of eelworm build-up within roots*

Treatments	Shoot weight	Root weight	Eelworm count
Hand pulled	112.6	26.3	1.24
Winched	152.5	34.4	1.04
LSD ($P = 0.05$)	53.8	11.3	0.91
	(NS)	(NS)	(NS)

Although there is no significant difference between treatments in respect of shoot and root growth and eelworm build-up in roots, in general, there is a trend towards a better growth of plants and a lower eelworm build up, in the winched plots than in the hand-pulled plots. Winching out of old tea bushes, by itself, is not a satisfactory method of uprooting; deep forking and root removal must necessarily follow the winching out of bushes, particularly, when the land is to be rehabilitated under Guatemala grass.

S. Samarajewa & A. R. M. Hassim

N13 — *Fertilizer levels and their effects on the build-up of populations of P. loosi in tea (TRI 2025)* — (1966)

As all the pots were inoculated with eelworms, the extent of pathogenicity in respect of the different fertilizer treatments, could not be evaluated. The results of analysis of shoot and root growth and nematode counts within roots, are presented in Table 6.

As seen from Table 6, a highly significant response to nitrogen and potassium was observed in respect of both shoot and root growth. No significant response to phosphorus was observed with respect to shoot growth and only a small response was observed with respect to root growth. The results of this investigation indicate that potassium may be important for improving the growth of eelworm infested plants. In order to assess possible variations in the extent of pathogenicity, the above experiment is repeated with modifications (*vide* N17).

S. Samarajewa, A. R. M. Hassim & P. A. John

TABLE 6 — *Performance of clone TRI 2025 in respect of different fertilizer treatments and eelworm infestation*

Fertilizer treatment (Nitrogen levels) (lb per acre per year)	Shoot weight (g)	Root weight (g)	Eelworm count per g root (sq root trans)
0	48.6	60.3	10.54
60	160.5	129.9	12.40
120	214.4	182.7	7.94
180	193.2	173.9	9.68
LSD ($P = 0.05$)	31.4	31.7	2.57
($P = 0.01$)	41.8	42.1	3.42
($P = 0.001$)	54.2	54.7	(NS)
(Phosphorus levels) (lb per acre per year)			
0	142.7	128.2	10.72
30	150.9	125.1	10.60
60	168.9	156.7	9.11
LSD ($P = 0.05$)	27.2 (NS)	27.4	2.91 (NS)
(Potassium levels) (lb per acre per year)			
0	131.2	115.5	10.03
35	161.7	135.6	10.82
70	169.6	159.0	9.57
LSD ($P = 0.05$)	27.2	27.4	2.91
($P = 0.01$)	36.2	36.5	(NS)

N17 — *Fertilizer levels on the build up and pathogenicity of P. loosi in tea — (1967)*

The results of this experiment indicate that although there was a response to nitrogen in both the infested and uninfested plants, the degree of pathogenicity, increased with increasing nitrogen application. Elemental analysis of both leaves and roots indicates that with increasing nitrogen, the percentage of potassium decreased markedly, in both leaves and roots (see Table 7).

TABLE 7 — *Results of elemental analysis and assessments of pathogenicity*

Levels of N (lb per acre per year)	Mean % K in leaves	Mean reduction in shoot growth	Mean % K in roots	Mean reduction in root growth	Nematode count per g root (log transformed)
0	1.46	4.6	1.76	64.7	2.91
15	1.21	69.5	1.19	129.3	2.89
30	1.20	67.9	1.48	142.3	3.01
60	1.06	99.7	0.98	142.6	3.05
120	0.53	137.2	0.55	160.3	3.20
LSD ($P=0.05$)		71.6	0.49	88.9	0.23
($P=0.01$)	0.34	—	0.68	—	—
($P=0.001$)	0.47	—	—	—	—

The decrease in potassium within leaves and roots was found to be inversely proportional to the increase in pathogenicity. Potassium, therefore, appears to be playing a significant role in nematode pathogenicity. Lowering of the potassium content within the host plant appears to be enhancing damage caused by eelworms. Details of this investigations will be published shortly.

N18 — *4 levels of application of Nemagon granules (20% w/w) infested nursery soil, on the growth of cuttings and the population build up of P.loosi in roots of clone TRI 2024 — (1967)*

No significant difference in growth rates of cuttings was observed between those planted in soil mixed with Nemagon at the different rates of application, and the controls. At the eight month, the majority of the cuttings had developed only a few roots and most of them had callused heavily. Mixing nursery soil with Nemagon granules, therefore, does not seem to be useful. This experiment is now terminated.

A. R. M. Hassim

N19 — *Selective removal of old tea roots of varying sizes, followed by a period of rehabilitation, on the subsequent growth of tea plants and eelworm build up within roots at Ferham Estate, Lindula — (1967)*

The Guatemala grass was uprooted and the plots were planted to tea in August 1968. This experiment is continuing.

S. Samarajeewa

N20 — *Selective removal of old tea roots of varying sizes, followed by soil fumigation without a period of rehabilitation, on the subsequent growth of tea plants and eelworm build up within roots at Kirimetiya Estate, Galaha — (1967)*

Growth assessments of tea plants made at the end of one year, indicate no significant difference between treatments. A small degree of eelworm build-up has been observed only within the control plots. This experiment is continuing.

S. Samarajeewa

N22 — *Levels of N, K, and Ca on nematode reproduction and pathogenicity — in sand culture in pots — (1967)*

Although variations in growth were observed because of differences in treatments, at the time of assessment no eelworms were recovered from the roots. It is possible that the original inoculum added to sand would have leached out soon after inoculation and that the few that escaped leaching would have been insufficient to colonize the roots successfully. This experiment is being repeated, with modified inoculation techniques.

T. Manivasagar

N24 — *Inoculum levels of Radopholus similis and pathogenicity to tea (TRI 2024) — (1967)*

No differences in growth were observed between inoculated and uninoculated plants and only a very few eelworms were recovered from the roots of plants that received the highest inoculum. It is possible, that the clone TRI 2024, is resistant to *R. similis*. This experiment is now being repeated, using TRI 2025, which was subsequently assessed to be susceptible to *R. similis*.

S. Samarajeewa & A. R. M. Hassim

1968 Experiments

N25 — *The effect of using arboricides on old tea due for uprooting, on the build-up of eelworm populations in replanted young tea at Great Western Estate, Talawakele—5 replicates of 3 treatments+control (2 chemicals), in randomized blocks — (1968)*

Old infested tea roots left in the soil continue to harbour eelworm populations for more than two years. Although, during the period of rehabilitation under Guatemala grass there is an appreciable reduction in the soil population, when the land is planted to tea, the eelworms 'incubating' within the old tea roots become attracted towards the feeder roots of the young plants. As a result, a rapid build up is known to occur. The use of tree-killers was considered to be a possible means of minimizing the hazards of leaving such live infested roots in the soil. In this experiment, the old tea due for uprooting was treated with two arboricides, Shell Weed-killer T at two and three gallons per acre and Prefix wettable powder at 36 lb per acre. All plots treated with Shell Weedkiller T, were found scorched within one month after application, whilst those treated with Prefix, remained unaffected. The post-treatment eelworm counts in the different treatments, are presented in Table 8.

TABLE 8 — *Post-treatment eelworm count, following treatment with arboricides*

Treatments		Mean eelworm counts (log n + 1)
Arboricide	Dose	
Shell Weed-killer T	2 gallons	1.428
	3 gallons	0.432
Prefix	3 lb	1.482
Control		1.797
LSD ($P = 0.05$)		0.764
	($P = 0.01$)	1.053

A highly significant reduction in eelworm numbers in the soil was observed only in the plots treated with Weedkiller T, at the rate of three gallons per acre. The ten plots treated with this weedkiller, were all uprooted and planted with Guatemala grass. At the end of one year, these plots will be replanted with tea. Of the remaining ten plots, the five plots treated with Prefix that continued to remain unaffected, will be uprooted, fumigated and replanted with tea, while the remaining five plots will continue to be control plots and will be replanted with tea, without any treatments. Growth assessments of tea plants and eelworm build-up within the roots, will be made at regular intervals.

S. Samarajeewa

N26 — *Arboricides on old tea due for uprooting, on the build-up of eelworm populations in replanted young tea at Galkandewatte Estate, Talawa-kele—4 replicates of 3 treatments + control—in randomized blocks—(1968)*

This experiment is similar to N25, except that the Weedkiller T was applied at three and six gallons per acre and instead of Prefix, Hyvar X was used at four lb per acre. Three months after treatment, the plots were uprooted and planted with Guatemala grass. The experiment is continuing.

S. Samarajeewa

N27 — *Soil temperature on the build-up and pathogenicity of P. loosi in tea—3 treatments of 9 assessments each using 4 replicates at each assessment—(1968)*

The plants are being grown in a constant environment growth chamber, maintained at the requisite temperature. Assessments are being carried out at three different temperatures, viz 82.5, 70.0 and 52.5°F. The experiment is continuing.

T. Manivasagar

N28 — *Dose of methyl bromide required for fumigating nursery soil*—3 replicates of 4 treatments + control in randomized blocks — (1968)

Polythene sleeves filled with heavily-infested soil, were stacked in beds measuring 40 ft × 5 ft, and fumigated with methyl bromide at 1, 2 and 4 lb per 200 sq. ft. Growth assessments and eelworm counts are to be made at the end of one year. This experiment is continuing.

S. Samarajeewa & A R. M. Hassim

N29 — *Varietal susceptibility of potatoes to P. loosi*—5 replicates of 5 varieties + tea (TRI 2024 — control) in randomized blocks — (1968)

Earlier findings (Sivapalan 1968a), have shown that potatoes serve as a useful trap crop to reduce potential dangers of eelworm damage to young tea clearings. In order to test the efficacy of the different varieties of potatoes as trap crops for the meadow eelworm, five varieties of potato, viz, Arka, Pamir, Cosima, Wanda and Condea, were tested by establishing the tubers of the respective varieties in soils heavily infested with *P. loosi*. Tuber weights and eelworm counts in roots were assessed at the end of three months. The results are presented in Table 9.

TABLE 9 — *Potato yields and eelworm build up in roots*

	Mean tuber weights (g)	Mean eelworm count (log)
Condea	119.2	1.38
Wanda	110.4	2.10
Pamir	100.9	2.29
Cosima	86.3	2.53
Arka	119.4	2.61
Tea	—	2.03
LSD ($P = 0.05$)	30.4	0.70
	(NS)	

The results given in Table 9 indicate that although there were no significant differences between varieties in respect of tuber weights; the variety Arka was found to be the most susceptible and Condea the least susceptible to *P. loosi*. As a source of removing eelworm colonies from infested lands, the variety Arka appears, therefore, to be the most suited, for planting in uprooted tea clearings.

S. Samarajeewa, T. Manivasagar & P. A. John

N30 — *Fertilizer types and levels on pathogenicity and build-up of populations of P. loosi in tea*—2 sources of N, at 4 levels + control — each applied to infested and uninfested plants—each treatment replicated 4 times— (1968)

The two sources of nitrogen used in this investigation were urea and sulphate of ammonia. One half the number of pots in each treatment was inoculated with approximately 10,000 eelworms per pot. Growth assessments and eelworm build-up in roots are to be assessed at the end of one year. The experiment is continuing.

S. Samarajeewa & P. A. John

N31 — *Field performance and tolerance of clones to the Root-Knot Nematode, Meloidogyne brevicauda at Kabaragalla Estate, Elamulla—4 replicates of 6 clones in compact randomized blocks in 2 sets, one fumigated and the other unfumigated — (1968)*

The test clones include DT 1, TC 9, K 145, TRI 2024, TRI 2025 and TRI 2142. These clones are being tested in soils heavily infested with the Root-Knot Nematode, *M. brevicauda*. One set of plots was fumigated with methyl bromide at 1 lb per 200 sq. ft. Build-up of root-knot nematode populations is to be assessed periodically.

S. Samarajeewa

N32 — *Sampling time on population levels of 3 species of parasitic nematodes in tea at 8 widely-spaced locations — (1968)*

The three species of parasitic nematodes under investigation are *P. loosi*, *Pratylenchus curvatus* and *Helicotylenchus erithrinae*. The different test locations include St Coombs; Craighead Estate, Nawalapitiya; Kirimetiya Estate, Galaha; Mooloya Estate, Hewaheta; Park Estate, Kandapola; Leangahawela Estate, Bandarawela; Kew Estate, Bogawantalawa and Derryclare Estate, Kotagala. Fortnightly samples are being collected from these locations and population counts of the above species of nematodes are being estimated. Records of rainfall, soil moisture and soil temperature are being taken at each sampling time in the different locations. This investigation is to be carried over a period of one year.

S. Samarajeewa & T. Manivasagar

Publications

SIVAPALAN, P. (1968a). Potato cultivation and Root-Lesion Nematode of tea. *Tea Q.* 39, 4-5.

SIVAPALAN, P. (1968b). Association of *Radopholus similis* with decline in young tea fields. *Plant Dis. Repr.* 52, 528.

REPORT OF THE ENTOMOLOGY DIVISION

Entomologist — W. Danthararayana, BSc, PhD, DIC

General

Mr. H. B. Herath left the service of the Institute on 31st May ; Mr K. D. Bandularatne assumed duties on 1st August. Dr W. Danthararayana served on the Standing Committee on Agro-chemicals of the Ministry of Agriculture and Food, and also on the Subpanel for Agrochemicals and Fertilizer of the Industrial Development Board.

Laboratory Investigations

Control of the Ambrosia fungus (*Monacrosporium ambrosium*)

A systemic fungicide, Du Pont 1991, was evaluated for its ability to prevent the growth of the ambrosia fungus cultured in Petri dishes. The fungicide was tested at concentrations of 0.25, 0.5, 1.0, 1.5, 2, 5 and 10 ppm in five replicates. All concentrations above 1.5 ppm caused fungistasis of the mycelium and also prevented sporulation. These effects were greater when the fungicide was incorporated into the agar medium, than when the surface was brushed with the solution of the fungicide.

W. Danthararayana & H. B. Herath

A laboratory experiment to supplement the field experiments E60 and E62 was carried out to test the fungicide Du Pont 1991. Cut tea branches were placed in bottles containing solutions of the fungicide at concentrations of 0, 333, 666, 1332 ppm. These concentrations were identical to those used in the field experiments E60 and E62. Live beetles were induced to make galleries in these branches. The branches were dissected later to reveal the galleries. Scrapings from the galleries were inoculated on to culture media on Petri dishes. The Ambrosia fungus was detected in all Petri dishes showing that the fungicide had no systemic effect when applied through cut ends of branches.

W. Danthararayana & S. N. Fernando

Behavioral studies on Shot-hole Borer (*Xyleborus fornicatus*)

A series of experiments were begun to study the behaviour of Shot-hole Borer in relation to gallery construction. The results show that the beetles prefer nodes to internodes for gallery construction. The experiments are being continued.

S. N. Fernando

Biological Control Project on Shot-hole Borer

In 1967, the Institute gave a grant to the Commonwealth Institute of Biological Control (CIBC) to look into the possibility of the biological control of Shot-hole Borer. Work on these lines has since been carried out at various stations of the CIBC, situated in different parts of the world, in order to obtain possible parasites, predators or disease that could be introduced into Ceylon.

A chalcidoid parasite known as *Perniphora robusta* was obtained from the wood-boring beetle *Xyleterus (Trypodendron) lineatus* in West Germany. *Perniphora* appears to be the principal parasite of bark beetles in Europe boring

the wood of coniferous and deciduous trees. It is known to be a primary parasite of beetle larvae. In May 1968, a test shipment of 150 adults of *Perniphora* were received from the European station of the CIBC. Many of the parasites were dead in transit, but those alive were released at Carolina Group, Watawala. More consignments of the parasite are expected in 1969.

Biology of the Red Spider Mite (Oligonychus coffeae)

Preliminary studies on the life history are being observed on mites bred on rooted clonal cuttings maintained in nutrient culture solutions. Adult female mites were placed on each mother leaf and then removed after an egg was laid. In the laboratory, the incubation period of the egg was nine days. The eggs were found firmly attached on to the upper surface of the leaf. They are spherical, but flattened on their lower surface and have an average diameter of 0.14 mm. The studies are continuing.

A. Kathiravetpillai

Field Experiments and Trials

The following experiments have been concluded and the results published: E25, E29-E31, E47, E48, E52, E53, XE1-XE8 (see Report for 1967).

E28, E32, E34, E35, E41, E43-E46 (see Danthanarayana, Fernando & Shanmugam 1968)

Shot-hole Borer (*Xyleborus fornicatus*)

E33 — Aldrin, dieldrin and heptachlor for shot-hole borer control in new clearings at Carolina Group, Watawala — (1966)

The data for the first year after treatment have been statistically analysed and published (Danthanarayana, Fernando & Shanmugam 1968). The results up to this time showed that all treated plots gave significantly lower numbers of shot-hole borer than the untreated plots. Heptachlor at 1.7 lb (six pints 23% EC) and dieldrin at 1.5 lb (six pints 20% EC) gave the best results. There was, however, no significant difference between their efficacy. Aldrin at 1.5 lb (six pints 20% EC) was the next best followed by dieldrin at 0.5 lb and heptachlor at 0.6 lb per acre. The borer population in all plots other than those treated with 1.5 lb dieldrin increased at the end of the first year. The heptachlor treatments were, therefore, repeated at 13 months after the first application and the results indicate that annual applications of heptachlor at 1.7 lb per acre provide highly effective borer control. The experiment is in progress.

E42 — Azinphos-methyl, Bordeaux Mixture, azinphos-methyl + Bordeaux Mixture, ethylene dibromide, fenthion, endrin and DDT for shot-hole borer control at Downside Estate, Welimada — (1967)

The results at the end of 20 months after treatment are presented in Table 1. The statistical analysis is based on results upto 16 months after treatment only, and shows that 1.25 lb endrin and 1.7 lb heptachlor gave significant reductions in shot-hole borer numbers. None of the other treatments was as effective. Azinphos-methyl and DDT gave good results upto eight months after spraying. There was no significant difference between the efficacy of endrin and that of heptachlor. Sampling carried out at the 18th and 20th months after treatment shows that heptachlor is slightly superior to endrin at these months indicating that heptachlor is more persistent than endrin.

TABLE 1 — Post-treatment counts of all live stages of Shot-hole Borer in Experiment E42

Treatment	Dose (lb ai per acre)	No. per 200 sample units (months after treatment given in parantheses)										Mean no. per 50 units (as log (n + 1))
		(2)	(4)	(6)	(8)	(10)	(12)	(14)	(16)	(18)	(20)	
Azinphos-methyl	1.0	1	8	50	34	181	82	84	202	117	556	0.84
Bordeaux Mixture	7.5	12	9	126	120	171	77	127	144	169	470	0.96
Azinphos-methyl + Bordeaux Mixture	1.0 + 7.5	18	2	26	121	148	120	151	215	143	623	1.01
Heptachlor	1.7	0	0	16	10	33	23	73	89	95	250	0.40*
Methiocarb	1.9	1	23	84	104	94	104	133	143	162	450	0.89
Ethylene dibromide	1.2	0	0	56	120	176	78	89	124	71	356	0.93
Fenthion	1:5	1	17	46	113	44	199	130	17	185	435	0.93
Endrin	1.2	0	7	1	36	48	3	21	38	113	423	0.39*
DDT	2.7	0	1	53	9	101	108	135	127	121	653	0.78
Untreated control		1	19	44	113	128	142	85	118	114	508	0.90
LSD ($P = 0.05$)												0.24

* Significantly different from the untreated at $P < 0.05$

NB Analysis of variance carried out on data up to 16th month after treatment only

1968 Experiments

E59 — *Heptachlor post-prune, heptachlor mid-cycle, heptachlor + Estab, heptachlor + Lovo, heptachlor-impregnated jute, endrin, endrin + Estab, endrin + Lovo, endrin-impregnated jute, endosulphan and dieldrin for shot-hole borer control at Ury Group, Passara*—4 replicates of 11 treatments + control in randomized blocks — (1968)

Each plot is 1/20th acre in extent. The spraying was done with knapsack sprayers with a spray volume of 80 gallons of water per acre. The main object of this experiment is to determine whether the persistence of heptachlor and endrin can be increased by additive stickers. Mid-cycle and post-prune applications of heptachlor and heptachlor-impregnated and endrin-impregnated pieces of jute are also tested for their effect on borer control. If the latter method is found to be effective, then it will be possible to treat densely-planted VP plants without contaminating the foliage, and also overcome the difficulties involved in mid-cycle spraying which is not practicable in dense stands of VP tea. Two assessments of the borer population were made during the year. The experiment is continuing.

W. Danthararayana & A. Kathiravetpillai

E60 — *Heptachlor, heptachlor + Plyac, heptachlor-impregnated jute, endrin, endrin + Plyac, endrin-impregnated jute, DDT, DDT + Plyac, BHC, BHC + Lovo, fenthion, fenthion + Lovo and Du Pont 1991 for shot-hole borer control at Kataboola Estate, Kotmale*—3 replicates of 15 treatments + control in randomized blocks — (1968)

This experiment is similar to **E59**. Each plot is 1/20th acre in extent. The spraying was done with knapsack sprayers, with a spray volume of 80 gallons of water per acre. The plots were sprayed at the end of one year from prune. Du Pont 1991 is a new systemic fungicide and is tested against the Ambrosia fungus of Shot-hole Borer. Two assessments of the borer population were made during the year. The experiment is continuing.

E61 — *DDT at 3 levels, DDT + Plyac, endrin at 3 levels, endrin + Plyac, heptachlor, heptachlor + Plyac and dieldrin for shot-hole borer control at Kataboola Estate, Kotmale*—4 replicates of 11 treatments + control in randomized blocks — (1968)

The plot size is 1/20th acre. The spraying was carried out with knapsack sprayers, with a spray volume of 80 gallons of water per acre. All treatments were given immediately after pruning. The experiment is in progress and no assessments have been made yet.

E62 — *Three levels of Du Pont 1991, fenitrothion, fenitrothion + Plyac, endosulphan, endosulphan + Plyac, H-14503, dioxathion, UC 21149 (Temic 10G) and Du Pont 1179 (Lannate) for shot-hole borer control at Carolina Group, Watawala* — 4 replicates of 11 treatments + control in randomized blocks — (1968)

Each plot is 1/20th acre in extent. The spraying was done with knapsack sprayers with a spray volume of 80 gallons of water per acre. The treatments were carried out at the end of one year from pruning. UC 21149 is a new granular systemic insecticide belonging to the carbamate group and was given as a soil dressing around the plants.

Lannate is a new carbamate insecticide, and dioxathion is an organophosphate compound not previously tested. Fenitrothion is known to control shot-hole borer for short periods (Danthararayana *et al.* 1968) and is tested with the additive sticker, Plyac. Two assessments of the borer population were made during the year. The experiment is continuing.

E63 — *Endrin, DDT, endrin + DDT, heptachlor, heptachlor + Tenac, dieldrin, chlordane, perthane, methoxychlor and Resitox at two levels for shot-hole borer control at Rothschild Estate, Pussellawa*—4 replicates of 11 treatments + control in randomized blocks — (1968)

Each plot is 1/20th acre in extent. The spraying was done with knapsack sprayers, with a spray volume of 80 gallons of water per acre. The treatments were applied immediately after pruning. Perthane and methoxychlor are organochlorine insecticides, and Resitox is a mixture of endrin and DDT formulated by the Shell Co. The experiment is in progress and no assessments have been made yet.

E64 — *VCS 506, Dowco 179 (Dursban), formothion, Resitox, DDT at 3 levels, endrin at 2 levels and C-10015 for shot-hole borer control at Telbedde Estate, Badulla*—4 replicates of 11 treatments + control in randomized blocks — (1968)

Each plot was 1/20th acre in extent. The spraying was done with knapsack sprayers with a spray volume of 80 gallons of water per acre. The treatments were given at the end of one year from pruning. VCS 506 is a new insecticide and its chemical composition is not yet disclosed. Dowco 179 (Dursban) is an organophosphate compound. C 10015 is a new insecticide belonging to the carbamate group. Two assessments of the borer population were made during the year. The experiment is continuing.

E65 — *Heptachlor, endrin, endosulphan, endosulphan + Plyac, phenthoate, phenthoate + Plyac, toxaphene, Torbidan, Toxaphene-DDT, toxaphene + Plyac and Miltox for shot-hole borer control at Meddecombra Estate, Watagoda*—4 replicates of 11 treatments + control in randomized blocks — (1968)

Each plot is 1/20th acre in extent on VP tea planted in 1966. The spraying was done with knapsack sprayers with a spray volume of 80 gallons of water per acre. The spraying was done in November 1968. Phenthoate is a new organophosphate insecticide. Torbidan is a mixture of toxaphene, DDT and parathion formulated by Hercules International Corporation. Miltox is a fungicide containing copper oxochloride and Zineb and is included as a treatment against the ambrosia fungus. One assessment of the borer population has been made so far. The experiment is continuing.

E66 — *DDT at 3 levels, endrin at 3 levels, endrin-impregnated jute, Resitox, heptachlor, heptachlor-impregnated jute and dieldrin for shot-hole borer control at Deltotte Group, Galaha*—4 replicates of 12 treatments—control in randomized blocks — (1968)

Each plot is 1/20th acre in extent. The spraying was done with knapsack sprayers with a spray volume of 80 gallons of water per acre. The applications of the insecticide were made as post-prune sprays. No assessment of borer control has been made yet. The experiment is continuing.

W. Danthanarayana, C. Shanmugam & S. N. Fernando

Mites

E21 — *Mites, shade and fertilizer on yield at Downside Estate, Welimada* — (1965)

The experiment began in January 1965 was concluded in September 1968. Definite conclusions can be made only after statistical analysis which has not yet been carried out.

E49 — *Purple mite attacks on yield and the effects of shade and fertilizer applications on purple mite numbers at Liddesdale Group, Halgranoya — (1967)*

The results for 22 months available up to the end of 1968 show that there is a definite increase in yield in the plots protected from mites with applications of Kelthane. Treated plots consistently showed lower numbers of Purple, Scarlet and Red Spider Mites. The results also indicate that purple mite numbers are higher in the unshaded plots. The Red Spider Mite seems to thrive under shaded conditions. The scarlet mite populations were very low and the differences are not clear. The experiment is in progress.

E50 — *Purple mite on yield at Diyanilla Division, Liddesdale Group, Halgranoya — (1967)*

The experiment has been in progress for 17 months. The mite populations have not been very heavy during this period. Sampling for mites was carried out at monthly intervals. There were smaller numbers of mites in the plots treated with Kelthane. A slight yield increase was recorded in the plots where the mites were controlled. The experiment is continuing.

E51 — *Red Spider Mite on yield at Dambawinna Division, Welimada group, Welimada — (1967)*

As a result of the very severe drought conditions that prevailed in 1968, a large number of tea bushes died in all plots. It was, therefore, decided to discontinue this experiment.

1968 Experiments

E67 — *Oxythioquinox at 3 levels, dicofol at 3 levels, dicofol + tetradifon at 2 levels, tetradifon at 2 levels, dinobuton and Dowco 213 (Plictran) for purple, scarlet and red spider mite control at Glenanore Estate, Haputale — 4 replicates of 11 treatments + control in randomized blocks — (1968)*

The main object of this experiment is to evaluate oxythioquinox (Morestan) for mite control and determine the minimum dose required. In experiment E48 this acaricide gave very good control of Red Spider and Scarlet Mites. Dinobuton (Acres) and Plictran are two new acaricides. Each plot is 1/20th acre in extent. Spraying was done with knapsack sprayers with a spray volume of 60 gallons of water per acre. One pre-treatment assessment and eight post-treatment assessments of the mite numbers have been made so far. The results of only six post-treatment counts of Red Spider and Scarlet Mites have been statistically analysed, and are presented in Tables 2 to 5. Results of this experiment show that all treatments other than those of tetradifon (Tedion) controlled both active stages and eggs of Red Spider and Scarlet Mites. Dicofol (Kelthane) at the higher rate of 0.26 lb (10 fl. oz) per acre was more effective than the lower dose of 0.13 lb (5 fl. oz) per acre. Oxythioquinox (Morestan) gave extremely good and consistent control of all

TABLE 2—Control of the active stages of the Red Spider Mite with acaricides (Experiment E67)

Treatment	Rate (lb ai per acre)	Pre-treatment count	No. of mites per 100 leaves						
			Post-treatment counts						
			(Weeks after treatment given in parantheses)						
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oxythioquinox	0.11	792	538	144*	8*	9*	16*	0*	02*
Oxythioquinox	0.22	942	490	198*	7*	14*	14*	06*	01*
Oxythioquinox	0.33	966	364	194*	5*	11*	21*	04*	04*
Dicofol	0.13	868	802	248*	44*	102	142	87*	57
Dicofol	0.26	810	594	340	8*	43*	30*	09*	13*
Dicofol + tetradifon	0.13 + 0.025	540	676	446	38*	104	46*	27*	07*
Dicofol + tetradifon	0.07 + 0.013	480	540	286	31*	97	38*	28*	26*
Tetradifon	0.025	964	702	400	37*	45*	31*	34*	14*
Tetradifon	0.05	894	740	368	9*	36*	30*	26*	09*
Dinobutan	0.6	662	368	144*	34*	61*	97*	42*	55
Plictran	0.2	502	512	11*	7*	2*	06*	09*	03*
Untreated control	—	628	770	576	122	172	199	132	69

NB Analyses of variance and covariance carried out on \sqrt{n} and $\sqrt{n+1}$ transformed values.

* Significantly different from the untreated at $P < 0.05$.

TABLE 3 — *Effect of acaricides on the numbers of red spider mite eggs (Experiment E67)*

Treatment	Rate (lb ai per acre)	Pre-treatment count	No. of eggs per 100 leaves						
			Post-treatment counts (weeks after treatment given in parantheses)						
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oxythioquinox	0.11	2196	1998	394*	65*	40*	25*	14*	08*
Oxythioquinox	0.22	2352	2224	718*	96*	71*	51*	10*	05*
Oxythioquinox	0.33	2588	1128	698*	62*	60*	34*	07*	02*
Dicofol	0.13	1790	3186	682*	272*	384*	266	213	207
Dicofol	0.26	1810	1728	706*	60*	133*	104*	31*	74*
Dicofol + tetradifon	0.13 0.025	1596	1844	1518	152*	319*	81*	68*	36*
Dicofol + tetradifon	0.07 0.013	1410	2014	1088	229*	290*	102*	85*	65*
Tetradifon	0.025	2482	3026	1962	564	519	340	90	116*
Tetradifon	0.05	2402	2936	1474	298*	448	158*	75*	51*
Dinobuton	0.6	1166	1320	548*	203*	363*	105*	165	134*
Plictran	0.2	1736	1214	130*	76*	72*	28*	17*	17*
Untreated control		1682	2230	1892	770	713	578	277	262

NB Analysis of variance was carried out on \sqrt{n} transformed values

* Significantly different from the untreated at $P < 0.05$

TABLE 4 — Control of the active stages of the Scarlet Mite with acaricides (Experiment E67)

Treatment	Rate (lb ai per acre)	Pre-treatment count	No. of mites per 100 leaves						
			Post-treatment counts (weeks after treatment in parantheses)						
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oxythioquinox	0.11	2128	634	218*	16	62	71*	33*	61
Oxythioquinox	0.22	3428	182	80*	05*	10*	16*	15*	17*
Oxythioquinox	0.33	1046	916	52*	7*	15*	31*	02*	25
Dicofol	0.13	1130	434	84*	17	31	36*	22*	32
Dicofol	0.26	1762	298	76*	05*	16	12*	04*	20*
Dicofol + tetradifon	0.13 0.025	632	836	56*	11*	22	40*	08*	30
Dicofol + tetradifon	0.07 0.013	330	2058	46*	16	20	27*	57	28
Tetradifon	0.025	1408	842	364	76	253	311	157	196
Tetradifon	0.05	1046	318	686	31	136	168	56	79
Dinobuton	0.6	390	258	38*	06*	10*	24*	06*	10*
Plictran	0.2	374	46	04*	07*	06*	08*	14*	16*
Untreated Control		662	842	422	47	88	453	145	99

NB Analysis of variance and covariance carried out on $\sqrt{n+1}$ transformed values

* Significantly different from the untreated at $P < 0.05$

TABLE 5 — *Effect of acaricides on the number of scarlet mite eggs (Experiment E67)*

Treatment	Rate (lb ai per acre)	Pre-treatment count	No. of eggs per 100 leaves						
			Post-treatment counts (weeks after treatment in parantheses)						
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oxythioquinox	0.11	1694	532	310*	88*	66	37*	35*	164
Oxythioquinox	0.22	2950	332	222*	21*	26*	16*	19*	28*
Oxythioquinox	0.33	1092	1442	68*	14*	26*	17*	06*	11
Dicofol	0.13	1282	400	134*	40*	22*	21*	54	20
Dicofol	0.26	1648	284	122*	31*	08*	24*	12*	06*
Dicofol + tetradifon	0.13 + 0.025	562	700	108*	71*	47	21*	28*	26
Dicofol + tetradifon	0.07 + 0.013	312	1696	96*	73*	25*	17*	52	18
Tetradifon	0.025	1520	730	308*	396	353	143	147	112
Tetradifon	0.05	974	296	688	199	164	108	53	41
Dinobuton	0.6	552	290	100*	24*	12*	14*	21*	18
Plictran	0.2	308	123	23*	23*	11*	17*	06*	20
Untreated Control		604	800	538	345	125	352	152	49

NB Analysis of variance and covariance carried out on $\sqrt{n+1}$ values, on corrected data.

* Significantly different from the untreated at $P < 0.05$

stages of both species of mites, confirming the results of experiment E48. These results provide sufficient evidence to recommend Morestan for red spider and scarlet mite control as an alternative to Kelthane. Morestan may be used at the rate of 10 to 14 oz per acre in a suitable quantity of water in knapsack sprayers or mistblowers. Recommendations based on these new findings will be released in 1969. Plictran and dinobuton (Acres) proved themselves to be effective acaricides. These compounds need further investigation in this respect.

E68 — *Oxythioquinox at 3 levels, dicofol at 3 levels, dinobuton and prothoate for purple, scarlet and red spider mite control at Welimada Group, Welimada*—4 replicates of 7 treatments + control in randomized blocks — (1968)

The layout of this experiment is similar to that of E67. The results of this experiment are similar to those of E67, but they have not yet been statistically analysed.

E69 — *Oxythioquinox at 3 levels, dicofol at 2 levels, dinobuton and Dowco 213 (Plictran) for purple, scarlet and red spider mite control at Gonamotawa Estate, Haputale*—4 replicates of 7 treatments + control in randomized blocks — (1968)

The layout of this experiment is similar to that of E67. The results of this experiment are similar to those of E67 and E68, but have not yet been statistically analysed.

W. Danthanarayana & D. J. W. Ranaweera

Tea Tortrix (*Homona coffearia*)

E56 — *The biology and population dynamics of Tea Tortrix* — (1967)

Data for one complete year on the build up of the tortrix population after dieldrin application are now completed. In addition to *Macrocentrus homonae*, the external larval parasite (*Phytodietus capuae*) and the egg parasite *Trichogamma* sp. have been obtained. Two pathogenic organisms, a bacterium and a fungus have been isolated from tortrix larvae and are now being cultured for laboratory-controlled tests. Data for the first year are being analysed. The experiment is continuing.

W. Danthanarayana, A. Kathiravetpillai & K. D. Bandularatne

1968 Experiments

E57 — *Azinphos-methyl, fenitrothion, methyl-parathion, SD 8447 (Gardona) Du Pont 1179 (Lannate), GS 13005 (Supracide), DDT, aminocarb + trichlorphon and aminocarb for tea tortrix control*—4 replicates of 11 treatment + control in randomized blocks — (1968)

This experiment has been concluded and the results published (Danthanarayana & Ranaweera 1968).

E58 — *DDT, methyl parathion, DDT + methyl parathion, aminocarb, du Pont 1179 (Lannate), SD 8447 (Gardona), fenitrothion, H-14503, dioxathion, SD 9129 (Azodrin) and phosalone for tea tortrix control*—4 replicates of 11 treatments + control in randomized blocks — (1968)

This experiment has been concluded and the results published (Danthanarayana & Ranaweera (1968).

E70 — *Loss of crop caused by Tea Tortrix*—12 replicates of 2 treatments in randomized blocks — (1968)

Each block consist of four plots 1/20th acre in extent each. Two plots were treated with DDT for tortrix control and the other two plots were left untreated for the tortrix population to build up. Pre-assessment of yield of all plots was carried out for one year in 1968 at the end of which a round of dieldrin was applied onto specific plots to induce tortrix development. The experiment is in progress.

W. Danthanarayana & C. Shanmugam

Termites

E54 — *Dieldrin, aldrin, heptachlor, chlordane, chlordane + aldrin, chlordane + heptachlor, dimethoate, phosphamidon and dichlorvos for the control of the Up-Country Live Wood Termite at Moray Group, Maskeliya* — (1967)

The insecticides were sprayed on the frame and on the soil surrounding the tea bushes. None of the treatments gave a satisfactory degree of control. The treatments were then modified by applying the insecticide solutions through open galleries into the termite nests. This was done by cutting the infested branch, exposing the gallery and injecting the insecticide through the open gallery. The swirl plate of the nozzle was removed, the lance of the knapsack sprayer was placed at the cut end of the gallery and a squirt of insecticide was then forced in. This method was found to work well with all insecticides, provided the liquid penetrated most galleries. This is not an entirely satisfactory method of control. The experiment is concluded.

D. J. W. Ranaweera

E55 — *Dieldrin, aldrin, heptachlor, chlordane, chlordane + aldrin, chlordane + heptachlor, dimethoate, phosphamidon and dichlorvos for the control of the Low-Country Live Wood Termite at Galbode Estate, Ratnapura* — (1967)

None of the treatments was found to be effective. The experiment is concluded.

1968 Experiments

E71 — *Dieldrin, aldrin, heptachlor, chlordane, UC-21149 (Temik 10G), dimethoate, Dowco 179 (Dursban), phenthoate, prothoate, endrin and DDT + endrin for the control of the Low-Country Live Wood Termite at Galbode Estate, Ratnapura*—4 replicates of 11 treatments + control in randomized blocks — (1968)

None of the treatments were found to be appreciably effective. A few bushes treated with dieldrin, aldrin, chlordane or heptachlor showed signs of termite control.

W. Danthanarayana & A. Kathiravetpillai

Lectures and Symposia

Lectures

- DANTHANARAYANA, W.—“Some problems of tea production in the hill country” at a symposium on “Some aspects of agricultural development in the hill country of Ceylon” conducted by the Ceylon Association for the Advancement of Science at Peradeniya in August.
- DANTHANARAYANA, W.—“Shot-hole borer control with heptachlor” to the Kelani Valley Planters’ Association at Talduwa in September.
- DANTHANARAYANA, W.—“Shot-hole borer control” at a symposium organized by Carson Cumberbatch & Co. Ltd., at Colombo in September.
- DANTHANARAYANA, W.—“Shot-hole Borer and side-effect problems” to the Pussellawa Planters’ Association at Pussellawa in December.
- DANTHANARAYANA, W.—“Application of integrated control concept to the shot-hole borer problem of tea” at the 24th Annual Sessions of the Ceylon Association for the Advancement of Science at Colombo in December.
- DANTHANARAYANA, W. & WICKREMASINGHE, N.*—“Insecticides and problems arising from chemical pest control” at a symposium on “Crop Protection” at the 24th Annual Sessions of the Ceylon Association for the Advancement of Science at Colombo in December.

*Central Agriculture Research Institute, Peradeniya.

Symposium

Dr W. Danthanarayana participated in a symposium on “Drought” organized by the Institute for the Uva Planters’ Association at Badulla in November.

Publications

- DANTHANARAYANA, W. (1968a). The distribution and host range of the Shot-hole Borer (*Xyleborus fornicatus* Eichh.). *Tea Q.* 39, 61-69.
- DANTHANARAYANA, W. (1968b) Shot-hole borer control : Recommendations—1969. *Tea Q.* 39, 115-118.
- DANTHANARAYANA, W. & RANAWEEERA, D. J. W. (1968). The chemical control of Tea Tortrix (*Homona coffearia* Nietner). *Tea Q.* 39, 50-60.
- DANTHANARAYANA, W., FERNANDO, S. N. & SHANMUGAM, C. (1968). Recent developments in research on shot-hole borer control. *Tea Q.* 39, 94-114.

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Glossary of insecticides, acaricides and fungicides used in field experiments

Active constituent	Trade name	Owner	Agent
Aldrin	Aldrex-20	Shell	Shell
Aminocarb	Metacil 50% WP	Bayer	Shell
Azinphos-methyl	Gusathion 20% EC	Bayer	Hayleys
Chlordane	Intox-8 (70% EC)	Sandoz	Baurs
C-10015	C-10015, 50 WP	Ciba	Baurs
Dichlorvos	Vapona 48% EC	Shell	Shell
Dichlorvos	Nogos 100% EC	Ciba	Baurs
Dicofol	Kelthane MF 42%	Rhom & Hass	Mackwoods
DDT	Deenol	Baurs	Baurs
DDT	Arkotine D-18	Shell	Shell
DDT-endrin	Resitox	Shell	Shell
Dieldrin	Dieldrex-20	Shell	Shell
Dimethoate	Rogor-40 (30% EC)	Fisons	Fisons
Dimethoate	Roxion EC 40	Cela	Ceypag
Dinobuton	Acres 30 EC	Murphy	—
Dioxathion	Delnav 80% EC	Hercules	—
Dowco 179	Dursban 4 E	Dow	Harrison & Crosfield
Dowco 213	Plictran 50 WP	Dow	Harrison & Crosfield
Du Pont 1179	Lannate 90%	Du Pont	Shell
Du Pont 1991	Du Pont 1991-50%	Du Pont	Shell
Endosulphan	Thiodan 35% EC	Hoechst	Mackwoods
Endrin	Endrex-20	Shell	Shell
Ethylene dibromide	Dowfume W-85	Dow	Harrison & Crosfield
Fenitrothion	Folithion EC 50	Bayer	Hayleys
Fenitrothion	Sumithion EC 50	Sumitomo	Shell
Fenthion	Labaycid 50% EC	Bayer	Hayleys
Fenthion	Baytex 40% WP	Bayer	Hayleys
Formothion	Anthio 25% EC	Sandoz	Baurs
GS 13005	Supracide	Geigy	Fisons
Heptachlor	Heptachlor 2E	Velsicol	Baurs
Heptachlor	Heptamul 20 & 40 EC	—	Mackwoods
H-14503	H-14503-EC 80	Hercules	—
Methoxychlor	Marlate 2-MR	Du Pont	Shell
Methyl-parathion	Folidol M-50	Bayer	Hayleys
Oxythioquinox	Morstan 25% EC	Bayer	Hayleys
Perthane	Perthane 40% EC	Rhom & Hass	Mackwoods, Shell
Phenthoate	Cidial 50% EC	Montecatini	C. E. Peries & Co.
Phosalone	Zolone 35% EC	Rhone-Poulenc	Baurs
Phosphamidon	Dimecron 50% EC	Ciba	Baurs
Prothoate	Fac 40	Montecatini	C. E. Peries & Co.
SD 847	Gardona 50 % EC	Shell	Shell
SD 9129	Azodrin 50% EC	Shell	Shell
Tetradifon	Tedion V-18	Duphar	Mackwoods
Toxaphene	Toxaphene 60% EC	Hercules	—
Toxaphene+DDT	Toxaphene-DDT 4:2	Hercules	—
Toxaphene+DDT+parathion	Torbidan 4:2:1	Hercules	—
Trichlorphon	Dipterex SP 80	Bayer	Hayleys
UC-21149	Temik 10G	Union Carbide	Mackwoods
VCS-506	VCS-506	Velsicol	Baurs
Zineb+copper oxychloride	Miltox	Sandoz	Baurs

REPORT OF THE BIOCHEMISTRY DIVISION

Biochemist — R. L. Wickremasinghe, BSc, PhD, FRIC

General

Mr W. A. B. de Silva, Technical Assistant, joined the staff of the Division on 1st August, and filled the vacancy created by the resignation of Mr M. H. Rodrigo on 26th December 1967. Dr. R. R. Selvendran returned to Ceylon on 23rd October after three years of post-graduate, and one year of post-doctoral work in the United Kingdom. His doctoral thesis dealt with "The metabolism of phosphate esters and nucleotides in mature strawberry leaves", and his post-doctoral work (as Broodbank Fellow) was on "The metabolism of phosphate compounds in tea leaves". Mr K. Sivapalan returned to Ceylon on 15th October from New Delhi after a two-year period of post-graduate work at the Indian Agricultural Research Institute, where he was awarded a Master's Degree in Science on his thesis entitled "Nucleic acid metabolism in two varieties of wheat in relation to nitrogen fertilization". Dr A. S. L. Tirimanna resigned from the Institute on 31st October.

A part of the staff and equipment of the Biochemistry Division was moved to the Low-Country Station, Ratnapura, during May.

Laboratory Investigations

Chemical analyses of different types of tea

Chemical analyses for polyphenols and amino-acids were carried out on samples of black, green and instant teas. Some of the results, summarized in Table 1, indicate the wide dissimilarities in the chemical constituents. The following points are noteworthy :

- 1 — Liquors of low-grown black tea have a higher level of polyphenols than those of black tea manufactured from high grown leaf.
- 2 — Black tea has a lower level of free polyphenols and a higher level of bound polyphenols than green tea. This is to be expected because the first stage of green tea manufacture is the destruction of the enzyme responsible for the conversion (oxidation) of polyphenols to a form which is easily bound.
- 3 — The finest grade of Japanese green tea has a low level of polyphenols and a high level of amino acids. Green tea made from clonal leaf grown at St Joachim had a much higher level of polyphenols and a lower level of amino acids. Samples of this clonal green tea were sent through Consolexpo to Japan, where the tasters reported the samples as being 'too bitter' for the Japanese palate.
- 4 — The values given in Table 1 for instant tea are a rough average of the analyses of ten commercial samples, and are given only for purposes of comparison. Although the polyphenol content of instant tea was similar to that of the liquor of a St Coombs tea, the qualitative paper chromatographic picture showed that the instant teas were lacking in several desirable components.

TABLE 1 — *Analyses of different types of tea*

	Polyphenols		Amino acids
	Free	Bound	
Black tea, St Coombs	130		20
Black tea, St Joachim	180		20
Instant tea	130		15
Black tea (average value)	60	130	20
Green tea (Japanese, high grade)	143	36	48
Green tea (Japanese, average)	168	61	22
Green tea (St Joachim) Clone 162	400	13	17
Clone 165	510	31	16
Clone 19	399	26	15
Green tea (Chinese)	238	21	17

U. L. L. de Silva & W. A. B. de Silva

Proteins of tea

Quantitative analyses for protein were made of aqueous extracts of tea flush, freed of polyphenols by treatment with Polyclar. These analyses indicated that some of the polyphenols (chlorogenic acids, p-coumarylquinic acids and theogallin), were not, in fact, removed by the polyclar treatment and interfered with the quantitative determinations of protein. Accordingly, the aqueous extracts of protein were separated by paper electrophoresis, after which the pure protein was eluted from the paper and estimated. The results obtained so far indicate that there is a slight drop in protein levels of flush during withering, and a very marked decrease during fermentation. The aqueous extracts of protein will, however, contain only a part of the protein fraction (albumin and perhaps, globulins), and attempts are now in progress for the estimation of other protein fractions (prolamines and glutelins).

U. L. L. de Silva

Analyses of different parts of the tea bush

Analyses have been carried out for the polyphenol and amino acid contents of leaves of different ages, large roots, small roots and tea bark. The results, summarized in Table 2, show a progressive decrease with age in the amount of polyphenol and amino acids present in leaves, and also that St Joachim flush has a higher level of polyphenols than St Coombs flush. Tea bark contained an appreciable amount of polyphenols, but chromatographic analyses showed that the picture was different to that of leaves, and suggested that extracts of tea bark would be suitable for the tanning of animal hides in leather production. The roots had a comparatively low level of polyphenols, and among the amino acids, theanine was predominant.

TABLE 2—Analyses of different parts of the tea bush

Clone 2025	Total polyphenols		Vanillin reacting polyphenols		Amino acids	
	SJ	SC	SJ	SC	SJ	SC
Bud	885	288	355	156	22	21
1st leaf	649	333	322	208	20	15
2nd leaf	676	304	310	177	16	17
3rd leaf	598	222	309	149	10	14
5th leaf	487	186	282	105	10	14
7th leaf	481	—	286	—	8	—
Tea bark	300	—	212	—	10	—
Small roots ($\frac{1}{2}$ - 1 mm diameter)	76	—	58	—	12	—
Large roots (3-6 mm diameter)	74	—	49	—	15	—

SJ = St Joachim
SC = St Coombs

B. P. M. Perera, K. P. W. C. Perera & W. A. B. de Silva

Studies on flavour

A comparison was made of the chemical compounds present in the volatile fractions from high-grown (St Coombs) and low-grown (St Joachim) black teas. Separation was effected by gas liquid chromatographic methods. Table 3 gives a list of the compounds identified, together with a description of the characteristic aroma and the peak area percentage. This percentage is a measure of the relative quantity of the compound present in the volatile fraction.

It is seen from Table 3 that many compounds, *eg* linalool and its derivatives, geraniol and *cis*-jasmone are present in relatively higher concentrations in the St Coombs tea samples than in the St Joachim sample. This relatively high level is mainly due to the large quantity of compounds of low retention time (including sulphides and mercaptans, not identified in the present study), which occur in St Joachim teas. It is possible that the occurrence of these compounds in low-grown tea may overwhelm and nullify the effect of any desirable compounds which are present in these teas. These gas liquid chromatographic studies were carried out together with Professor Tei Yamanishi, who worked at St Coombs for about a month, in her capacity as an Expert Adviser under the auspices of the Asia Productivity Organization. Part of the analyses were carried out at St Coombs and part in her own laboratories, which specialize in flavour research, at Ochronomizu University, Tokyo. A more detailed account of the results of these findings have been reported in *The Tea Quarterly* (Yamanishi, Wickremasinghe & Perera 1968).

Other experiments were attempts to induce flavour by feeding leucine to tea flush, and also by artificially increasing the manganese content of tea flush by spraying manganous sulphate on tea growing in the field. The use of leucine was based on the hypothesis that leucine was a precursor of the compounds responsible for tea flavour (Wickremasinghe 1967), whilst the possible importance of manganese was indicated by the finding that the manganese

TABLE 3 — Comparison of the aroma pattern of high and low grown tea

Peak No.	Retention time (min)	Peak assignment	Aroma of effluent	St Coombs	St Joachim
1	2.8	iso-Butanal	sweet	0.7	3.2
2	3.8	n-Butanal	"	0.5	2.2
3	4.6	iso-Pentanal	"	4.4	8.2
4	5.4	Unknown		—	—
5	6.4	"	methional-like	—	—
6	7.7	"	greenish	—	trace
7	9.8	iso-Butanol (include unknown)	cheese-like	—	0.6
8	11.0	n-Hexanal (n-Butanol)	greenish	—	—
8'	11.8	Unknown	sweet & fruity	—	1.6
9	13.4	1-Penten 3-ol	somewhat stimulant	—	0.9
10	14.2	Unknown	sweet & acidic	0.9	1.0
11	16.0	Unknown	blood & metal odour	0.4	0.4
12	17.6	iso-Pentanol	sweet alcoholic	0.1	0.4
13	18.7	n-Heptanal	greenish 2	—	1.6
14	20.3	trans-2-Hexenal (n-Pentanol)	greenish & somewhat cinnamon-like	3.8	2.3
15	22.3	Unknown	metallic, unpleasant odour	0.2	0.4
16	23.8	"	amylacetate-like	—	—
16'	24.2	"	greenish	—	1.5
17	26.0	cis-2-Pentenol	sweet & fruity	3.1	2.2
18	26.8	Octanal (include unknown)	acetamide-like	—	—
19	28.5	cis-3-Hexenylacetate	pear-like	1.0	0.1
20	29.4	n-Hexanol (include unknown)	greenish, cinnamaldehyde-like	—	9.4
21	31.3	cis-3-Hexenol	grassy, fresh leaf-like	7.7	13.0

TABLE 3 — Comparison of the aroma pattern of high and low grown tea — (Continued)

Peak No.	Retention time (min)	Peak assignment	aroma of effluent	St Coombs	St Joachim
22	32.7	trans-2-Hexenol	chrysanthemum leaf-like	4.2	1.6
23	24.8	trans-2-Octenol (cis-5-member)	somewhat oily	—	—
24	36.7	Linalool oxide I (cis-5-member)	Japanese parsley-like	3.2	1.5
25	39.0	Linalool oxide II (trans-5-member)	earthy & camphor-like	15.5	4.2
26	40.6	Unknown	—	—	—
27	43.2	Linalool	Lily-of the valley-like	29.0	7.3
28	45.3	Unknown	cucumber-like	trace	—
29	47.2	3,5-Octadienone	fresh trepang-like	trace	0.7
30	48.6	Unknown	earthy & mould-like	0.2	0.1
31	49.5	„	rose-like	—	—
32	51.0	Phenylacetaldehyde	rose-like	4.6	3.0
33	53.4	Unknown	sweet aroma	0.8	0.3
34	56.0	„	menthol-like	0.5	trace
35	57.2	Linalool oxide II	cucumber-like	6.9	2.8
36	60.2	Unknown	greenish	—	—
37	63.1	Methylsalicylate (Nerol)	winter green oil-like	1.1	0.7
38	63.8	Geraniol	rose & citrous-like	5.2	2.4
39	66.4	Benzyl alcohol	somewhat hay-like	2.2	1.0
40	70.7	Phenylethanol	rose-like	3.6	9.4
41	75.0	cis-Jasmone	jasmin & hay-like	0.3	0.2
42	84.2	Nerolidol	flowery	4.1	2.6
43	86.9	Pyrrylmethylketone	stimulant, smoky	—	—
44	102.7	Pyrrol aldehyde	bitter, sweet & phenolic	3.9	4.3
45	127.8	Indole ?	somewhat flowery	3.9	5.5

content of flush rose during the flavoury season (Wickremasinghe, Perera & de Silva, 1969). In both experiments the TRI taster valued the treated teas higher than the controls, although he found no evidence of flavour in the leucine-feeding experiment.

The detailed results of the manganese spray experiment are given in Table 4. Here manganous sulphate (0.25% w/v), in aqueous solution was sprayed on clonal tea (DT 1) growing at St Coombs. Spraying was done after each pluck at about weekly intervals, and the flush analysed for manganous manganese and ferric iron, and mini-manufactured, after which the taster examined the black teas. The results indicated that the spraying of manganese was beneficial, but that excessive levels of manganese resulted in rawness of the liquor, presumably due to the toxic effect of high levels of the metal on the enzymes responsible for fermentation. It is of interest that the spraying of manganese caused changes in the concentrations of ferric iron as well, and this is noteworthy because the ratio of manganous manganese to ferric iron (Mn^{++}/Fe^{+++}), may be a factor of some importance in tea manufacture. The detection of flavour in the treated sample on 25.1.68, doubtful flavour on 1.2.68, and its disappearance thereafter, may indicate an optimal level of Mn^{++} or Mn^{++}/Fe^{+++} for flavour development. It must also be mentioned that the experiment was carried out during flavoury weather conditions at St Coombs.

In a separate experiment, manganese contents and Mn^{++}/Fe^{+++} ratios in seven clones were determined at monthly intervals over a period of one year. The clones analysed were TRI 777, DT 1, TK 48, TRI 2024, CH 13, TRI 2142, TRI 2025, TRI 26 and TRI 740, and very marked seasonal and inter-clonal variations were observed to occur. Perhaps the only significant finding was that DT 1 and TRI 777 always had comparatively higher levels of manganese than the other clones.

K. P. W. C. Perera & U. L. L. de Silva

Microbiology of tea flush

The studies of the seasonal changes in the microbial flora of tea flush initiated in 1967, were continued. It was observed at St Coombs, that the microflora showed marked qualitative and quantitative changes throughout the year. In the months preceding the flavoury season, yellow colonies of a xanthomonad, white colonies of a micrococcus and a bacillus, and a black-spored *Aspergillus* spp. were the predominant micro-organisms. All of these showed a very marked decrease in numbers during the flavoury season, and increased again at the end of the flavoury season. A similar sequence of changes in the microbial flora occurred in Uva where, however, examinations were carried out only during the period July to September. A very similar picture had been obtained in 1967 and confirmed that climatic conditions affect the microbial microflora on tea flush.

B. P. M. Perera

Metabolism of phosphate compounds in tea leaves

This work was done by Dr R. R. Selvendran during the tenure of his post-doctoral Broodbank Fellowship at the Low Temperature Research Station, Cambridge.

An investigation was undertaken to ascertain the major phosphate esters and nucleotides in tea flush (TRI 777) and the changes which they undergo during tea manufacture. The first stage in this study was the isolation of the acid-soluble phosphate compounds in a trichloroacetic acid extract by two

TABLE 4 — *Effect of Manganese spray on clonal (DT 1) flush growing at St Coombs*

FLUSH PLUCKED BEFORE SPRAYING ON	Mn ²⁺ (ppm)		Fe ³⁺ (ppm)		Mn ²⁺ /Fe ³⁺		Taster's reports		A = Treated B = Control			
	Treated	Control	Treated	Control	Treated	Control	Colour of infused leaf	Infused leaf	Colour	Strength	Quality	Flavour
9th January 1968 No Plucking	Not Analysed		—	—	—	—	No Manufacture					
18th January 1968	775.9	874.4	34.5	22.0	22.49	39.75	A C	8	5	6	8	—
							B C/G	7	5	6	7	—
25th January 1968	846.6	830.0	29.0	15.0	29.19	55.33	A C/G	7	4	6	8	2
							B C/G	7	4	6	8	—
1st February 1968	1020.2	798.1	37.0	40.0	27.57	19.95	A C/G	7	4	6	8	?
							B C/G	7	5	5	8	?
10th February 1968 No Plucking	1283.9	805.1	44.0	30.5	24.29	26.40	No Manufacture					
16th February 1968 No Plucking	1283.9	909.1	30.5	28.5	42.10	31.89	No Manufacture					
23rd February 1968 No Plucking	1519.9	756.4	50.0	39.0	30.40	19.39	No Manufacture					
28th February 1968	1158.3	895.3	60.0	49.0	19.32	18.27	A C/G	6	4	4	6	Raw
							B C/G	7	5	6	8	—
14th March 1968 Not Sprayed	1757.2	999.4	33.0	22.0	53.25	45.43	A G	5	4	5	7	V. green
							B G	9	7	5	7	Green
29th March 1968 Not Sprayed	1082.6	846.7	38.0	22.5	28.49	37.63						

Mn²⁺ — Manganous manganese
Fe³⁺ — ferric iron

A = Sprayed with manganese sulphate solution in water (0.25% w/v)
B = Unsprayed control
C = Coppery
C/G = Coppery/Green

stage chromatography on cellulose columns using organic solvents (Selvendran & Isherwood 1967). The purified extract was fractionated on Dowex-1 formate columns using ammonium formate buffers. Individual phosphate esters and some nucleotides in the purified extract were estimated enzymatically.

The following nucleotides were found to be present in appreciable quantities in fresh flush, ATP, UTP, CTP, ADP, UDP, UMP-5, UMP-3 and UDP-sugars (UDP-glucose). ATP, ADP, (AMP), UDFG, glucose-6-phosphate, fructose-6-phosphate, glucose-1-phosphate, glucose-1, 6, diphosphate and sucrose-6-phosphate in the purified extract were determined enzymatically.

Manufacture of tea was accompanied by the following changes :

- 1 — The carbondioxide output decreased markedly; acid-soluble inorganic phosphate increased, particularly during fermentation and firing; total acid-soluble phosphate increased.
- 2 — Withering caused a significant decrease in the level of nucleoside triphosphates, while nucleoside diphosphates changed little. Mincing caused rupture of the cell membranes and considerably altered the respiratory mechanism of the tissue. This was reflected in the marked increase in the level of nucleoside triphosphates. Firing resulted in a decrease in the level of triphosphates and a parallel increase in the level of diphosphates. The most notable change on firing was a ten-fold increase in UMP-3.
- 3 — Changes in the level of phosphate esters in shoot tips during manufacture of black tea were typical of senescing plant tissues. Notably the levels of glucose-6-phosphate, fructose-6-phosphate and glucose-1-phosphate were markedly reduced during withering. The changes in these compounds during fermentation and firing were slight.

The possible implications of these changes on the quality of the made tea are being investigated.

R. R. Selvendran

Peroxidases in tea flush

Polyclar extracts of tea leaf juice, analysed by starch gel electrophoresis, showed the occurrence of seven bands having peroxidase activity. The bands were visualized by the method based on the oxidation of benzidine in the presence of hydrogen peroxide. Preliminary experiments indicated that changes occurred in the peroxidases during fermentation.

A. S. L. Tirimanna

Upgrading of St Joachim tea

Experiments on the upgrading of St Joachim tea were directed mainly to the adaptation of the process to orthodox manufacture rather than CTC-Rotorvane methods. These experiments were successful, but more work remains to be done in making the process reproducible.

K. P. W. C. Perera

Visits, Lectures and Symposia

TIRIMANNA, A. S. L. — “Studies on the flavour of Ceylon teas” — presented at 24th Annual Sessions of the Ceylon Association for the Advancement of Science at Colombo in December.

TIRIMANNA, A. S. L. & RANASINGHE, A. — “The occurrence of peroxidases in the tea leaf” — presented at 24th Annual Sessions of the CAAS at Colombo in December.

WICKREMASINGHE, R. L. — “Chemistry of tea manufacture” — Invitation lecture to University undergraduate students — in March.

WICKREMASINGHE, R. L. — “Biochemistry and tea manufacture” — address to the Kelani Valley Planters' Association in July.

WICKREMASINGHE, R. L. — Participated in the “Symposium on Drought” at Badulla on 29th November.

Acknowledgement

Grateful thanks are due to Messrs Ranjit Sri Nissanka, C. H. Wickremesinghe and O. L. de Kretser, without whose ready and enthusiastic help, the up-grading and other experiments on manufacture could not have been evaluated.

Publications

SELVENDRAN, R. R. & ISHERWOOD, F. A. (1967). Identification of guanosine derivatives of D-xylose, D-mannose, D-glucose and D-galactose in mature strawberry leaves. *Biochem. J.* **105**, 723-727.

WICKREMASINGHE, R. L. (1968). Some observations on tea in Japan. *Tea Q.* **39**, 25-28.

WICKREMASINGHE, R. L., PERERA, B. P. M. & DE SILVA, U. L. L. (1969). Studies on the quality and flavour of tea—4—Observations on the biosynthesis of flavour. *Tea Q.* **40**, 26-30.

YAMANISHI, TEI, WICKREMASINGHE, R. L. & PERERA, K. P. W. C. (1968). Studies on the quality and flavour of tea—3—Gas chromatographic analyses of the aroma complex. *Tea Q.* **39**, 81-86.

Reference

WICKREMASINGHE, R. L. (1967). Fact and speculation in the chemistry and biochemistry of tea manufacture. *Tea Q.* **38**, 205-209.

REPORT OF THE TECHNOLOGY DIVISION

Technologist — D. Kirtisinghe, BSc, PhD, DIC, C Eng, AMIChemE

General

During the year under review the staff position of the Division continued to deteriorate. The Tea Taster's contract was not renewed when it expired early in the year. Mr N. M. Abdul Gaffar, Research Assistant, proceeded overseas on a Commonwealth Scholarship for training in Biochemical Engineering at the University College, London. Mr S. Jayaratnam was appointed Technical Assistant. The Technology Units at Kottawa and Passara were closed down as a measure of economy and the officers of the Technology Divisions at these stations were detailed for duties outside the Division.

Factory Experiments

Experiments T1 to T3, T5 to T21, T23 to T25, T28, T30 and T31 have been concluded.

High-country Experiments (St Coombs)

T4 — Quality assessment of new clones — (1966)

The clones assessed for quality are classified in Table 1.

TABLE 1 — Quality assessment of clones

Classification Group*	Estate	Clones	Remarks
2	Gonamotava Tangakelle	GMT 9 WY	Fir colour —
3	Somerset	E727	Greenish infusions, lacking colour
3	St Coombs "	TRI 62/1* TRI 62/5*	
4	Bogawana St Coombs " "	B 275* TRI 62/3* TRI 62/4* TRI 62/6*	
5	St Coombs	TRI 62/2*	

(see Kirtisinghe, de Silva
& Samarasingham 1968)

* Provisional classifications

T22 — Tat withering under controlled conditions of temperature, humidity and airflow rate — (1966)

This experiment has been abandoned because it has not been possible to effect the necessary repairs in the machine.

A. Thevathasan

T26 — Handpicking, shearing and machine harvesting of low-jat seedling tea from Pedro Estate, Nuwara Eliya, on yield and manufacturing properties (P67) — (1967)

The experiment was carried out to determine made tea characteristics of tea harvested with three different types of mechanical pluckers. In the initial stage of this experiment, leaf from all 16 plots were plucked by hand to determine homogeneity. The results of this preliminary experiment show that there are no inherent differences between the teas from these plots.

In the second stage of this experiment leaf from 12 of these plots were harvested with three different types of mechanical pluckers and four plots were plucked by hand as a control. The teas were manufactured on an experimental scale and evaluated by the TRI taster as well as by a panel of tasters in Colombo. The results of the evaluations are summarized in Tables 2 and 3 respectively.

TABLE 2 — *The effect of the use of mechanical pluckers compared with hand plucking on made tea characteristics as assessed by the TRI taster*

Treatments	Infusion	Colour	Strength	Quality	Valuation (cents)
Handpicking	5.0	5.2	4.0	4.4	141.2
Ochiai	4.9	5.1	4.1	4.5	147.1
Robin	4.1	5.3	3.4	3.5	93.3
Shears	4.1	5.1	3.3	3.4	78.5
LSD ($P = 0.05$)	0.16	NS	0.55	0.74	13.25

TABLE 3 — *The effect of the use of mechanical pluckers compared with handplucking on made tea characteristics as assessed by the Colombo panel of tasters*

Treatments	Infusion	Colour	Strength	Quality	Valuation (cents)
Handpicking	3.9	5.6	4.4	3.8	140.2
Ochiai	3.9	5.2	4.4	3.8	141.6
Robin	3.9	5.6	4.3	3.6	133.5
Shears	3.7	5.4	4.3	3.2	121.2
LSD ($P = 0.05$)	NS	NS	NS	NS	13.2

Evaluations by the TRI taster indicate that the BOP's from low jat leaf gathered with the Ochiai machine produced a tea as good as that handpicked. The leaf from the Robin machine was inferior to both these treatments but was better than that gathered with the shears. The trends from the reports of the Colombo panel of tasters were similar but the only statistically significant difference that emerged was that the shear plucked leaf produced a tea that was worth less than that gathered by hand or with the Ochiai machine.

R. L. de Silva & S. Samarasingham

T27 — *Time of plucking on the liquoring characteristics of made tea —(1967)*

The object of this experiment was to determine whether the time of plucking has any noticeable effect on the characteristics of the resultant tea. Two adjacent plots in a field, one planted with clone TRI 777 and the other with seedling tea, were selected for the experiment. Each of these plots was divided into three sections and these sections were plucked at 07 hr, 11 hr and 15 hr respectively on an eight-day round. The sections plucked at different times were in a randomized order and the experiment was carried out over five plucking rounds.

Teas were manufactured on a miniature scale and evaluated by the TRI taster. The results indicate that teas produced from leaf plucked at different times, were not different with respect to all made tea characteristics.

N. M. Abdul Gaffar

T29 — Evaluation of the merits of preconditioning in mixed orthodox-rotorvane manufacture — (1967)

This experiment was carried out to study the effect of preconditioning withered leaf in an orthodox roller before rotorvaning in a programme of mixed orthodox-rotorvane manufacture.

The treatments applied were :

- 1 — Ten minutes preconditioning roll, one rotorvane pass and two × 30 min. orthodox rolls,
- 2 — No preconditioning roll, one rotorvane pass and two × 30 min. orthodox rolls,
- 3 — No preconditioning, two rotorvane passes.

The liquoring properties of teas were evaluated by a taster in Colombo and also by the TRI taster. The Colombo taster did not report differences between any of the treatments for both BOP and BOPF grades. The TRI taster could detect no significant differences between the BOPF grades after any of the treatments. His report on the characteristics of the BOP grades is summarized in Table 4.

TABLE 4 — *Characteristics of BOP assessed by the TRI taster*

Treatments	Infusion	Colour	Strength	Quality	Valuation (cents)
1	5.2	5.6	4.7	5.5	280.0
2	5.2	5.8	4.7	5.2	254.2
3	5.2	5.7	4.6	5.2	252.5
LSD ($P = 0.05$)	NS	NS	NS	0.28	8.8
($P = 0.01$)	—	—	—	NS	12.0

The TRI taster could detect no significant differences in the BOPs from these three treatments with regard to the infusion, colour and strength. He, however, preferred the treatment which consisted of a ten-min. preconditioning roll, one rotorvane pass and two × 30 min. orthodox rolls to the other two treatments with regard to quality and over-all valuation.

T32 — Drier project — (1967)

Development work on the tea drier was carried out at the Low-Country Station. See LT9 for progress on this experiment.

W. Joseph & C. Kandappah

1968 Experiments

T33 — Paper sacks as a substitute for tea chests — (1968)

A trial was conducted to ascertain the suitability of paper sacks for shipping Ceylon teas. The sacks had two layers of polyethylene film as waterproof inner liner. The consignment was shipped to a London firm, who reported

that they arrived in very good mechanical condition. The teas were reported as having a musty taste. It would therefore appear that there is no suitable alternative yet to plywood chests for shipping high-quality teas.

T34 — *Fermentation of teas in an atmosphere of carbon dioxide* — (1968)

The object of this experiment was to determine whether quality and flavour could be enhanced by allowing dhools to ferment in an atmosphere of carbon dioxide. A mixture of carbon dioxide and air in the ratio of 3 : 2 by volume was passed through water and then into a tent made of polythene, where dhool was allowed to ferment. At the same time, another portion of the same dhool was allowed to ferment under normal ambient conditions (control). Experiments were carried out with different dhools which were also allowed to ferment for varying periods of time. Teas were fired, graded and evaluated by the TRI taster on 15 occasions. He found no detectable differences between the carbon dioxide-treated teas and the controls.

N. M. Abdul Gaffar

T35 — *Comparison of trough withering with withering on nylon tats and hessian tats during the quality season* — 3 × 3 Latin square replicated 4 times — (1968)

Leaf plucked at different times (morning, noon and evening) was withered on nylon and hessian tats as well as by the use of a trough. Treatments were arranged in four replicates of 3x3 latin squares in order to eliminate the variation resulting from times of plucking (morning, noon or evening) and days of manufacture. Only one of the withering treatments was given to leaf plucked at any one time. The type of treatment given was governed by the latin square arrangement. The average periods of wither were 10½, 9¾ and 6½ hr for morning, noon and evening leaf respectively. Leaf was given four 30-min. orthodox rolls. BOP and BOPF grades were evaluated by the TRI taster as well as by a panel of tasters in Colombo. Results are presented in Tables 5 to 7.

TABLE 5 — *Comparison of trough withering with withering on hessian and nylon tats—Made tea characteristics of BOP as assessed by the TRI taster*

Treatments	Infusion	Colour	Strength	Quality	Valuation (cents)
Nylon	5.00	5.44	4.42	5.08	231.9
Hessian	5.04	5.08	4.33	4.92	228.3
Trough	4.83	5.38	4.38	5.08	222.1
LSD ($P = 0.05$)	NS	0.263	NS	NS	NS

TABLE 6 — *Comparison of trough withering with withering on hessian and nylon tats—Made tea characteristics of BOPF as assessed by the TRI taster*

Treatment	Infusion	Colour	Strength	Quality	Valuation (cents)
Nylon	5.42	6.08	5.62	5.92	300.0
Hessian	5.46	5.92	5.71	5.71	290.8
Trough	5.38	5.88	5.33	5.88	293.8
LSD ($P = 0.05$)	NS	NS	0.273	NS	NS

TABLE 7 — Comparison of trough withering with withering on hessian and nylon tats—Made tea characteristics of BOPF as assessed by the Colombo panel of tasters

Treatment	Infusion	Colour	Strength	Quality	Valuation (cents)
Nylon	5.92	6.08	6.75	6.08	271.2
Hessian	6.50	6.58	7.25	6.42	286.7
Trough	5.83	5.33	6.25	6.50	279.6
LSD ($P = 0.05$)	NS	0.482	0.427	NS	NS

TRI taster considered the colour of BOP liquor of nylon and trough-withered leaf, preferable to that of hessian-withered leaf. He could not detect any differences between the three treatments with respect to other characteristics of the BOP grade. The Colombo panel of tasters could not detect any differences between any treatments for the BOP grades.

The strength of BOPF liquors of nylon-withered and hessian-withered leaf was preferred to that of trough-withered leaf by the TRI taster. He could not detect any differences in the infusions, colour and quality between treatments, and overall valuations were not significantly different for the BOPF grades. The Colombo panel of tasters considered the colour of BOPF of hessian-withered leaf to be superior to that of nylon-withered leaf, which in turn was considered to be better than that of trough-withered leaf. The strength of the BOPF grade was considered to follow a similar trend. They could not detect any significant differences between treatments for the BOPF grade for other characteristics.

T36 — Blending of clone TRI 2025 with clones possessing excellent quality — (1968)

This experiment was carried out to ascertain whether the blending of TRI 2025 (Group 4 classification, Kirtisinghe *et al.* 1968) with clones DT1 and TRI 777 (Group 1 classification) is an economic proposition. Blending was carried out both before and after manufacture. The teas were manufactured on a miniature scale. The different blends and the pure clonal teas were :

- 1 — TRI 2025
- 2 — TRI 777
- 3 — DT1
- 4 — TRI 2025 and TRI 777 mixed in the ratio of 1 : 1 in the roller
- 5 — TRI 2025 and DT1 mixed in the ratio of 1 : 1 in the roller
- 6 — TRI 2025, TRI 777 and DT1 mixed in the ratio of 1 : 1 : 1 in the roller
- 7 — TRI 2025 and TRI 777 mixed in the ratio of 1 : 1 after manufacture
- 8 — TRI 2025 and DT1 mixed in the ratio of 1 : 1 after manufacture
- 9 — TRI 2025, TRI 777 and DT1 mixed in the ratio of 1 : 1 : 1 after manufacture.

The results have still to be analysed, and will be published in a separate paper.

S. Samarasingham

Low-Country Experiments (St Joachim)

Experiments LT1 to LT3, and LT5 to LT7 have been concluded.

LT4 — Rotorvane-CTC manufacture in the Low-Country — (1967)

Teas produced during the latter part of 1967 were found to be acceptable by the trade. Commercial production of Rotorvane-CTC teas continued up to June 1968. A schedule of opinions expressed by the tea trade are given below.

*Schedule of opinion on low-country Ceylon CTC teas ex St Joachim Estate***Broker (London)**

Leaf is black to rather grey. It is even and free from stalk and fibre, but it has the disadvantage of being gritty, for the small ball-like particles of leaf will not assimilate in a blend. No doubt a little attention in manufacture, perhaps in withering, can overcome this severe disadvantage.

Infused leaf is bright and rather green; it could be more even.

Liquors, though a little raw and harsh, are bright, have good strength and cream up well. They are red on the milk.

The value on the liquor only on today's market is 4s 0d for the BOP and 4s 3d for the BOPF.

Conclusion : These samples certainly give the impression of good mid-country tea, taking only the liquoring character into consideration. We would value them at 6d to 9d per lb above the low-grown average.

Blender (London)

BOP	Leaf	— neat, even shot-like appearance
	Infused leaf	— bright
	Liquor	— light, bright with milk, brisk and good flavour.
BOPF	Leaf	— small, neat even
	Infused leaf	— bright
	Liquor	— more colour than the BOP, bright with milk, brisk and good flavour.

Comments : Both teas would be very useful for blending purposes giving a blend character and flavour. More fannings would be required than the broken. With the modern packing machines now operating in most factories the density of this type of manufactured tea might cause some problems.

Blender (London)

The samples of BOP and BOPF of CTC manufacture from St Joachim were most interesting, the liquors proving bright and useful. The leaf of both teas is very black and compares favourably with other Ceylon CTC sorts. There is some sales resistance to increasing quantities of CTC manufacture, and well-made sizey BOPF with flavour are an attraction, but on the other hand the liquors of these two teas seem to have been improved considerably. In the case of the BOP the leaf is rather brittle and too shotty to suit all buyers.

Packer & Distributor (Manchester)

BOPF Good black leaf, bright infusion—Reasonably thick in liquor—Price approximately 4s 0d—Useful tea as price reducer.

BOP Neat black leaf, bright infusion—Thin in liquor—Price approximately 3s 10d—Both teas slightly astringent in taste.

Both teas are excellent price reducers but would come out very much better in the London water and possibly might be used for this purpose.

Packer & Distributor (Liverpool)

This Company were not very keen on either of these teas and did not think they came out very well in this water and could only be used as price reducers. Both teas came out quite well in Manchester water but evidently Liverpool water is very different from Manchester water.

National Tea Distributor

Our information is that these would not be suitable for the catering trade. They all seem surprisingly thin for this type of manufacture and lacking in body. We have seen Ceylon teas from the States that have changed from orthodox to CTC resulting in much fuller liquors but these seem to be the exception.

LT8 — *Live shade on the manufacturing properties of tea* — (1967)

The experiment has been concluded but the results have still to be analysed.

T. F. Saldin

LT9 — *Drier project* — (1967)

Research activity centered mainly round the application of fluid bed technique to the drying of tea. Satisfactory fluidization of low-country CTC tea was achieved on a flat bed drier and indications have also been obtained that an appreciable fuel saving on more conventional drying technique was also possible. The liquoring characteristics of these teas were not significantly different to those of the same manufacture dried in an ECP drier. Further development of the drier is needed before it can find application in the drying of teas rolled in the orthodox manner. The project has suffered a set back because the firm with whom the Institute was collaborating on this project changed hands while the experiments were in progress.

W. Joseph & C. Kandappah

*1968 Experiments***LT10** — *Instant tea project* — (1968)

Experiments with the manufacture of instant tea were carried out in collaboration with the Biochemist. The samples manufactured at St Coombs represented a significant improvement on the samples manufactured hitherto by the spray-drying process. The equipment was sent to the Low-Country Station in May and has not functioned satisfactorily since.

S. Jayaratnam

LT11 — *Manufacture of low-grown leaf at low temperatures* — (1968)

Leaf was withered, rolled and fermented at 60°F, 70°F and at ambient temperatures (about 80°F). Graded samples could not be evaluated because the tea-taster left the service of the TRI.

C. Kandappah

Mid-Country Experiments

Experiments **MT2** and **MT3** have been concluded

Experimental progress was affected during the second half of the year under review because the tea samples manufactured at this Station could not be evaluated by a tea taster.

MT1 — *Quality assessments of clones* — (1966)

Of the 18 clones tested during the year, MO 209, CW 21 and H 1/58 show great promise. On account of the difficulties that arose in having the manufactured samples evaluated by a tea taster, these clones have to be re-tested and evaluated again before a final assessment of quality is possible. Clones assessed for quality are classified in Table 8.

TABLE 8 — *Quality assessment of new clones (Mid-Country)*

Origin	Clone	Remarks
Classification Group 2	—	Clones with good manufacturing quality
Passara	MPA 1	Good colour and strength
Classification Group 3	—	Clones with satisfactory manufacturing quality
St Coombs	TRI 2026	Good strength
	TRI 2151	—
Balangoda	DG 7	Bright infusions, lacking in colour
	DG 39	—
Canaverella	CV4 B1	Good infusions, colour and strength
	NK4 B29	—
	MG3 B1	—
Craighead	CH 13	Good infusions
Diyagama	G	Good colour
	N	Dull infusions
Endane	EN 31	Good infusions
Kenilworth	KEN 16/3	Good colour
Nayabedde	NAY 3	Good infusions, colour and strength needs further testing
Pitakande	W 2/145	Good infusions, colour and strength needs further testing
Somerset	E 7/27	Poor infusions, insufficient colour
Wooton	W3	—
Classification Group 4	—	Clones with little manufacturing quality
St Coombs	TRI 2022	Dull infusions
Balangoda	BG 18	Poor infusions, insufficient colour
	MT/BG	—
Canaverella	CV5 B1	Poor colour
Craig	CR4	—
Classification Group 5	—	Clones with poor manufacturing quality
St Coombs	TRI 2043	Coppery infusions
Thotulagalla	T 5/3	Poor infusions, lacking in strength
Tangakelle	CY 9	Poor strength

MT4 — *Plucking rounds-cum-plucked unit — (1967)*

This experiment aims at determining the effect of plucking rounds of different durations (four, six and twelve days rounds) and the type of plucked units (a bud and either one, two or three leaves) on the liquoring characteristics of made tea. Pre-treatment manufactures were concluded. Analysis of tasters' reports indicated no significant differences between the leaf from each of the experimental plot. The treatments were given in May. The experiment is in progress.

MT5 — *Gramoxone (and hand weeding in combination with 2 levels of nitrogen) on made tea characteristics — (1967)*

The manufacturing properties of leaf from plots to which eight weed control treatments (in MW1) are being applied, were compared, and the differences were not found to be significant. There were also no significant differences in made tea characteristics between leaf from plots receiving 100 lb and 200 lb nitrogen per acre per annum. Gramoxone-sprayed teas were reported to be taint-free. The experimental area was pruned in October.

MT6 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels and 3 levels of K on made tea characteristics — (1967)*

This experiment was carried out in conjunction with the District Advisory Officer (Mid-Country). Pre-treatment tests were concluded and no significant differences were observed between the leaf from the experimental plots. The treatment applications were done in June and October and the manufacturing tests are in progress.

MT7 — Age from prune on the characteristics of made tea — (1967)

The aim of this experiment is to determine the liquoring characteristics of made tea in relation to age from pruning. Pre-treatment manufacturing tests were concluded. The experimental plots have been divided into three groups of which the first one was pruned in October. The second and the third groups will be pruned in 1969 and 1970 respectively, so that at the end of the third year (1970), the green leaf from the tea bushes that aged in the three successive years from the prune, could be tested simultaneously. Manufacturing tests will begin, after the tea recovers from pruning.

T. A. Munasinghe

St Coombs factory

The nett sale average for teas manufactured at St Coombs factory for the year under review was Rs 2.29. Prices were satisfactory mainly because a reasonable standard of leaf arriving at the factory was maintained for most of the year and also because fewer experiments were carried out on a factory scale as a consequence of staff problems, making it easier to maintain a uniform standard of manufacture.

Trough withering followed by a mixed orthodox-rotorvane rolling programme was adopted in the factory. The process consisted of a 15 min. condition roll with little pressure, one rotorvane pass followed by two conventional rolls of 30 min. duration reducing the bulk to under ten per cent. The period of fermentation ranged from a minimum of 1 hr 45 min. during the quality season in February/March to a maximum of three hr for one day in November. During the rush period a period of about two hr 45 min. was given for fermentation.

Visits, Lectures and Symposia

Dr D. Kirtisinghe addressed the following District Planters' Associations on matters relating to manufacture, developments in machinery and on factory designs: Kelani Valley, Uva, Kandy and Galle.

Dr Kirtisinghe also served as a member on the Bureau of Ceylon Standards Drafting Sub-committee on tea.

Acknowledgements

Assistance given to us by several tea tasters in Colombo and useful discussions with some members of the TRI staff in other research divisions are gratefully acknowledged.

Publications

- KIRTISINGHE, D., DE SILVA, W. A. C., SAMARASINGHAM, S., (1968). Manufacturing properties of Ceylon tea clones. *Tea Q.* 39, 29-36.
- MORRIS, P. J., KIRTISINGHE, D. & STRICKLAND-CONSTABLE, R. F., (1968). Retardation of growth of salol crystals in the melt in capillary tubes. *J. Crystal Growth.* 2, 97-105.

REPORT OF THE STATISTICS DIVISION

Statistician — P. Kanapathipillai, BSc, FSS

General

The staff position was the same as last year. In addition to his normal duties, the Statistician was appointed Acting Chief Administrative Officer with effect from October 15th. The Statistician also continued to function as Convener/Secretary of the Experimental & Estates Committee of the TRI.

Design and Analyses

The designs were all of the simple types *viz* randomized blocks, split-plots and $3 \times 3 \times 3$ factorials. It is now standard practice in all field experiments, to use pre-treatment data for covariance analyses. A measure of the gain in precision can be seen from the figures given in the last column of the following table. The variation within the experiment is given by the coefficient of variation.

Types of design	No. of Experiments	Mode of analyses	Range of coefficients of variation	Gain range
Randomized blocks (with suitable transformations where necessary)	70	Analysis of covariance	3%—50%	175%—880%
Randomized blocks	80	Analysis of covariance	11%—48%	—
Split-plot	4	Analysis of covariance	6%—14%	—

Over 150 field experiments were analysed and the results further partitioned into meaningful single degrees of freedom. The statistical interpretations of the results of such analyses were also given.

Computer Processing

The volume of data flowing into the Division for statistical analyses has steadily increased to an extent that it has now become impossible for one technical assistant to cope with this rush. Consequently, the feasibility of processing experimental data on the ICI Computer at the State Engineering Corporation was examined. It is heartening to note that the Corporation has already undertaken the task of preparing programmes for the two types of design most commonly used *viz* randomized blocks and $3 \times 3 \times 3$ factorials. The cost of these operations was found to be a small fraction compared with the cost of recruiting additional technical staff. In the case of $3 \times 3 \times 3$ factorial it was found that this particular computer was able not only to produce the final analysis of variance of table but also to print the intermediate stages of the calculation *viz* all the two-way tables—very important components of the analysis for the study of interactions. As the inversion of matrices can also be done on this computer, the question of preparing programmes for multi-variate analyses is also being considered.

REPORT ON THE LOW-COUNTRY STATION AND THE KOTTAWA SUBSTATION

Director — L. H. Fernando, BSc, PhD

Research Officer — D. T. Wettasinghe, BSc, PhD

General

The Low-Country Station, St Joachim, Ratnapura

Dr L. H. Fernando was appointed Director of the Tea Research Institute and left St Joachim on the 28th December. Mr J. V. Sabanayagam, Advisory Officer, returned to Ceylon in June after successfully completing his post-graduate studies and obtaining a Master's Degree in Science at the University of Guelph, Canada. He was initially stationed at St Coombs but was transferred to the Low-Country Station in December. Mr W. Joseph, Developmental Engineer, was transferred to the Low-Country Station in June. Mr U. P. de S. Waidyanatha, Technical Assistant, left the service of the Institute in November. Mr R. I. Pereira, Chief Clerk, was appointed Accounting Assistant and was transferred to St Coombs in April. Mr W. J. Samuel succeeded him as Chief Clerk in May but returned to his substantive post at St Coombs in October, when Mr T. R. B. Sally was appointed to the post of Chief Clerk at the Low-Country Station. Mr K. D. B. H. Abeygunawardena, Accounts Clerk, was transferred back to St Coombs in June. Mr K. D. L. Nanayakkara was appointed Accounts Clerk in September and left after two months of service.

Two junior staff quarters and two minor staff quarters were completed and officers went into occupation of them.

The Kottawa Substation, Talgampola, Galle District

Mr K. H. G. Gunapala remained in charge of the Substation. The results of experiments carried out at the Substation are presented in this report.

Advisory Service

The Assistant Director and the Research Officer continued to visit estates and address planters at District Associations. The Advisory Officer returned from overseas leave on 13th June 1968, and took over the advisory visits and correspondence with estates in the low country. The Institute participated in the Agricultural & Industrial Exhibitions in Ratnapura and Horana.

Heptachlor was used to control Shot-hole Borer successfully on many estates in the low-country with less side effects of tea tortrix and looper or twig caterpillar attacks. Diseases of tea were not serious. Rim Blight with discoloured veins continued to occur in dry weather, following pruning or fertilizer application.

Advice on fertilizer applications on estates was given in accordance with the results of low-country experiments. In old seedling tea a level of nitrogen ranging from 80 to 120 lb per acre along with 20 lb phosphoric acid (P_2O_5) and 40 lb potash (K_2O) per acre per year was found to be adequate. In younger seedling teas a maximum level of 200 lb nitrogen along with 28 lb P_2O_5 and 90 lb K_2O per acre per year was recommended. In VP teas the young tea manure mixture—T200 was recommended for the first two years from planting.

In the third year, when plants are brought into plucking, 200 lb to 240 lb nitrogen along with 55 lb P_2O_5 and 120 lb K_2O per acre per year is recommended. Subsequently after a proper prune the levels of nitrogen may be increased to a maximum level of 360 lb per acre and phosphorus and potassium levels reduced to 28 lb P_2O_5 and 90 lb K_2O respectively.

The use of Gramoxone at a rate of half pint in 50 gallons of water applied six times per year continued to be the chemical used in the weed control programme on low-country estates. Karmex-diuron at the rate of $\frac{3}{4}$ lb plus 15 fl. oz Surfactant N in 60 gallons water per acre was recommended to estates on an experimental basis.

Many estates reported dieback of tea bushes and poor crop responses due to adverse weather conditions experienced in the early part of 1968.

The clones TRI 2023 and TRI 2026 continued to be popular in low-country replanting programmes. The drought-tolerant clones DG 39, MT 18 and Sri-kandura S 106 were recommended to areas susceptible to prolonged droughts in the low-country districts.

J. V. Sabanayagam

Field Experiments and Trials

The following experiments have been concluded :

LA6, LA15, LA23, LA30, LW9, LW10, LW11 and LW12.

LA1 — NPKMg on seedling tea at Endane Estate, Kahawatte — (1955)

The yields during the first year of the eighth experimental cycle 1968 to 1970 are presented in Table 1.

TABLE 1 — Yield over the first year of the cycle 1967 to 1969

Treatments (lb per acre per year)	1st six months Made tea per acre		2nd six months Made tea per acre		1st year Made tea per acre		
	(lb)	(%)	(lb)	(%)	(lb)	(%)	
N	0	411	100	890	100	1301	100
	40	440	107	976	110	1415	109
	80	443	108	1016	114	1459	112
P_2O_5	0	436	100	967	100	1403	100
	30	427	98	955	99	1381	98
	60	430	99	959	99	1390	99
K_2O	0	422	100	929	100	1351	100
	40	439	104	979	105	1419	105
	80	433	103	972	105	1405	104
MgO	0	425	100	951	100	1375	100
	20	440	104	977	103	1417	103
	40	428	101	953	100	1382	101
LSD ($P = 0.05$)		18	4	43	5	58	4

For the first time since the introduction of the present nitrogen levels in 1960 there was a response to nitrogen at 40 lb per acre per year in the first year of the cycle. Potash at 40 lb per acre per year has also given a significant increase in yield, again for the first time since the introduction of the zero level five years ago in 1963. There is no response to phosphate. Twenty pounds per acre per year of magnesium oxide gave a significant yield response during the first six-months of the cycle.

A. A. C. Karunaratne

LA2 — NKMg and frequency of application on VP tea at Karapincha, Palm-garden Group, Ratnapura — (1961)

The third experimental cycle which was extended to three years (1965 to 1968) has now been completed and the results are presented in Table 2.

TABLE 2 — Mean yields of made tea in lb per acre per year during the three year cycle 1965 to 1968 at Karapincha, Palmgarden

Treatments (lb per acre per year)	Yield of made tea per acre per year						
	Mean of 1st and 2nd years		3rd Year		Cycle		
	(lb)	(%)	(lb)	(%)	(lb)	(%)	
N	75	3294	100	3493	100	3388	100
	150	3614	110	3770	108	3637	107
	225	3668	111	3790	109	3712	110
K ₂ O	50	3440	100	3646	100	3496	100
	100	3602	105	3718	102	3653	105
	150	3533	103	3688	101	3588	103
MgO	0	3493	100	3576	100	3533	100
	24	3546	102	3711	104	3605	102
	48	3537	101	3715	104	3599	102
Interval between appli- cations (weeks)	12	3395	100	3675	100	3488	100
	10	3598	106	3715	101	3625	104
	8	3583	106	3662	100	3624	104
LSD (<i>P</i> = 0.05)		110	3	152	4	104	3

The yields in successive years were 2569, 4485 and 3684 lb per acre; the third year yields may have been higher, but for the uncomfortably high plucking table (see Annual Report 1967) and the unprecedented drought early this year. Nitrogen at 75 lb per acre continued to sustain a yield as high as 3388 lb per acre; 150 and 225 lb N per acre increased this yield significantly by seven and ten per cent respectively. Increasing potash from 50 to 100 lb per acre per year raised the yield by five per cent, but increasing potash to 150 lb per acre did not increase the yield any further.

The tea was pruned in June 1968 and the recovery was good; there were no casualties. The tea was brought into plucking 95 days after pruning.

N. Yogaratham

LA3 — NPKMg shade on seedling tea at the Low-Country Station, Ratnapura— (1964)

The results of the two year cycle 1966 to 1968 are presented in Table 3.

TABLE 3 — Yield in lb made tea per acre over the two-year cycle 1966 to 1968

Treatments (lb per acre per year)	Yield		
	(lb per acre)	(%)	
N	75	1526	100
	150	1555	102
	225	1539	101
P ₂ O ₅	0	1516	100
	40	1530	101
	80	1574	104
K ₂ O	0	1478	100
	60	1565	106
	120	1577	107
MgO	0	1441	100
	24	1533	106
	48	1645	114
LSD (<i>P</i> = 0.05)		114	7
Unshaded		1652	100
<i>G. maculata</i> shade at 14 ft x 14 ft		1534	93
<i>G. maculata</i> shade at 7 ft x 7 ft		1434	87
LSD (<i>P</i> = 0.05)		156	10

Although the difference in yield between 0 and 120 lb K₂O per acre was significant, there was no difference in yield between 60 and 120 lb K₂O per acre. There was a significant yield response to magnesium at 48 lb per acre per year respectively. *Gliricidia maculata* shade trees, spaced 7 ft x 7 ft apart caused a significant reduction in yield.

H. H. Samarakoon

LA4 — NPKMg on VP tea at the Kottawa Substation — (1963)

This experiment was pruned in July after two and a half years of plucking. The results are summarized in Table 4.

TABLE 4 — Mean yields in lb made tea per acre over the first cycle 1965 to 1968

Treatments (lb per acre per year)	First six months		Second six months		Third six months		Fourth six months		Fifth six months		
	(lb per acre)	(%)	(lb per acre)	(%)	(lb per acre)	(%)	(lb per acre)	(%)	(lb per acre)	(%)	
Nitrogen	75	347	100	311	100	364	100	449	100	400	100
	150	477	137	498	160	557	153	755	168	787	197
	225	613	177	678	218	798	219	1058	235	952	238
Phosphate	0	389	100	406	100	469	100	665	100	651	100
	30	487	125	510	126	596	127	825	124	746	115
	60	561	144	571	141	654	139	772	116	742	114
Potash	0	463	100	481	100	547	100	722	100	567	100
	50	473	102	497	103	579	106	740	102	754	133
	100	501	108	510	106	593	108	800	111	818	144
Magnesia	0	460	100	488	100	561	100	734	100	656	100
	30	447	97	475	97	538	96	694	95	715	109
	60	530	115	524	107	620	111	834	114	768	117
LSD (<i>P</i> = 0.05)		91	19	88	18	98	17	122	16	132	19

There were significant responses to nitrogen up to the highest level tested (225 lb per acre per year) throughout the first cycle. The large responses to phosphate observed in the early stages gradually decreased and in the fifth six-months period there was no significant response to the phosphate treatments. The response to potash at 50 lb per acre per year reached the level of significance only in the fifth six-months period. The response to magnesia did not reach the level of significance throughout the cycle but appears to be increasing with age.

H. D. Jayasinghe

LA5 — *Zn, N frequency of application on seedling tea at the Low-Country Station, Ratnapura* — (1963)

This experiment is now in the third pruning cycle. Over the first 18 months of this cycle the highest yields were obtained with ten lb zinc sulphate and 125 lb nitrogen per acre per year, but the treatment differences were not significant.

E. J. B. de Silva

LA7 — *Rehabilitation : Species and fertilizer at the Low-Country Station, Ratnapura* — (1963)

The yields over the first eighteen months of plucking were not significantly different between treatments.

LA8 — *Rehabilitation with legumes at the Low-Country Station, Ratnapura* — (1963)

The yields over the first year of plucking did not reveal differences between the rehabilitation treatments.

LA9 — *Rehabilitation : Species, fertilizer and duration at the Low-Country Station, Ratnapura* — (1965)

The plants were given the first cut at 15 in. A visual assessment prior to this operation indicated that the best growth was made in the rehabilitated plots. An examination of height measurements and the weight of the cuttings also leads to a similar conclusion. The height and other growth measurements made on these plants will be analysed in greater detail later.

N. Yogaratham

LA10 — *Six clones at 3 levels of nitrogen and 3 levels of shade at the Low-Country Station, Ratnapura* — (1965)

All clones were brought into plucking on 8th July 1967, 25 months after planting. The yield during the first year of plucking is recorded in Table 5.

TABLE 5 — Yield in made tea lb per acre per year over the first year of plucking

Clones	Yield (lb per acre per year) (%)	
TRI 2023	1057	100
TRI 2026	1036	98
TRI 2043	683	65
MT 18	840	79
N 3	657	62
KEN 16/3	901	85
LSD ($P = 0.05$)	108	10
Nitrogen		
(lb per acre per year)		
40	668	100
80	967	145
120	953	143
LSD ($P = 0.05$)	287	43
Unshaded	854	100
<i>G. maculata</i> shade at 14 ft × 14 ft	815	95
<i>G. maculata</i> shade at 7 ft × 7 ft	918	107
LSD ($P = 0.05$)	287	34

TRI 2023 and TRI 2026 were superior to the other clones tested. There was a 45% increase in yield when the nitrogen level was raised from 40 lb per acre per year to 80 lb per acre per year. As from October 1968 the nitrogen levels were increased to 80, 160 and 240 lb per acre per year. There was no difference between the shade treatments, but it should be mentioned that the shade trees had not grown sufficiently.

LA11 — *Bringing into bearing, plucking, pruning, levels of N and duration of cycle in VP tea at the Low-Country Station, Ratnapura — (1965)*

The yields of the first cycle (1966 to 1968) do not indicate significant differences between the nitrogen levels of 240, 320 and 400 lb per acre per year, nor between the three bringing into bearing treatments of one bending, two bendings and centering.

D. D. Kroon

LA12 — *3 clones, 3 spacings and 3 levels of N at the Kottawa Substation — (1961)*

In the first eighteen months of the third experimental cycle clone TRI 2024 gave the highest yield. Three hundred lb nitrogen per acre per year was better than 100 lb or 200 lb. There was no difference in yield between the spacing treatments 4 ft x 1½ ft, 4 ft x 2 ft and 4 ft x 2½ ft.

LA13 — *3 clones, 3 spacings and 3 levels of N at the Kottawa Substation — (1962)*

In the second two-year experimental cycle 1966 to 1968 there was no significant difference in yield between the three clones TRI 2023, 18B and TRI 2026, nor between the three spacings 4 ft x 14 in., 4 ft x 28 in. and 4 ft x 42 in. There was a significant yield response to nitrogen up to 300 lb per acre per year, the highest level tested.

H. D. Jayasinghe

LA14 — *Spacing and fertilizer on VP tea at the Low-Country Station, Ratnapura — (1965)*

The tea was brought into plucking on 9th November 1967, 26 months after planting. The yield during the first year of plucking is presented in Table 6.

TABLE 6 — Yield in lb made tea per acre over the first year of plucking (November 1967 to October 1968)

Treatment Nitrogen (lb per acre per year)	Yield (lb per acre per year)	(%)
50	732	100
100	865	118
150	990	135
Spacing between rows (ft)		
3.5	869	100
4.0	879	101
4.5	839	93
Spacing within rows (ft)		
1.5	896	100
2.0	793	89
2.5	907	101
LSD ($P = 0.05$)	80	9

There was an 18% increase in yield when the nitrogen level was increased from 50 lb per acre to 100 lb per acre and a further increase of 17% in yield when the nitrogen level was increased to 150 lb per acre. As from October 1968 the nitrogen levels have been increased to 100, 200 and 300 lb per acre per year. There was no significant difference in yield between the spacing treatments, except in the case of the 2 ft within-row spacing which is lower than all other treatments tested; this is difficult to explain.

D. D. Kroon

LA16 — NPKMg frequency of application on VP tea at Hunuwella, Opanaike—(1965)

The yields over the two-year cycle 1966 to 1968 are presented in Table 7.

TABLE 7 — Mean yields in lb made tea per acre at Hunuwella over the two-year cycle (1966 to 1968)

Treatments (lb per acre per year)	1st year		2nd year		Mean over the cycle		
	(lb)	(%)	(lb)	(%)	(lb)	(%)	
N	120	3519	100	4785	100	4152	100
	240	3819	109	5452	114	4635	112
	360	3784	108	5424	113	4603	111
P ₂ O ₅	0	3697	100	5196	100	4446	100
	30	3740	101	5195	100	4467	100
	60	3685	100	5269	101	4477	101
K ₂ O	0	3748	100	5185	100	4466	100
	60	3726	99	5262	101	4494	101
	120	3649	97	5213	101	4431	99
MgO	0	3796	100	5201	100	4498	100
	25	3671	97	5293	102	4482	100
	50	3655	96	5167	99	4411	98
Interval between applications (weeks)	6	3863	100	5318	100	4590	100
	8	3738	97	5311	100	4524	99
	10	3521	91	5032	95	4276	93
LSD ($P = 0.05$)		203	5	237	5	183	4

There was a significant response to nitrogen up to 240 lb per acre per year during the first and second years of the cycle. Intervals of six and eight weeks between fertilizer applications were better than ten weeks. There was no response to phosphate, potash or magnesium treatments.

A. A. C. Karunaratne

LA17 — *Types and levels of N, levels of dolomite on seedling tea at the Low-Country Station, Ratnapura — (1965)*

In this experiment, over the first 18 months of the present cycle (June 1967 to June 1969) the mean yield was 2,384 lb per acre. There was no significant difference in yield between the three forms of nitrogen *viz* sulphate of ammonia, calcium ammonium nitrate and urea, and the three levels of nitrogen *viz* 100, 200 and 300 lb per acre per year. These treatments have now been applied for a period of two and a half years.

H. H. Samarakoon

LA18 — *Rehabilitation with legumes at the Low-Country Station, Ratnapura — (1966)*

These plants were cut across at 15 in. in December 1968. Differences in growth between treatments were not evident.

N. Yogaratnam

LA19 — *Bringing into bearing, plucking, pruning and duration of cycle in VP tea at the Kottawa Substation — (1966)*

The frequency of plucking treatments *viz* every four, five and six days was introduced in November 1968. The results will be statistically analysed at the end of one year of plucking.

H. D. Jayasinghe

LA20 — *NPKMg and frequency of application on VP tea at Ratnayaka Group, Deniyaya — (1966)*

The mean yields during the first eighteen months of the cycle 1967 to 1969 are presented in Table 8.

TABLE 8 — *Mean yields in lb made tea during the first 18 months of the cycle (1967 to 1969)*

	Treatments (lb per acre per year)	Yield	
		(lb per acre)	(%)
N	240	8169	100
	360	8360	102
	480	8196	100
P ₂ O ₅	0	8060	100
	30	8387	104
	60	8278	103
K ₂ O	0	8305	100
	60	8169	98
	120	8251	99
MgO	0	8223	100
	25	8251	100
	50	8251	100
Intervals between applications (weeks)	8	8251	100
	6	8142	99
	4	8332	101
LSD (<i>P</i> = 0.05)		218	3

Although the yields were very high, there was no response to nitrogen beyond 240 lb. Phosphate at 30 lb P_2O_5 per acre increased the yield significantly, but not potash.

LA21 — *NPKMg and frequency of application on VP tea at Kobomella Group, Beralapantara — (1966)*

TABLE 9 — *Mean yields in lb made tea per acre in the first eighteen months of the cycle (1967 to 1969)*

	Treatments	Yield	
	(lb per acre per year)	(made tea per acre)	(%)
N	240	7499	100
	360	7914	106
	480	7878	105
P_2O_5	0	7874	100
	30	7734	98
	60	7683	98
K_2O	0	7680	100
	60	7818	102
	120	7793	101
MgO	0	7737	100
	25	7812	101
	50	7743	100
Interval in weeks between applications	8	7780	100
	6	7797	100
	4	7715	99
LSD ($P = 0.05$)		368	5

There was a response to nitrogen up to 360 lb per acre per year. There was no response to the phosphate, potash and magnesia and frequency of fertilizer application treatments.

LA22 — *NPKMg and frequency of application on seedling tea at Anningkande Estate, Deniyaya — (1966)*

The mean yields during the first eighteen months of the cycle 1966 to 1968 are presented in Table 10.

TABLE 10 — *Mean yields in lb made tea per acre during the first 18 months of the cycle (1966 to 1968)*

	Treatments	Yield	
	(lb per acre per year)	(lb per acre)	(%)
N	100	4066	100
	200	4066	100
	300	4114	101
P_2O_5	0	4162	100
	30	4017	97
	60	4090	98
K_2O	0	3993	100
	60	4162	104
	120	4090	102
MgO	0	4114	100
	25	4090	99
	50	4041	98
Interval in weeks between applications	10	4090	100
	8	4090	100
	6	4041	99
LSD ($P = 0.05$)		169	4

Potash at 60 lb K_2O per acre increased yield significantly.

LA23 — 3 types of N, urea, calcium ammonium nitrate and sulphate of ammonia, 3 levels of N, 3 frequencies of application and 3 levels of dolomite on VP tea at Dankoluwa Estate, Pitabeddera — (1966)

This experiment was terminated, following casualties in the plots during a period of unprecedented dry weather.

LA24 — 3 types of N (urea, calcium ammonium nitrate and sulphate of ammonia), 3 levels of N, 3 frequencies of application and 3 levels of dolomite on VP tea at Deniyaya Estate, Deniyaya — (1966)

The yields obtained over the two year cycle 1966 to 1968 are presented in Table 11.

TABLE 11 — Mean yields in lb made tea per acre per year over the two-year cycle 1966 to 1968

Treatments (lb per acre per year)	Yield (lb per acre per year)	(%)	
N	160	4754	100
	320	5235	110
	480	5411	114
Interval in weeks	8	5027	100
between	6	5209	104
applications	4	5165	103
Sulphate of ammonia		5126	100
Urea		5159	101
Calcium ammonium nitrate		5116	100
Dolomite (tons per acre per year)	0	4934	100
	$\frac{1}{2}$	5257	107
	1	5210	106
LSD ($P = 0.05$)		272	5

There was a yield response up to 320 lb nitrogen per acre per year and half ton dolomite per acre per year increased yields. The differences in yield between the frequency of application treatments and the forms of nitrogen were not significant.

LA25 — 3 types of nitrogen (urea, calcium ammonium nitrate and sulphate of ammonia), 3 levels of N, 3 frequencies of application and 3 levels of dolomite on VP tea at Enselwatte Group, Deniyaya — (1966)

There were no significant differences between treatment yields over the first 18 months of the cycle 1967 to 1969.

LA26 — Methods of pruning, frequency of plucking and duration of cycle on VP tea at Handford Estate, Deniyaya — (1966)

The yield for the first eighteen months of the cycle 1966 to 1968 are presented in Table 12.

TABLE 12 — Mean yields in lb made tea per acre in the first eighteen months of the cycle 1966 to 1968

Treatments Frequency of plucking (days)	Yield (lb per acre)	(%)
4	4972	100
5	4353	89
6	4262	86
Method of pruning		
Rim-lung	4519	100
Centre-lung	4522	100
Cut-across	4545	101
LSD ($P = 0.05$)	90	2

Plucking every four days gave a significantly higher yield than plucking every five or six days. There was no difference in yield between the pruning methods.

LA27 — *Methods of pruning, frequency of plucking and duration of cycle on seedling tea at Anningkande Estate, Deniyaya — (1966)*

The yields obtained in the first eighteen months of the cycle 1967 to 1969 are presented in Table 13.

TABLE 13 — *Mean yields in lb made tea per acre over the first eighteen months of the cycle (1967 to 1969)*

Treatments Frequency of plucking (days)	Yield (lb per acre)	(%)
5	4443	100
6	4036	91
7	3891	88
Method of pruning		
Rim-lung	4101	100
Centre-lung	4158	101
Cut-across	4111	100
LSD ($P = 0.05$)	78	2

The differences in yield between pruning treatments were not significant. Plucking every five days gave a higher yield than plucking every six days. Plucking every seven days gave the lowest yield.

J. I. H. Bandaranayake

LA28 — *NPK, types of N and levels of lime on VP tea at Hapugastenne Group, Ratnapura — (1966)*

The results obtained during the cycle 1966 to 1968 are presented in Table 14.

TABLE 14 — *Mean yields in lb made tea per acre per year over the cycle 1966 to 1968*

Treatments	Yield (lb per acre per year)	(%)	
Sulphate of ammonia	3512	100	
Calcium ammonium nitrate	3483	99	
Urea	3423	97	
(lb per acre per year)			
N	240	3353	100
	360	3441	103
	480	3624	108
P ₂ O ₅	0	3464	100
	30	3492	101
	60	3463	100
K ₂ O	0	3477	100
	60	3486	100
	120	3456	99
Limbox (tons per acre per year)	0	3529	100
	$\frac{1}{2}$	3494	99
	1	3396	96
LSD ($P = 0.05$)	128	4	

There was no significant difference in yield between sulphate of ammonia, calcium ammonium nitrate and urea. Four hundred and eighty pounds nitrogen per acre per year gave a significantly higher yield than 360 lb and 240 lb, but the increase in yield was only 183 lb made tea with 120 lb nitrogen. There was no yield response to phosphate and potash application ; Limbux at one ton per acre per year depressed yields.

E. J. B. de Silva

LA29 — *NPK and frequency of application on seedling tea at Sapumalkande Group, Dehiowita — (1966)*

This experiment was due for pruning this year but the cycle was extended for another six months at the request of the Superintendent, Sapumalkande Group.

The yields during the second year of the cycle (1966 to 1969) are given in Table 15.

TABLE 15 — *Mean yield in the second year of the cycle 1966 to 1969*

	Treatments (lb per acre per year)	Yield (lb per acre per year)	(%)
N	120	3664	100
	240	3972	108
	360	3962	108
P ₂ O ₅	0	3965	100
	30	3768	95
	60	3865	97
K ₂ O	0	3963	100
	60	3860	97
	120	3773	95
Interval between applications (weeks)	9	3847	100
	7	3778	98
	5	3970	103
LSD (<i>P</i> = 0.05)		214	6

There was an 8% increase in yield when the nitrogen was increased from 120 to 240 lb per acre per year with no further increase in yield with 360 lb N. There was no significant response to the other treatments.

N. Yogaratnam

LA31 — *3 types of nitrogen (urea, calcium ammonium nitrate and sulphate of ammonia), 3 levels of nitrogen, 3 frequencies of application and 3 levels of dolomite on VP tea at Talangaha Estate, Nakiyadeniya — (1966)*

The yields obtained in the first eighteen months of the cycle (1967 to 1969) are presented in Table 16.

TABLE 16 — *Mean yields in lb made tea per acre over the first eighteen months of the cycle 1967 to 1969*

Treatments		Yield (lb per acre per year)	(%)
Sulphate of ammonia		5051	100
Calcium ammonium nitrate		4602	91
Urea		4732	94
(lb per acre per year)			
N	240	4621	100
	360	4865	105
	480	4899	106
Interval between applications (weeks)	8	4774	100
	6	4813	101
	4	4798	101
Dolomite (tons per acre per year)	0	4890	100
	$\frac{1}{2}$	4800	98
	1	4694	96
LSD ($P = 0.05$)		253	5

Sulphate of ammonia gave significantly higher yields than calcium ammonium nitrate and urea. There is a significant response in yield up to 360 lb nitrogen per acre per year but not thereafter.

LA32 — *3 types of nitrogen (urea, calcium ammonium nitrate and sulphate of ammonia), 3 levels of nitrogen, 3 frequencies of application and 3 levels of dolomite on VP tea at Talgaswella Estate, Talgaswella — (1966)*

There were no significant differences between treatment yields over the first eighteen months of the cycle 1967 to 1969.

H. D. Jayasinghe

LA33 — *NPKMg and frequency of application on VP tea at Nil. Ella Estate, Morawaka — (1967)*

In this experiment the following treatments are being compared : nitrogen at 240, 360 and 480 lb per acre per year ; P_2O_5 at 0, 30 and 60 lb per acre per year ; MgO at 0, 25 and 50 lb per acre per year, and 6, 8 and 12 fertilizer applications per year. Over the first eighteen months of the first experimental cycle there were no differences in yield between treatments.

J. I. H. Bandaranayake

LA34 — *NPKMg on VP tea at the Low-Country Station, Ratnapura — (1967)*

The plants were bent twice and then cut at 14 in. All plots were tipped at 18 in. in December 1968, and will be brought into plucking early next year.

N. Yogaratnam

1968 Experiments

LA35 — *Levels of nitrogen, phosphorus, potassium and magnesium on young plants of TRI 2023 in pots at the Low-Country Station, Ratnapura — 4 randomized blocks — (1968)*

In this experiment, six levels each of sulphate of ammonia, saphosphosphate, muriate of potash and kieserite are being applied to young plants of clone TRI 2023 growing in cement pots. The plants will be allowed to grow freely. It is intended to study the nitrogen, phosphorus, potassium and magnesium contents of flush shoots and mature leaves in relation to the level of fertilizer application. Non-destructive assessments of growth will also be made. Each fertilizer is being tested in a separate experiment.

D. T. Wettasinghe & N. S. Rajendram

LA36 — 3 levels of nitrogen on 4 clones at the Low-Country Station, Ratnapura
— 4 randomized blocks — (1968)

In this experiment TRI 2023, TRI 2025, TRI 2026 and CW 21 are being tested at three levels of nitrogen viz 75, 150 and 225 lb per acre per year. The twelve treatment combinations are randomized within each block. This experiment was planted in July on old tea land which was not rehabilitated. The first bending was done in September 1968.

N. Yogaratnam

LVP1 to LVP6 — Clonal testing at the Kottawa Substation — (1961 to 1965)

The results from these experiments are presented in the Report of the Plant Physiology Division and are, therefore, not repeated here.

H. D. Jayasinghe

LVP6 — Clonal testing at the Low-Country Station, Ratnapura — (1964)

The tea was pruned in April and the bushes allowed to grow up for obtaining cuttings for propagation. The following clones whose performance was encouraging were selected for inclusion in a replicated experiment: TRI 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2043, 2045 and 2151, CW 21, PGG 2, PUH 5, NK 4B 29, MT 18, DG39, DG 3, H 1/58, H 13/4, M 20, MPA 1, KEN 16/3 and GMT 9.

LVP7 — Clonal selection at the Low-Country Station, Ratnapura — (1965)

Selections from St Joachim

Of the 220 St Joachim selections, 23 were outstanding. These were pruned in November 1968 and allowed to grow up as a source of planting material. These clones will be included in a replicated experiment in 1969. Yield records are being maintained on the rest.

Selections from Lansdowne TRI 2023 × TRI 2026 seedling

All 116 selections were brought into plucking in December, 1968, eighteen months after planting.

Selections from Endane seedlings

These selections will be brought into plucking in January next year.

D. D. Kroon

LVP8 — Clonal selection at the Kottawa Substation — (1966)

Eleven selections are now in plucking. Yield records are being maintained.

K. H. G. Gunapala

LVP9 — *Clonal selection for drought resistance at Rye Estate, Balangoda — (1966)*

Eighty nine selections were planted out in rows of ten plants each, in November 1968. Five plants in each row were bent and the rest allowed to grow freely.

D. D. Kroon

LPH2 — *Methods of pruning seedling tea at the Low-Country Station, Ratnapura — (1966)*

This experiment was terminated at the end of the third six-months of the cycle 1966 to 1968. The yields during this period were similar to those obtained during the second six-months period (see Annual Report for 1967). Rim-lung pruning gave a higher yield than centre-lung or cut-across pruning, but the difference was not significant.

LPH3 — *Duration of lung retention on recovery from pruning and on yield in seedling tea at the Low-Country Station, Ratnapura — (1966)*

The treatments are described fully in the Annual Report for 1966. The yields obtained for the two-year cycle, 1966 to 1968 are presented in Table 17.

TABLE 17 — *Mean yields in lb made tea per acre over the two year cycle 1966 to 1968*

Treatments	Yield (lb per acre)
Pruning without lungs	1813
Pruned and lungs removed after 4 weeks	2604
Pruned and lungs removed after 11 weeks at	
(a) pruning level and tipped 4 in. above	2623
(b) 4 in. above pruning level and tipped at this same level	2844
(c) pruning level and tipped 8 in. above this	2634
LSD ($P = 0.05$)	335

The highest yields were obtained where lungs were removed after 11 weeks four in. above pruning level with tipping also done four in. above the pruning level. This experiment is terminated.

LPH4 — *Duration of lung retention on recovery from pruning and on yield of seedling tea at the Low-Country Station, Ratnapura — (1967)*

Over the first 18 months of the cycle 1967 to 1969 the highest yield was obtained where lungs were removed eight weeks after pruning. The results will be presented when the two-year experimental cycle is completed.

N. S. Rajendram

1968 Experiments

LPH5 — *Plucking the lungs on recovery from pruning and yield of seedling tea at the Low-Country Station, Ratnapura—3 randomized blocks — (1968)*

Rim-lung and centre-lung-pruned bushes, where the lungs were plucked, were compared with those where the lungs were not plucked. The lungs were removed eight weeks after pruning, and the tipping done either four or eight in. above the pruning level. The tipping weights and the yields obtained during the first six months of the cycle are presented in Table 18.

TABLE 18 — *Mean yields in lb made tea per acre over the first six months of the cycle 1968 to 1970*

Treatments	Fresh weight of tipping (lb per 0.02 acre plot)	Made tea per acre	
		First six months (lb)	(%)
Rim-lung pruning	12.83	187	100
Centre-lung pruning	8.56	151	81
Lungs plucked	11.31	182	100
Lungs not plucked	10.08	157	86
Tipped at 4 inches		173	100
Tipped at 8 inches		166	96
LSD ($P = 0.05$)		21	12

Rim-lung pruning gave significantly higher yields than centre-lung pruning and confirms the results of previous experiments carried out at this Station. The yields obtained from plots where the lungs were plucked were significantly higher than where the lungs were not plucked.

N. S. Rajendram

Evaluation of herbicides

LW13 — *Simazine, diuron, 2, 4-D and amitrole on the yields of seedling tea — (1967)*

The treatments were applied on seven occasions. According to the treatment given, the plots, therefore, received a total of 5.6 lb or 11.2 lb diuron ; 5.6 lb or 11.2 lb 2,4-D ; 7 lb or 14 lb simazine, 7 lb or 14 lb of amitrole, per acre within a period of 16 months. None of the above treatments had any effect on the yield of tea during this period. Soil samples were taken three months after the seventh application of the treatments. These samples will be bio-assayed for residues.

D. T. Wettasinghe & U. P. de S. Waidyanatha

LW14 — *Pentachlorophenol on yield of seedling tea — (1967)*

In this experiment the highest rate tested *viz* 2.4 lb pentachlorophenol (PCP) monthly for a period of nine months, did not cause a significant reduction in the yield during this period. This experiment was abandoned as there were a number of casualties during the drought.

LW15 — *Primary evaluation of herbicides — (1967)*

Of the 15 materials tested the following have been selected for further evaluation in **LW21**—Fluometuron (Cotoran), metabromuron (Patoran), chloroxuron (Tenoran), chlorbromuron (Maloran), benzthiazuron (Gatnon), prometryne, desmetryne and NPH 1221.

1968 Experiments

LW20 — *Simazine, diuron, fluometuron and pentachlorophenol on the growth of young tea (clone TRI 2023) — 4 randomized blocks — (1968)*

The primary object of this experiment is to determine the tolerance of young tea plants of clone TRI 2023 to soil applications of the following herbicides :

- Simazine at 0.5, 1.0 and 2.0 lb per acre
- Diuron at 0.2, 0.4 and 0.8 lb per acre
- Fluometuron at 0.2, 0.4 and 0.8 lb per acre, and
- Pentachlorophenol (sodium salt) at 1.5, 3.0 and 6.0 lb per acre.

The first application was made 40 days after the tea was transplanted, and the treatments would be repeated at bi-monthly intervals. The spray is directed to the soil and care taken to avoid spraying the foliage. The plots are frequently hand-weeded to prevent weed competition. The phytotoxicity of the herbicides will be determined by visual observations as well as growth assessments.

LW21 — *Evaluation of herbicides* — observation plots in duplicate — (1968)

The following were screened for their residual effect on weeds when used as soil-applied herbicides : Fluometuron, metabromuron, chloroxuron, chlorbromuron, benzthiazuron, prometryne and desmetryne—all at 0.5 and 1.5 lb per acre, and NPH 1221 at 1 and 3 lb per acre.

The performance of these materials were assessed by visual rating and the following selected for further evaluation in **LW22** : Fluometuron, chloroxuron, prometryne and desmetryne.

D. T. Wettasinghe & H. H. Samarakoon

LW22 — *Evaluation of herbicides* — 3 randomized blocks — (1968)

The following are being screened for their residual effect on weeds when used as soil-applied herbicides in tea : Fluometuron, chloroxuron, linuron, neburon, diuron and lenacil all at 0.6 and 1.2 lb per acre ; atrazine, atratone, desmetryne and prometryne, all at 0.5 and 1.0 lb per acre ; Propachlor at 0.65 lb per acre, CP 44939 at 1 and 2 lb per acre, PCP (Na) at 2.7 and 5.4 lb per acre, a trifluralin E.C. of unknown strength at 0.25 and 0.5 gallon per acre, Pesco 18-25 at 0.5 and 1.0 gallon per acre and Ustinex PA (containing diuron and amitrole) at 0.75 and 3.0 lb per acre.

D. T. Wettasinghe & N. S. Rajendram

Weed Control

LW18 — *Gramoxone, diuron, simazine and 2,4-D on one-year-old plants of clone TRI 2023* — (1967)

The 2,4-D treatment controlled the dicotyledonous species but grasses such as *Axonopus* spp. and *Digitaria* spp. became predominant. The Gramoxone treatments were better but the control was inadequate, particularly of *Borreria hispida* (formerly *Spermacoce latifolia*). Simazine at one lb per acre gave adequate control of weeds for about 2½ months but the plot had to be clean weeded before repeating the simazine treatment. Diuron at half lb per acre also gave about 2½ month weed control. The plots were not clean weeded before repeating the diuron treatments. It was necessary, however, to hand pull weeds growing in the tea row. This experiment has been concluded.

1968 *Experiments*

LW19 — *Control of a very dense stand of Paspalum conjugatum in tea* — Randomized blocks in 3 replicates — (1968)

Plots (16 ft x 24 ft) were demarcated in an area where the tea had been recently uprooted. The weed growth was almost entirely *Paspalum conjugatum*. The following treatments were tested : 1 and 2 lb amitrole per acre ; 0.6 and 1.2 lb diuron per acre ; 1½ and 3 pints Gramoxone per acre ; 0.25 and 0.5 lb amitrole per acre, each level being followed 14 days later by 0.4 lb diuron or 0.8 lb diuron, or ½ pint Gramoxone or 1 pint Gramoxone. All treatments were applied in a spray volume of 75 gallons water per acre. The degree of

weed control was assessed visually at approximately fortnightly intervals over a period of $2\frac{1}{2}$ months. None of the above treatments gave complete control of the grass. The most effective treatments were the low rates of amitrole 0.25 and 0.5 lb per acre followed by either diuron or Gramoxone, all of which gave satisfactory control of *P.conjugatum* for almost 75 days. Amitrole at two lb per acre on its own also gave similar control but is a more expensive treatment.

D. T. Wettasinghe & U. P. de S. Waidyanatha

LW23 — Diuron for weed control in mature tea — 7 randomized blocks — (1968)

In a number of experiments it has been shown that diuron is active against many weed species common in low-grown tea. Rates as low as 0.5 lb per acre have given good control for approximately two months. It may be possible to use higher rates safely and obtain a longer duration of weed control. In this experiment various levels of diuron, viz 0.5, 1.0, 1.5 and 2.0 lb per acre, are being tested to determine the most economical rate to bring about and maintain weed control. At the commencement of the experiment the plots had about 80 to 90% weed cover consisting mainly of *Borreria hispida*, *Cleome burmanii*, *Paspalum* spp. and *Ageratum conyzoides*. The treatments are repeated when the weed growth warrants it. A schedule of operations and weed growth assessments are given in Table 19.

Crassocephalus crepidioides appeared in most plots in November, and as this weed seemed quite resistant to diuron it was hand-pulled and the weight per plot recorded. The apparently better control of *C.crepidioides* at the lower levels of diuron may be due to some contact effect of the October applications which were confined to the $\frac{1}{2}$ and 1 lb per acre levels.

The plots were clean weeded in December, and the weight of all weeds recorded. Treatment 2 (3 applications of 1 lb diuron per acre) appears to be the most effective in bringing about weed control. The treatments will be resumed next year and carried out over a full year to determine the most economic level to maintain control.

LW24 — Diuron for weed control in shaded and unshaded mature tea—Split plot with shade in main plots, diuron in subplots with 3 replicates — (1968)

The experiment is similar to LW23. All treatments have been repeated once, three months after the initial application. The experiment is in progress.

LW25 — Control of *Paspalum conjugatum*—3 randomized blocks — (1968)

The following treatments are being tested :

- 1 — D + S
- 2 — D + $\frac{1}{2}$ pint Gramoxone + S
- 3 — D + $\frac{1}{4}$ pint Gramoxone + S
- 4 — D + $\frac{1}{8}$ pint Gramoxone + S
- 5 — D + $\frac{1}{4}$ pint Gramoxone
- 6 — D + $\frac{1}{2}$ pint Gramoxone
- 7 — D + $\frac{1}{8}$ pint Gramoxone
- 8 — Control

D = 0.6 lb diuron per acre

S = 0.75 pint surfactant 'N' per acre

All treatments were applied in a spray volume of 50 gallons per acre.

D. T. Wettasinghe & N. S. Rajendram

TABLE 19 — *Schedule of operations and weed assessments in LW23*

Treatment	Applied on 30.4.68 (lb per acre)	% weed cover 2.8.67	Applied on 2.8.68 (lb per acre)	% weed cover 5.10.67	Applied on 10.10.68 (lb per acre)	Fresh weight lb of <i>C. crepidoides</i> 29.11.68	% weed cover 13.12.68	Plots clean weeded on 17.12.68. Fresh weight of all weeds (lb)
1	0.5	47	0.5	50	0.5	9.0	38	52.2
2	1	37	1	41	1	7.0	30	23.3
3	1.5	24	1.5	19	—	19.3	32	33.5
4	2	32	2	29	—	22.7	31	39.7
LSD ($P = 0.05$)						6.6		27.1

*Weed competition***LW5 — Weed effects on crop and yield of seedling tea at the Low-Country Station, Ratnapura — (1965)**

This experiment was pruned in May 1967. Following pruning there was a profuse growth of weeds, particularly creepers, which threatened to smother the tea. Creepers originated in the four-monthly and six-monthly weeded plots but invaded all plots; all plots had to be clean-weeded manually in October 1967. The original treatments were applied thereafter.

The yields obtained in the first year of the cycle 1967-1968 are recorded in Table 20.

TABLE 20 — *Mean yield in lb made tea per acre in the first year of the cycle 1967 to 1969*

Treatments	Yield (lb per acre)		Mean
	N levels 100 (lb per acre)	200	
Weeds removed every 2 months	1144	1244	1194
Weeds removed every 4 months	1003	1183	1093
Weeds removed every 6 months	983	1041	1012
Gramoxone $\frac{1}{2}$ pint per acre	1138	1118	1128
LSD ($P = 0.05$)	164		116
Mean	2458	2658	
LSD ($P = 0.05$)	82		

Manual weeding at two-monthly intervals and Gramoxone applications at two-monthly gave significantly higher yields than weeding at six-monthly intervals. Nitrogen at 200 lb per acre per year gave a higher yield than 100 lb per acre per year, but the difference just failed to reach the level of significance.

U. P. de S. Waidyanatha

LW16 — Competitive effect of weeds on the growth of young tea — 5 randomized blocks — (1967)

Six months after the commencement of the treatments the plants were cut at eight in. above ground level and the dry weights of the tops were determined and used to assess the effect of weed competition. The best growth was made by plants in plots weeded every two or every four weeks, and made nearly twice the growth in plots weeded every ten weeks. The plants in plots weeded six and eight weeks were intermediate. The main weeds present were *Axonopus affinis* and *Borreria hispida*.

D. T. Wettasinghe & H. H. Samarakoon

*Weed biology***LW17 — Seasonal pattern of weed emergence under mature seedling tea— 8 paired plots — (1967)**

Routine counts were kept and will be continued for another year before attempting to analyse the data.

D. T. Wettasinghe & U. P. de S. Waidyanatha

LW26 — Herbarium of weeds — (1968)

A herbarium of weeds in low-grown tea is being compiled. Seventeen species have been collected and are being prepared.

D. T. Wettasinghe & N. S. Rajendram

*Miscellaneous***LW27 — Paraquat on bud break in pruned tea—4 randomized blocks — (1968)**

Paraquat is used on some estates as an overall application after pruning to control moss and ferns growing on the frames. This experiment was designed to study the effect of the above practice on bud break.

The following treatments were tested :

- 1 — 0.05% paraquat applied on the day of pruning
- 2 — 0.05% paraquat applied 5 days after pruning
- 3 — 0.05% paraquat applied 10 days after pruning
- 4 — 0.05% paraquat applied 15 days after pruning
- 5 — 0.05% paraquat applied 20 days after pruning
- 6 — Control.

The paraquat was applied with a paint brush on to the frames. The tea was clean pruned to facilitate the application of treatments, but this together with particularly unfavourable weather resulted in poor and delayed bud break. This experiment will be repeated.

D. T. Wettasinghe & N. S. Rajendram

LW28 — Formulation of diuron — (1968)

Diuron is a residual herbicide which is taken up into plants mainly through the roots. It has been shown that foliar uptake may be increased by the addition of surfactants (McWhorter and Sheets 1961). Commercial formulations do not, however, seem to have adequate foliar activity. Experiments indicate that the addition of surfactant 'N' (octylphenol/ethylene oxide condensate) at the rate of $\frac{3}{4}$ pint of the surfactant to 50 gallons of the spray solution considerably increased the foliar activity of diuron. It was observed that environmental factors such as temperature, light intensity and humidity at the time of application greatly influenced the activity of diuron. The effect of these factors or the optimum level of surfactant cannot be determined until precision equipment is available.

D. T. Wettasinghe & H. H. Samarakoon

Extension Experiments**XLA1 — 3 types and 3 levels of nitrogen (urea, calcium ammonium nitrate, sulphate of ammonia) and 3 levels of lime on VP tea at Hunuwella Group, Opanaike — (1965)**

The yields recorded over the two-year cycle 1966 to 1968 do not show significant differences between the treatments tested. During the second year of the cycle, however, 360 lb N per acre per year gave an yield of 5,444 lb made tea per acre which was eight percent more and significantly better than at 240 lb N.

XLA2 — 3 levels of nitrogen and 3 frequencies of application on VP tea at Hunuwella Group, Opanaike — (1965)

The two-year cycle 1966 to 1968 has now been completed. There are no significant differences in yield between 240, 360 and 480 lb N per acre per year, or between the three frequencies of fertilizer application.

XLA3 — 4 levels of nitrogen x 2 levels of shade on VP tea at Hunuwella Group, Opanaike — (1965)

The results of the two-year cycle 1966 to 1968 are presented in Table 21.

TABLE 21 — Mean yield in lb made tea per acre during the cycle 1966 to 1968

Treatments N nitrogen (lb per acre per year)	2nd Year (made tea per acre)	(%)	Mean of cycle (made tea per acre)	(%)
0	4647	100	3871	100
120	5798	125	4655	120
240	6276	135	5158	133
360	6196	133	5168	133
LSD ($P = 0.05$)	483	10	400	10
No shade	5704	99	4732	101
Shade	5755	100	4696	100
LSD ($P = 0.05$)	1471	26	1259	27

The response to nitrogen extends up to 240 lb per acre per year but not beyond this. The difference in yield between shaded and unshaded plots is not significant.

XLA4 — 4 levels of nitrogen x 2 levels of shade on seedling tea at Hunuwella Group, Opanaike — (1965)

The yield recorded over the two-year cycle 1966 to 1968 do not show significant differences between the treatments tested. During the second year of the cycle there was a significant response to nitrogen up to 120 lb per acre per year.

XLA5 — 3 types of nitrogen (urea, calcium ammonium nitrate and sulphate of ammonia) and 2 levels of lime on VP tea at Endane Estate, Kahawatte — (1965)

The two-year cycle has now been completed. During the first year of the cycle calcium ammonium nitrate gave higher yields than urea and sulphate of ammonia, but over the entire cycle these differences do not reach the level of significance. Application of lime has not increased yields.

XLA6 — 5 levels of nitrogen on VP tea at Endane Estate, Kahawatte — (1965)

The results of the cycle 1966 to 1968 are presented in Table 22.

TABLE 22 — Mean yield in lb made tea per acre per year during the cycle 1966 to 1968

Treatments Nitrogen (lb per acre per year)	2nd Year (made tea per acre)	(%)	Mean of cycle (made tea per acre)	(%)
0	3695	100	3659	100
120	4768	120	4116	113
240	5153	130	4472	122
360	5237	132	4620	126
480	4741	120	4182	114
LSD ($P = 0.05$)	459	12	404	11

The response to nitrogen extends up to 240 lb per acre per year. From 360 to 480 lb N there is a significant depression in yield.

A. A. C. Karunaratne

XLA7 — 4 levels of nitrogen × 4 levels of shade on seedling tea at Rayigam Estate, Ingiriya — (1965)

Four levels of shade were being tested in this experiment. From the beginning of the second experimental cycle the shade trees were removed where 1/3rd shade was previously provided, and the normal shade blocks were thinned to the 2/3rd shade level. At present only two shade treatments are, therefore, being tested, viz unshaded and shade (equivalent to the previous 2/3rd shade level). This alteration gives an increased replication which leads to greater precision in the comparison of the shade treatments. The results of the first year of the cycle 1967 to 1969 are presented in Table 23.

TABLE 23 — Mean yields in lb made tea per acre in the first year of the cycle (1967 to 1969)

Treatments Nitrogen (lb per acre per year)	Yield of made tea (lb per acre per year)	(%)
80	1209	100
120	1199	99
160	1257	104
200	1229	102
LSD ($P = 0.05$)	148	12
Shade	1040	100
No Shade	1407	135
LSD ($P = 0.05$)	203	20

The unshaded plots yielded 35% more than the shaded plots. This result is significant. There is no response to nitrogen applications above 80 lb per acre per year.

XLA8 — 4 levels of nitrogen × 2 levels of shade on seedling tea at Hatherleigh Estate, Rakwana — (1965)

The results of the two-year cycle 1966 to 1968 are shown in Table 24.

TABLE 24 — Mean yields in lb made tea per acre per year over the two-year cycle (1966 to 1968)

Treatments	(made tea per acre per year)	(%)
Shade	1741	100
No shade	1815	104
LSD ($P = 0.05$)	255	15
Nitrogen (lb per acre per year)		
0	1707	100
80	1824	107
160	1772	104
240	1809	106
LSD ($P = 0.05$)	92	5

The difference in yield between shaded and unshaded treatments was not significant. There was a response to nitrogen at 80 lb per acre per year but not beyond this. This experiment has now been terminated.

XLA9 — 4 levels of nitrogen × 2 levels of shade on VP tea at Millakande Estate, Bulathsinhala — (1965)

The yields over the first experimental cycle 1966 to 1968 are presented in Table 25. The plucking was interrupted for three months on account of a labour strike. The cycle was extended up to 26 months.

TABLE 25 — Mean yield in lb made tea per acre per year for the period March 1966 to May 1968

Treatments Nitrogen (lb per acre per year)	Yields (lb per acre per year)	(%)
0	3060	100
160	3383	111
320	3694	121
480	3960	129
LSD ($P = 0.05$)	77	3
Shade	3557	100
No Shade	3492	98
LSD ($P = 0.05$)	185	5

There was a significant yield response to nitrogen up to 480 lb N per acre per year. The difference in yield between the shaded and unshaded plots was not significant.

N. Yogaratham

XLA10 — Types of nitrogen (calcium ammonium nitrate, sulphate of ammonia and urea) on VP tea at Wellandura Estate, Kahawatte — (1966)

The yields during the first 18 months of the present cycle, July 1967 to July 1969 indicate that calcium ammonium nitrate is significantly better than urea (Table 26). The three fertilizers are being tested at the rate of 320 lb N per acre per year.

TABLE 26 — Mean yield of made tea per acre during the first 18 months of the cycle 1967 to 1969

Types of nitrogen	Yield (lb per acre per year)	(%)
Sulphate of ammonia	3506	100
Calcium ammonium nitrate	3695	105
Urea	3453	99
LSD ($P = 0.05$)	212	6

XLA11 — 4 levels of nitrogen × 2 frequencies of application on 6 VP clones at Balangoda Group, Bogawantalawa — (1966)

As from the 18th month of this experimental cycle, 1966 to 1970, the nitrogen levels were changed to 120, 240, 360 and 480 lb per acre per year, and the yields over the 12-months period thereafter is presented in Table 27. TRI 2023 and TRI 2024 were the highest yielding clones.

TABLE 27 — Mean yields in lb made tea per acre during the 12 months period from the 18th to 30th months of the cycle (1966 to 1970)

Clones	Levels of nitrogen				Mean	
	120	240	360	480	(clones)	(%)
MT 18	1376	2160	3024	3318	2470	100
MT 16	1768	2439	2610	2697	2380	96
DG 39	1279	2871	2828	3242	2581	105
TRI 2025	1437	2229	2788	3848	2577	104
TRI 2023	1924	2937	3369	3009	2811	114
TRI 2024	1967	2733	2067	3202	2744	11
LSD ($P = 0.05$)					262	11
Means (N levels)	1642	2562	2948	3129		
%	100	156	180	196		
LSD ($P = 0.05$)	between mean N levels			388		
	between %			24		

E. J. B. de Silva

XLA12 — 4 levels of nitrogen x 3 levels of shade on seedling tea at Sapumalkande Group, Dehiowita — (1966)

The pruning cycle of this experiment was extended by six months to 2½ years at the request of the Superintendent of Sapumalkande. Over the first two years of the present cycle the response to nitrogen appears to extend up to 240 lb per acre per year. The difference in yield between shade treatments is not significant. The results of analysis of the data will be presented at the end of the present cycle.

N. Yogaratnam

XLA13 — 4 levels of nitrogen on TRI clones 2024, 2025 and 2026 at Berubeula Estate, Urubokka — (1966)

The results upto the end of the first 18 months of the cycle 1966 to 1968 are presented in Table 28.

TABLE 28 — Mean yields in lb made tea per acre during first 18 months of the cycle 1966 to 1968

Clones	Yield (lb per acre)	(%)
TRI 2024	5412	100
TRI 2025	4980	92
TRI 2026	5066	94
LSD ($P = 0.05$)	605	11
Nitrogen (lb pre acre per year)		
0	5291	100
160	4876	92
320	5204	98
480	5222	99
LSD ($P = 0.05$)	692	13

The application of nitrogen did not increase yields; this is rather surprising.

J. I. H. Bandaranayake

XLA14 — 4 levels of nitrogen × 2 levels of shade on VP tea at Ratnayaka Group, Deniyaya — (1966)

The results at the end of the first year of the cycle are presented in Table 29.

TABLE 29 — Mean yields of made tea in lb per acre during the first year of the cycle

Treatments	Yield (lb per acre)	(%)
No shade	8223	100
<i>Gliricidia maculata</i>	6971	85
Nitrogen (lb per acre per year)		
0	7352	100
160	7461	102
320	7761	106
480	7815	106
LSD ($P = 0.05$)	517	7

The yields are very high. Application of nitrogen did not increase yields significantly.

J. I. H. Bandaranayake

XLA15 — 4 levels of nitrogen × 4 levels of shade on seedling tea at Panilkande Estate, Deniyaya — (1966)

The results at the end of 68 months of the cycle 1967 to 1969 are presented in Table 30.

TABLE 30 — Mean yields in lb made tea per acre during the first 18 months of the cycle 1967 to 1969

Treatments	Yield (lb per acre)	(%)
No shade	2795	100
<i>Gliricidia maculata</i>	2953	106
<i>Albizzia</i> sp.	2925	105
<i>Albizzia</i> sp. + <i>G. maculata</i>	2920	104
LSD ($P = 0.05$)	251	9
Nitrogen (lb per acre per year)		
80	2692	100
120	3027	112
160	2897	108
200	2976	111
LSD ($P = 0.05$)	256	10

Beyond 120 lb N there was no significant increase in yields.

J. I. H. Bandaranayake

XLA16 — 4 levels of nitrogen × 2 levels of shade on VP tea at Mahendra Estate, Morawaka — (1966)

The mean yields for the first 18 months of the cycle are presented in Table 31.

TABLE 31 — Mean yields in lb made tea per acre during the first 18 months of the cycle

Treatments	Yield (lb per acre)	(%)
No shade	6018	100
<i>Gliricidia maculata</i>	5991	100
LSD ($P = 0.05$)	654	11
Nitrogen (lb per acre per year)		
0	5010	100
160	5800	116
320	6317	126
480	6862	137
LSD ($P = 0.05$)	517	10

There is a significant increase in yield up to 480 lb N.

J. I. H. Bandaranayake

XLA17 — 4 levels of nitrogen \times 2 levels of shade on VP tea at Berubeula Estate, Urubokka — (1966)

The yields during the first year of the experiment February 1967 to February 1968 are recorded in Table 32.

TABLE 32 — Mean yields in lb made tea per acre during the period February 1967 to February 1968.

Treatments Nitrogen (lb per acre per year)	Yield (lb per acre)	(%)
0	4162	100
160	4852	117
320	5022	121
480	5182	125
LSD ($P = 0.05$)	340	8
No-shade	4916	100
Shade	4692	95
LSD ($P = 0.05$)	1039	21

There is no difference in yield between shade and no-shade treatments. There is a marked response to nitrogen up to 160 lb per acre per year. Above this level the response diminishes. This experiment was pruned in May 1968.

J. I. H. Bandaranayake

1968 Experiment

XLA18 — 3 types of nitrogen (urea, calcium ammonium nitrate and sulphate of ammonia) and 3 levels of nitrogen on TRI 2023 at Talgaswela Estate, Talgaswela — 3 randomized blocks — (1968)

In this experiment three types of nitrogen fertilizers are being tested each at 480, 600 and 720 lb N per acre per year. The plucking commenced in May 1968 and the results will be presented at the end of the first year.

H. D. Jayasinghe

XLPH1 — Shade vs no shade on seedling tea at the Low-Country Station, Ratnapura — (1966)

The results are presented in Table 33.

TABLE 33 — Yield of made tea with and without shade

Treatments	Pre-treatment yields (4 months) before removing shade		Yields after removing shade trees on no-shade blocks			
	(lb. per acre)	(%)	Before pruning (2 months)		After pruning (2 years)	
	(lb. per acre)	(%)	(lb per acre)	(%)	(lb per acre)	(%)
Shade	672	100	209	100	1734	100
No shade	730	109	233	11	2009	116

The yields in the no-shade blocks show an increasing trend relative to the yields of the shaded blocks.

N. S. Rajendram

Visits, Lectures & Symposia

Lectures

Dr L. H. Fernando addressed the following, on various aspects of tea cultivation.

- 1 — Students from the Buddhist University
- 2 — Kelani Valley Planters' Association.

Dr L. H. Fernando addressed the Low-Country Products Association of Ceylon on "Efficient use of fertilizers in low-grown tea".

Dr D. T. Wettasinghe addressed the Kelani Valley and Sabaragamuwa Planters' Association on various aspects of tea cultivation.

Symposia

Dr L. H. Fernando and Dr D. T. Wettasinghe participated in the following symposia :

- 1 — Symposium on "Drought" for the Uva Planters' Association at Badulla.
- 2 — Symposium organized by Carson Cumberbatch & Co Ltd. on "Tea" at Colombo.

Publications

- MACNEILL, B. H. & SABANAYAGAM, J. V. (1968). The induction of dodine tolerance in *Fusarium oxysporum* f. *melonis*: a technique applicable to the study of the bionomics of soil-borne fungal pathogens. *Canad. J. Microbiol.* 14, 1262-1263.
- SABANAYAGAM, J. V. (1968). Influence of host and non-host plants on the survival of *Fusarium oxysporum* f. *melonis* in soil. (In the press).
- WAIIDYANATHA, U. P. DE S. (1968). Investigations with paraquat (Gramoxone) as a herbicide for weed control in low-grown tea. *Tea Q.* 39, 11-18.
- WETTASINGHE, D. T. (1968a). The use of diuron for weed control in mature low-grown tea. *Tea Q.* 39, 119-120.
- WETTASINGHE, D. T. (1968b). A preliminary investigation of the effect of two plant factors on simazine toxicity. *Proceedings of the Ninth British Weed Control Conference.* 645-649.

Reference

- MCWHORTER, C. G. & SHEETS, T. J. (1961). The effectiveness of five phenylureas as foliar sprays and the influence of surfactants on their activity. *Prov. SWC* 14, 54-59.

REPORT ON THE MID-COUNTRY STATION

Mid-Country Scientific Officer — D. Calnaido, BSc, PhD

General

The purchase of 56 A—0 R—05 P of land from the Hantane Investment Co. Ltd was completed on the 26th August, and further progress towards the development of the Mid-Country Station was achieved. There were no changes of staff during the year.

Advisory Services

The Mid-Country Scientific Officer and/or the District Advisory Officer attended meetings of the District Planters' Associations when invited. Many planters visited the Station for discussions on agronomic problems. Several groups of school children visited the Station on study tours. One hundred and sixteen visits were made to estates in connexion with advisory and extension work.

Pests and diseases

No serious pest problems were prevalent in the mid-country districts this year. Two instances of light infestations of Looper and Twig Caterpillars were reported from the Hewaheta District. Sporadic infestations of Tortrix, mites, cockchafer grubs, nettle grubs, brown bugs and eelworms were encountered. The problem of Shot-hole Borer in new clearings was fairly serious as many estates had not resorted to spraying their clearings either with the lower concentration of dieldrin or with heptachlor.

The diseases encountered were cases of *Poria hypolateritia*, of which 4 were in the Madulkele district, 1 in the Hunasgiriya district and 1 in the Hewaheta district; and 4 instances of *Ustilina deusta*, 2 from Hewaheta, 1 from Kegalle and 1 from the Gampola district.

New clearings

Many new clearings suffered from severe wilting during the unprecedented drought experienced during the early part of the year, but fortunately most clearings recovered with the onset of the monsoonal rains. In most of these clearings the clone TRI 2024 was the most severely affected clone during the drought.

Nursery

The main faults in nursery management were the selection of unsuitable soil for the nursery bags, irregular watering, frequent over-watering and over-shading. The practice of gradually exposing the full-grown nursery plants to sunlight was sometimes not adopted, because of the desire to economise on coir matting. Other unsatisfactory methods of shading and premature fertilizer applications given even before 70% to 80% of the cuttings had rooted resulted in failures in nurseries. Another common fault was the practice of making holes with sticks in the soil bags to insert the cuttings. This resulted in air pockets at the base of the planted cuttings causing their death.

Fertilizer problems

Many estates resorted to the application of 15 to 20 lb of zinc sulphate and claimed to have benefited by it. Most of the mid-country estates that had cut down the phosphorus and potassium in the fertilizer mixture, as an economy measure in the past, now apply 20 to 30 lb P_2O_5 and 60 to 90 lb of K_2O per acre per annum.

Field Experiments, Trials and Factory Experiments

The following experiments were carried out with the collaboration of the respective Heads of Divisions, except the experiments in Entomology at the Mid-Country Station. Details of these experiments are given in the respective divisional reports.

MW1 — *Gramoxone, hand-weeding and N on seedling tea* — (1966)

There was no significant difference in yield between treatments during the first year of the experiment, which was the last year of the pruning cycle. The plots were pruned in October 1968, and all plots were hand weeded. The following labour, calculated on an acreage basis, utilized for removing ferns and weed the plots, gives an indication of the efficacy of the treatments :

Treatments	No. of labourers per acre required
W 1 (monthly weeding)	25
W 2 (unweeded since Sep. 1967)	96
G 1 (bimonthly application of Gramoxone)	35
G 2 (application of Gramoxone once in four months)	55

There was also no significant difference in the quality of made tea between the treatments. The experiment is to be continued in the next pruning cycle.

MW2—*Herbicides on weeds in seedling tea at Klrmetiya Estate, Galaha*—(1968)

The object of this observation trial was to determine the most useful chemicals for bringing the weed growth under control in a neglected tea field. The trial was located in abandoned tea overgrown with weeds. The plot size was 1/10 acre. The weed cover consisted mainly of *Digitaria marginata*, *Drymaria cordata*, *Bidens sinensis*, *Commelina bengalensis* and *Erigeron sumatrensis*. The woody shrubs were pulled out manually.

Two herbicides, 2, 4-D and paraquat appear to be the most suitable for bringing the weed growth under control while diuron may be useful in maintaining control. Further experiments on the rate, sequence and timing of these herbicides are envisaged.

MW3 — *Amitrole, 2, 4-D dalapon, diuron, pentachlorophenol and simazine on yield of seedling tea* — 3 randomized blocks — (1968)

Plots 1/50 of an acre in extent, were laid out at Field No. 7, Hantane Estate. Seven pre-treatment pluckings were done before the plots were pruned. Pre-treatment plucking will be continued for three months before treatments are given.

MPH1 — *Mulching of the young VP tea at the Mid-Country Station* — (1966)

The plots were re-mulched with the respective rates of paddy husk and Guatemala grass on 14th December 1966 and again on 18th July 1967, because the guatemala thatch had to be replaced subsequent to decay. Nine weedings were done during the two-year period. The plants were cut across at 12 in. on 18th January 1968 and again on 6th November 1968 at 15 in. above ground level.

The following are the total weights of weeds from each of the treated plots and the fresh weights of prunings calculated per acre are given in Table 1.

TABLE 1 — *Total weights of weeds from the mulch-treated and control plots and the fresh weights of prunings calculated per acre*

Type of mulch	Quantity (Tons per acre)	Fresh Wt of weeds (lb per plot)	Fresh Wt of prunings (lb per acre)
Paddy husk	20	47	21046
	10	108	18731
Guatemala grass	20	160	15485
	10	189	14696
Control	—	288	13493
LSD	$P = 0.05$	47	4594
	$P = 0.01$	63	6328
	$P = 0.001$	87	—

M. K. Vythilingam

It will be seen that very efficient weed control is obtained with paddy husk as mulch at both levels (significant at $P < 0.001$). The growth of the plants is superior when mulched with the higher level of either paddy husk or Guatemala grass.

MN2 — Screening of clones for tolerance to the burrowing nematode—*Radopholus similis*—replicated — (1968)

Recently, *Radopholus similis*, the burrowing nematode, has been found to infect tea in the Mid-Country. This experiment aims firstly to build up the population of *Radopholus similis* and subsequently to screen clones tolerant to it. Infested soils from three estates in the Mid-Country were collected, mixed and placed in four tanks, each measuring 15 ft x 5 ft x 1 ft. The susceptible clone TRI 2025 was planted in these tanks on 25th July 1968 in order to build up the nematode population, so as to enable the screening test for the different clones to be carried out.

M. K. Vythilingam

Vegetative Propagation

These experiments were undertaken in collaboration with the Plant Physiology Division and the results are presented in the report of the Plant Physiology Division.

MVP — Clonal testing at the Mid-Country Station — (1961)

This experiment completed its second year of its second pruning cycle in October. Among the high yielding clones the second-year yield was twice that of the first year of the cycle, with clone TRI 2023 giving the highest yield of 4278 lb made tea per acre. The following clones yielded over 2500 lb made tea per acre per year: TRI 2026, 2025, 2151, DG 39, KEN 16/3, MT/BG, DN, MT(BG) 18, GMT 9 and T 5/35 (arranged in order of decreasing yield). The interchange of shade between the shaded and unshaded blocks has to date not resulted in significant yield differences. The shade is not yet fully established in the shaded plots.

MVP — Clonal testing at the Mid-Country Station - (1962)

The first year's plucking of the second pruning cycle of this experiment was completed in July 1968. The yield remained relatively low.

MVP3 — Clonal testing at the Mid-Country Station — (1963)

The first three-year pruning cycle was concluded in October 1968. Three clones, TRI 2021, DG 7 and TRI 2024 yielded over 1500-lb made tea per acre per year, while four clones, W 3, DG 3, W 2/145 and E 7/27 yielded over 1200 lb per acre per year.

Drought resistance of clones — on MVP3 (1963)

Four observations following drought conditions were made on 12 clones of MVP3 (1963) on 30.3.66, 30.5.66, 19.9.67 and 14.2.68. Based on visual observations, marks were given to the clones, for their ability to resist drought. The analysed results are given in Table 2.

TABLE 2 — *The ability of 12 clones (of MVP3 — 1963) to withstand drought conditions*

Clones (arranged in order of merit)	Score
DG 7	7.25
TKG 2	5.50
W 3	5.31
DG	5.19
TRI 2021	4.19
DG 3	3.69
TRI 2046	3.56
E 7/27	3.25
ML 7	3.25
TRI 2024	2.75
W 2/145	1.44
TRI 2045	1.38
LSD at $P = 0.05$	1.84
$P = 0.01$	2.48
$P = 0.001$	3.29

MVP4 — Clonal testing at the Mid-Country Station — (1964)

The second year of its first pruning cycle of 16 clones of this experiment was completed in October. Only six of the 16 clones have yielded over 1000 lb of made tea per acre per year; they are PCG 2, TRI 2024, DW 12, MO/116, H 1/58 and QT 4/4. It is interesting to note that the plants raised from Lands-down seed yielded 1586 lb made tea per acre per year, unshaded, at this early stage of cultivation.

MVP5 — Clonal testing at the Mid-Country Station — (1965)

The first year's plucking of this experiment was completed in October. The yields are relatively poor.

MVP6 — Clonal testing at the Mid-Country Station — (1966)

Plucking of the five clones of this experiment commenced in November.

MVP7 — Clonal testing at the Mid-Country Station — (1967)

The nine clones of this experiment have completed their first year from planting.

Factory experiments

These experiments are fully described in the report of the Technology Division.

MT1 — *Quality assessment of clones* — (1966)

Of the 18 clones tested during the year, MO 209, CW 21 and H 1/58 show great promise. On account of difficulties that arose in having the manufactured experimental samples evaluated by a Tea Taster, these clones would have to be re-tested and evaluated again before a final assessment of quality is possible.

MT4 — *Plucking rounds cum plucked unit* — (1967)

Pre-treatment manufactures were completed. Analysis of taster's reports indicates no significant differences between each of the experimental plots. The treatments were given in May. The experiment is in progress.

MT5 — *Gramoxone (and hand-weeding in combination with 2 levels of nitrogen) on made-tea characteristics* — (1967)

The manufacturing properties of tea in plots subjected to eight weed-control treatments (in MW1) were compared and the differences were not found to be significant. There were also no significant differences in made tea characteristics between the teas from plots receiving 100 lb and 200 lb nitrogen per acre per year. Gramoxone-sprayed teas were reported to be free from taint. The experimental area was pruned in October.

MT6 — *Calcium ammonium nitrate, sulphate of ammonia and urea each at 3 levels and 3 levels of potash on made tea characteristics* — (1967)

Pre-treatment tests were concluded and no significant differences were observed between the experimental plots. The treatment applications were done in June and October and manufacturing tests are in progress.

MT7 — *Age from prune on the characteristics of made tea* — (1967)

Pre-treatment manufacturing tests were concluded. The experimental plots have been divided into three groups of which the first was pruned in October. The second and third groups will be pruned in 1969 and 1970 respectively, so that at the end of the third year (1970), the green leaf from the tea bushes that aged in the three successive years from the prune, could be tested simultaneously. Manufacturing tests will begin after the tea recovers from pruning.

T. A. Munasinghe

*Entomology***ME1** — *Ecology of Shot-hole Borer* — at Hantane, Kandy — (1962)

The population dynamics of Shot-hole Borer were studied. The daily aerial samplings were done by a vertical series of suction traps and terrestrial samplings were done monthly by the 'standard unit', 'entire stems' and the 'branch breakage' methods. The data for the six-year period, covering two pruning cycles, are being analysed for future publication.

Relation between new wood and infestation

There was a high correlation between the percentage of new wood, as measured by the number of units of new wood per 100 standard units and infestation, as measured by the number of all stages of live borers (eggs, larvae,

pupae and adults, males and females) per 100 standard units ($b = + 0.01493 \pm 0.00358$ when $P < 0.05$; $r = + 0.8589$). Both the quantity of new wood and the borer infestation increase sharply from the 9th to 12th month after the prune and reach a peak around the 18th month and then gradually decline. It is interesting to note that there is a gradual build-up of both the new wood and the infestation towards the latter half of the 3rd year or the pruning cycle, i.e. 30 to 36 months after the prune. This information, in the light of the earlier findings (Calnaido & Thirugnanasuntharan 1966), provides evidence that the borer populations in the tea fields are determined mainly by the synchronous growth of new wood that arises as a result of the practice of pruning.

Validity of the 'standard unit' method for borer sampling

The borer population in tea, as measured by the number of live borers per 100 standard units, was compared with the counts of all stages of live borers per 25 entire branches of tea stems and it was found that there was high correlation between the infestations as measured by the two methods of sampling ($b = + 0.9813 \pm 0.2171$ when $P < 0.05$; $r = 0.8850$). This indicates that borer sampling by the 'standard unit' method (Judenko 1968) gives an excellent assessment of the borer population in tea.

Relation between galleries and infestation

The high correlation ($r = + 0.9712$) between the number of galleries and infestation, as measured by counts of all stages of live borers in standard units of tea stems, indicates that a mere count of the occupied galleries in standard units would give a reliable estimate of infestation.

Relation between breakage of branches and the number of galleries in them

There was a high correlation ($r = + 0.6129$, $P < 0.01$) between branch breakage, as estimated by the number of broken branches in tea bushes, caused by the application of light pressure on them, and the total number of galleries (occupied, vacant and healed) in standard units. This direct correlation between gallery formation and branch breakage, would suggest that low yields resulting from borer damage are mainly due to the breakage of branches.

ME2 — Clonal selection for shot-hole borer tolerance (on MVP1 to MVP7) — (1966)

The investigations on 60 clones of MVP1 (32 clones), MVP2 (16 clones) and MVP3 (12 clones) were completed to date. The existing list of clones of MVP1 and MVP2 where the clones are arranged in order of yield and other characteristics, viz quality, drought resistance and shot-hole Borer tolerance, was revised so as to include the clones of MVP3 and has been published (Thirugnanasuntharan & Calnaido 1969).

A comparative study was made on the effect of shade vs none on the clones of experiments MVP1, MVP2 and MVP3 in respect of (a) shot-hole borer infestation, as measured by the number of galleries formed and (b) the ability of the galleries to heal in the different clones as measured by the percentage of healed galleries in prunings (Table 3). When all observations on the 60 clones of the three experiments were considered together, at the end of their first pruning cycle, there were no significant differences between the shaded and unshaded tea in respect of borer infestation. Clones under shade however showed significantly better healing of the galleries in tea stems, made by Shot-hole Borer.

TABLE 3 — *The effect of shade and no shade on*
(a) shot-hole borer infestation and
(b) the ability to healing of galleries
of clones (of MVP1, MVP2 & MVP3)

	Treatment	Experiments (No. of clones in brackets)			Mean of the 3 expts. (60)
		MVP1 (32)	MVP2 (16)	MVP3 (12)	
(a) No. of galleries (/25 branches)	shade	97	84*	91	92
	no shade	78**	110	63***	83
(b) % healed galleries	shade	87***	85	79*	85*
	no shade	81	87	78	82

*** = significant at $P = 0.001$
 ** = significant at $P = 0.01$
 * = significant at $P = 0.05$

ME3 — Fertilizer response to shot-hole borer control at Hantane, Kandy — (1966)

This experiment was concluded in September. The treatments were dieldrin (1.5 lb ai per acre) as a post-pruning spray and aldrin and heptachlor (1.5 lb ai per acre) as mid-cycle sprays together with two levels of fertilizer, viz 80 and 160 lb nitrogen per acre per year. Yield records were taken fortnightly and borer samplings were done once in every three months.

All treated plots were significantly less infested with borer than the untreated plots. There were, however, no significant differences in infestation between the two levels of nitrogen. Analysis on yield showed no significant differences between either the treatments or the two levels of nitrogen. The non-significant results were most likely due to the significant block variations noticed. This experiment shows that heptachlor is as good as dieldrin and aldrin in borer control, when applied as a mid-cycle spray.

ME4 — Fertilizer response to shot-hole borer control, at Bandarapola, Matate — (1966)

This experiment was concluded in June. The treatments were dieldrin (1.5 lb ai per acre) as a post-pruning spray at two levels of fertilizer, viz 80 and 160 lb nitrogen per acre per year. Yield was recorded fortnightly and the borer samplings were done once in every three months.

The treated plots were significantly less infested than the untreated plots. There was no significant difference in borer infestation between the levels of nitrogen application. There was also no significant difference in yield either in the treated plots or the plots with the two levels of nitrogen. Here again results were not significant, possibly because of the significant variations among the blocks.

ME5 — Biological vs insecticidal control for Shot-hole Borer at Hantane, Kandy — (1966)

This experiment was concluded in September. The treatments were dieldrin (1.5 lb ai per acre) as a post-pruning spray, aldrin and heptachlor (1.5 lb ai per acre), Baur's C 8949 (100 g ai per acre) and Carvicron (200 g ai per acre) as mid-cycle applications and the cultural treatment of clean pruning all the decayed branches. The fungicide nickel chloride was an added treatment given monthly from the mid-cycle onwards, to test whether the borer

could be controlled indirectly by spraying for controlling the Ambrosia fungus. All the treatments were given a higher dose of fertilizer, viz 180 lb nitrogen per acre per year. Fortnightly yields and borer samplings once in every three months were recorded. Here again the treatments did not show any significant difference either in borer infestation or in yield, possibly because of the large block variations noticed. The percentage control of the population, as measured by a method of integration indicated that dieldrin and heptachlor gave almost the same degree of borer control.

ME6 — *Control of Shot-hole Borer with mid-cycle applications of Heptachlor vs clonal tolerance of borer attack at Dartry Group, Gampola* — (1967)

The clones in this experiment are TRI 2023, CH 13 and KEN 16/3. Bi-monthly borer samplings are being carried out. The analysis of results up to the 30th month after the prune showed that both the treated and untreated plots of clones TRI 2023 and CH 13, and only the treated plot of KEN 15/3, were significantly less infested than the untreated plot of KEN 16/3. There was no significant difference in infestation between treated and untreated plots of clones TRI 2023 and CH 13. This experiment is in progress.

K. Thirugnanasuntharan

Extension Experiments

XMA1 — *Calcium ammonium nitrate, sulphate of ammonia and urea at 3 levels and 3 levels of potassium on seedling tea at Kellebokka Group, Madulkele* — (1966)

Todate, after one year of plucking, no significant differences in yield were noted between treatments.

XMA2 — *Calcium ammonium nitrate, sulphate of ammonia and urea at 3 levels and 3 levels of potassium on seedling tea at Wattakelle Estate, Madulkele* — (1966)

The yields with three levels of nitrogen over a period of 12 months are given below. The differences resulting from the use of different types of nitrogen and levels of potassium were not significant, but the differences resulting from the use of different levels of nitrogen were significant.

Levels of nitrogen (lb per acre per year)	Yield (lb per acre per year)
90	1774
180	1809
270	2097
LSD ($P = 0.01$)	288

XMA3 — *Calcium ammonium nitrate, sulphate of ammonia, urea each at 3 levels of nitrogen and 3 levels of potassium on seedling tea at Hantane Estate, Kandy* — (1966)

Pre-treatment yields were recorded from 19th November 1967. Treatment application of fertilizer was given on 19th June 1968. Yield records are being maintained. It is too early to analyse the results.

XMPH1 — *4 levels nitrogen and 3 levels shade on seedling tea at Kirimetiya Estate, Galaha* — (1966)

The yield response to nitrogen application was significant at the level of 90 lb N per acre per year.

Nitrogen (lb per acre per year)	Yield (lb per acre per year)
0	1073
90	1348
180	1310
270	1505
LSD ($P = 0.05$)	246

XMPH2 — 4 levels of nitrogen and 3 levels of shade on seedling tea at Kellebokka Group, Madulkele — (1966)

There were no significant differences between levels of shade and also between levels of nitrogen. The shade planted 18 months ago is not yet fully established.

XMPH3 — 4 levels of nitrogen and 3 levels of shade on seedling tea at Mausagalla Estate, Madulkele — (1966)

There were no significant differences between treatments after one year of plucking.

XMPH4 — Shade vs no shade, Mahaousa Estate, Madulkele — (1966)

After 2 1/2 years of plucking there is no significant difference in the yield of the shaded field (27 acres) and the unshaded field (32 acres) of this paired-field trial.

M. K. Vythilingam

Visits, Lectures & Symposia

Dr D. Calnaido read a paper entitled "Pest ecology in relation to pest control strategies" at a symposium on "Crop Protection", at the 24th Annual Sessions of the Ceylon Association for the Advancement of Science. He also participated at a symposium on "Drought in relation to tea" held at the Uva Club on 29th November.

Publication

THIRUGNANASUNTHARAN, K. & CALNAIDO, D. (1968). Further observations on the tolerance and susceptibility of tea clones to shot-hole borer infestation. *Tea Q.* 39, 6-10.

References

CALNAIDO, D. & THIRUGNANASUNTHARAN, K. (1966). Preliminary ecological studies on Shot-hole Borer and their relation to the control of the pest. *Tea Q.* 37, 28-45.

JUDENKO, E. (1958). Trials with a method of assessment of infestation caused by Shot-hole Borer (*Xyleborus fornicatus* Eichh.) on old tea. *Tea Q.* 29, 51-59.

REPORT OF THE UVA STATION

Uva Scientific Officer — L. M. de W. Tillekeratne, BSc, MEd

The Gonakelle Substation

Activities on this station continued to be confined to clonal testing and miniature manufacture. Results obtained during the year are given in the reports of the Plant Physiology and Technology Divisions. Mr T. R. B. Sally was transferred to the Low-Country Station in September.

The Agratenna Substation

The transfer of the selected land area to the Institute is still pending. The Agratenna Substation Committee was appointed by the Board to assist them in the establishment of the Agratenna Substation. The Committee consisted of the Chairman of the Uva Planters' Association, the TRI Board Member in the Uva Province, members of the Experimental and Estates Committee of the TRI representing the Badulla and Bandarawela Districts, the official visitor to the Substation and the Uva Scientific officer as Secretary. The Committee held one meeting and submitted a report on the progress of the Substation.

The Subcommittee went into the question of the area of land required for this project, and on their recommendation it has been decided to purchase approximately 207 acres of land, consisting of 72 acres old tea, six acres jak clearing and 129 acres scrub jungle and patna. Unfortunately it was difficult to obtain the services of a permanent officer to reside and look after the work on this substation and other arrangements for temporary staff had to be made. The junior staff bungalow was completed in March and was occupied by the Accounts Clerk until his transfer to Ratnapura in September.

The clonal testing experiment planted in 1967 was resupplied towards the end of the year. Different clones showed various degrees of resistance to the severe drought, and in some cases the casualty rate was as high as 40%. A further five acres was replanted towards the end of the year, the replanting taking the form of an experiment in conjunction with the Agricultural Chemistry Division. Five clones are under test, with three methods of bringing into bearing, and three levels of shade. The design is of the split plot type, with shade treatments being split on blocks, clones within the blocks, and subplots for bringing into bearing treatments. The experiment consists of nine blocks each containing 15 plots giving a grand total of 135 plots.

Field Experiments & Trials

Experiment UPH1 was concluded and results reported in the Report of the Advisory Division for 1967.

UPH7 — Time of pruning, fertilizer application one month before pruning and resting three months before pruning at Telbedde Group, Badulla — (1967)

This experiment which was started in January 1967 and reported in the Annual Report for that year was concluded this year. The results are being statistically analysed except the effects on dieback caused by fertilizer applications one month before pruning which are given in Table 1.

TABLE 1 — *Average dieback as assessed on 25 bushes per plot in lb*

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Fertilizer applied	3.48	3.79	2.92	3.46	3.71	2.54	3.24	4.62	3.21	3.13	2.48	3.04
Fertilizer not applied	4.24	4.74	6.14	5.15	3.96	3.50	4.87	6.60	3.53	4.12	2.92	3.85

The 't' test showed that the increase in dieback by applying fertilizer one month before pruning, is statistically highly significant.

UVP6 — *Performance of clones in soils of high acidity at Hugoland Estate, Uda Pussellawa — (1965)*

This trial was planted in late 1965. Plucking records and observations are being kept.

UVP7 — *Levels of fertilizer and clones at Mahadowa Group, Madulsima — (1966)*

This trial is being continued. The results have to be statistically analysed.

Extension Experiments

All extension experiments in Uva continued to be managed by the staff attached to the Uva Station. Most of the experiments completed two years of post-treatment pluckings. The results obtained have been statistically analysed.

XUA1 — *3 types of nitrogen at 3 levels at Aislaby Estate, Bandarawela — (1965)*

This experiment was pruned during the year and is being continued in the new cycle. None of the treatments for both types and levels of nitrogen resulted in significant differences in yield.

XUA2 — *NPK each at 3 levels and control in all combinations at Aislaby Estate, Bandarawela — (1965)*

This experiment completed two years of post-treatment pluckings. There was a highly significant linear response to the levels of nitrogen. (see Table 2)

TABLE 2 — *Yield response to nitrogen levels at Aislaby Estate, Bandarawela*

Nitrogen treatments (lb N per acre per year)	Yield per acre (lb made tea)
120	4387
240	4725
360	4872
LSD ($P = 0.05$)	222

XUA3 — *3 types of nitrogen at 3 levels at Hugoland Estate, Uda Pussellawa — (1965)*

This experiment completed two years of post-treatment pluckings. None of the treatments for both types and levels of nitrogen resulted in significant differences in yield.

XUA4 — *NPK at 3 levels and control in all combinations at Hugoland Estate, Uda Pussellawa — (1965)*

This experiment completed two years of post-treatment pluckings. None of the treatments for types or levels of fertilizer resulted in significant differences in yield.

XUA5 — *3 types of nitrogen at 3 levels at Telbedde Estate, Badulla — (1965)*

This experiment completed two years of post-treatment pluckings. None of the treatments for types or levels of nitrogen resulted in significant differences in yield. The experiment was discontinued after pruning.

XUA6 — *3 levels of nitrogen and 3 levels of Limbux at Telbedde Estate, Badulla — (1965)*

This experiment completed two years of post-treatment pluckings. None of the treatments resulted in significant differences in yield. The experiment was discontinued after pruning.

XUA7 — *Guatemala, Mana and Napier as rehabilitation species at Telbedde Estate, Badulla — (1965)*

Experimental plots were planted with tea and observations on the growth of tea are being made.

XUA8 — *3 types of nitrogen at 3 levels at Nayabedde Estate, Bandarawela — (1965)*

This experiment completed two years of post-treatment pluckings. The experiment was discontinued.

XUA9 — *Guatemala, Mana and Napier as rehabilitation species at Nayabedde Estate, Bandarawela — (1965)*

Experimental plots were planted with tea, and observations on the growth of the tea are being made.

XUA10 — *3 levels of nitrogen and 3 levels of Limbux at Canavarella Group, Namumukula — (1965)*

This experiment completed two years of post-treatment pluckings. The results given in Table 3, indicate that there was a significant yield response to nitrogen levels. There was no significant response to levels of Limbux.

TABLE 3 — *Yield response to nitrogen levels at Canavarella Group, Namumukula.*

Treatments (lb N per acre per year)	Yield (lb made tea per acre)
120	5391
240	5795
360	5924
LSD ($P = 0.05$)	249

XUA11 — *3 types N at 3 levels at Canavarella Group, Namumukula — (1965)*

This experiment completed two years of post-treatment plucking. The tea was pruned and the experiment is being continued in the new cycle. There was no significant yield response to types and levels of nitrogen.

XUA12 — *NPK at 3 levels and control in all combinations at Spring Valley Group, Namunukula* — (1965)

The experiment completed 20 months of post-treatment pluckings. The tea was pruned and the experiment is being continued in the new cycle. The results are given in Table 4, and indicate a significant response to levels of nitrogen. There was no response to the other treatments.

TABLE 4 — *Yield response to nitrogen levels at Spring Valley Group, Namunukula*

Treatments (lb N per acre per year)	Yield (lb made tea per acre)
120	2838
240	3060
360	3492
LSD ($P = 0.05$)	276

XUA13 — *3 types nitrogen at 3 levels at Spring Valley Group, Namunukula* — (1965)

The experiment completed two years of post-treatment pluckings. The results given in Table 5, indicate the response to levels of nitrogen which was significant. There was no significant response to the different types of nitrogen.

TABLE 5 — *Yield response to nitrogen levels at Spring Valley Group, Namunukula*

Treatments (lb N per acre per year)	Yield (lb made tea per acre)
120	6018
240	6300
360	6348
LSD ($P = 0.05$)	162

XUA14 — *NPK at 3 levels and control in all combinations at Kahagalla Estate, Haputale* — (1966)

The experiment completed 20 months of post-treatment pluckings. There were no significant yield responses to potassium and phosphorus at any level. There was a significant response to nitrogen levels (Table 6).

TABLE 6 — *Yield response to nitrogen levels at Kahagalla Estate, Haputale*

Treatments (lb N per acre per year)	Yield (lb made tea per acre)
120	3803
240	3778
360	4174
LSD ($P = 0.05$)	192

XUA15 — *3 types of nitrogen at 3 levels at Kahagalla Estate, Haputale* — (1966)

The experiment completed 20 months of post-treatment pluckings. The results, given in Table 7, show the significant response to levels of nitrogen. Response to the types of nitrogen was not significant.

TABLE 7 — *Yield response to nitrogen levels at Kahagalla Estate, Haputale*

Treatments (lb. N per acre per year)	Yield (lb made tea per acre)
120	3882
240	4128
360	4164
LSD ($P = 0.05$)	216

XUA16 — 3 levels of N and 3 levels of Limbux at Hugoland Estate, Uda Pussellawa — (1965)

The experiment completed 2 years of post-treatment pluckings. The results given in Table 8 indicate that there was a significant response to the levels of nitrogen. There was no significant response to levels of Limbux.

TABLE 8 — *Yield response to nitrogen levels at Hugoland Estate, Uda Pussellawa*

Treatments (lb. N per acre per year)	Yield (lb made tea per acre)
120	5046
240	5130
360	5304
LSD ($P = 0.05$)	195

Acknowledgements

Our sincere thanks are due to the Manager, Ury Group and his staff for their kind co-operation, especially in obtaining permits for the replanting subsidy scheme. Our sincere thanks are also due to Mr M. Clarke for his valuable help and guidance, readily given whenever required. A special word of thanks is due to the Managers of Gonekelle, and Ury Group and their staff for their help and guidance in running the Uva Station.

REPORT OF THE ADVISORY DIVISION

Acting Chief Advisory Officer — L. M. de W. Tillekeratne, BSc, MEd

General

Advisory activities of the mid-country and low-country districts are included in the reports on the Mid-Country and Low-Country Stations respectively, and are, therefore, not repeated in this report.

The following staff changes took place during the year. Mr J. V. Sabanayagam returned from overseas training in July 1968 after obtaining a Master's Degree from Guelph University in Canada. Mr Sabanayagam operated from St Coombs on his return until he was transferred to the Low-Country Station in late December. Mr R. K. Nathaniel proceeded in August for a course of studies leading to a Master's Degree at Guelph University in Canada.

Advisory Work

Types of inquiries received from estates and other sources predominating during the year dealt with the introduction of urea as a source of nitrogen, and the reduction of phosphates and potash in fertilizer programmes. With the withdrawal of the recommendation on the use of dieldrin for the control of Shot-hole Borer in 1967, the side effects of tortrix, twig and looper caterpillar damage continued to show a sharp decline in 1968. Nettle grub attack in Uva especially in the Badulla valley showed a sharp increase even during the wet weather. There were a number of inquiries from estates regarding replanting without rehabilitation and numerous visits had to be made in this connexion for purposes of soil sampling and general observations so as to submit reports for estates to qualify for the subsidy. Work in this connexion will increase rapidly in future.

In general, the climatic conditions during the year were not conducive to high crop production. The Up Country and to some extent Uva suffered badly from the severe drought conditions during the early part of the year. This was followed by a very wet and prolonged SW monsoon in the Up Country, and one of the worst droughts experienced in Uva, which extended well into September. The drought in Uva appears to be the worst for over forty years which is as far as most climatic records go. The rainfall recorded on almost all estates in Uva shows that only half the decennial average fell within the first six months of the year, the Welimada area registering about 11.6 inches of rain up to the end of June. The low rainfall following the early drought did not allow for sufficient storage of water in the soil to see the bushes through the July to September drought, with the result that the old seedling tea, especially fields late in the pruning cycle, as well as clearings planted from 1958 to about 1965 suffered severely. The younger clearings did not suffer so badly. Blister Blight was a problem in the Up Country because of the severe and prolonged SW monsoon, and recovery of fields pruned early in the monsoon suffered a setback due to blister attacks.

Extension Experiments

The extension experiments in the Up Country on the types and levels of fertilizer continued to be managed by the Agricultural Chemistry Division. Extension experiments on shade \times levels of nitrogen were managed by the Advisory Division in conjunction with the Plant Physiology Division. With the departure of Mr Nathaniel these experiments were handed over to the Plant Physiology Division. The details of these experiments are given in the Reports of the Agricultural Chemistry and Plant Physiology Divisions.

Extension Activities

Exhibitions

The Institute participated in the Schools' Agricultural Exhibition in the Ratnapura District from 28th to 30th January, and also at an Agricultural Exhibition in Horana from 3rd to 5th October.

Symposium

A largely attended Symposium on 'Drought' was organized in conjunction with the Uva Planters' Association on the 29th November. The proceedings took the form of questioning and answering panels. Four senior planters from each of the three sub-districts in Uva comprised the questioning panels, while Heads of Research Divisions and other members of the Senior Staff of the Institute were included in the answering panels. Questions were asked and answered on all aspects of tea cultivation and manufacture with special reference to drought conditions.

Public relations

A number of foreign visitors were shown round the Institute, and a number of batches of school children were instructed on tea cultivation. Three officers from the Ceylon Tea Propaganda Board spent a few days at the Institute before they left Ceylon on their foreign assignments.

Acknowledgements

Our sincere thanks are due to the Chairman, sub-district Chairmen of the Uva Planters' Association and all members of the panels for their kind co-operation in making the symposium on "Drought" a success.

Our thanks are also due to the President, Secretary and Members of the Committee of the Uva Club for permitting the use of the Club premises to hold the symposium; to all Managers, Superintendents and Assistants of estates that have come into the extension experiment scheme for their ready co-operation during the year, and to all Heads of Divisions for their co-operation in 1968.

REPORT ON ST COOMBS ESTATE

Agriculturist — L. A. Seevaratnam, BSc

General

Mr M. R. K. Gabriel, Junior Assistant Clerk/Storekeeper left the service of the Institute on 1st March. He was not replaced during the year. Mr G. Navaratnam was transferred to St Joachim in May. The construction and maintenance of all buildings and roads as well as the maintenance of the grounds and water supply at St Coombs was placed under the charge of the Agriculturist in October. The Institute's Central VP Nursery, handed over to the Agriculturist in July, now supplies plants for both St Coombs estate planting as well as for experiments.

Acreage as at 31st December 1968

	A	R	P
Seedling tea	162	3	15
VP tea	80	2	23
Young VP tea	12	0	20
Land under rehabilitation	22	2	09
Area reserved for clonal cuttings	7	0	17
Other land (fuel clearings, buildings, roads, gardens etc)	138	0	19
	<u>423</u>	<u>1</u>	<u>23</u>

Crop

St Coombs produced an all-time record crop of 397,894 lb made tea, which exceeded the estimated crop of 364,800 lb by no less than 33,094 lb. It was the highest crop ever recorded in the history of St Coombs.

There were several reasons for the record yield. The most significant of these were :

- 1 — A high standard of work was maintained throughout the year, and plucking rounds kept generally at five to seven days. A reasonable balance was maintained between the need for a high standard of plucking, and the need to produce a good overall yield. This policy has paid good dividends in terms of profitability.
- 2 — During 1968, 48 acres of tea completed four years from the last prune, but it was decided that this tea could be plucked economically for another year. The tea was, therefore, not pruned and contributed about 25,000 lb of made tea to the year's crop since 1st July.
- 3 — The area of VP tea which came into bearing during the year, as compared with similar figures for previous years are given in Table 1, and indicates the impact of this factor on the yield of St Coombs.

TABLE 1 — *Relation between the area of VP tea coming into bearing and the total crop on St Coombs from 1964 to 1968*

Year	Total crop	Acreage of VP tea coming into bearing		
1968	397,894	13A	2R	01P
1967	356,036		Nil	
1966	360,111	13A	3R	11P
1965	336,239		Nil	

The yield per acre per month for St Coombs Estate from 1964 to 1968, the total rainfall, the number of wet days and the average quantity of nitrogen applied for each year are given in Table 2.

TABLE 2 — *Yield per acre per month for St Coombs from 1964 to 1968; total rainfall, the number of wet days and the average quantity of N applied for each year*

Month	1968	1967	1966	1965	1964
January	141	116	155	136	152
February	75	109	117	88	112
March	82	106	151	97	114
April	177	140	149	183	145
May	178	187	161	177	147
June	173	134	132	129	168
July	100	105	138	108	77
August	136	120	147	87	112
September	169	118	123	106	95
October	181	120	122	125	115
November	220	152	141	137	76
December	181	146	127	137	117
TOTAL	<u>1813</u>	<u>1553</u>	<u>1663</u>	<u>1510</u>	<u>1430</u>
Total rainfall (in.)	90.59	83.96	70.94	93.21	79.76
No. of wet days	192	202	188	204	198
Average N per acre per annum (lb)	222	248	248	184	162

Fertilizer application

The fertilizer policy was modified from that adopted in 1967. Except in experimental areas, phosphate, potash, dolomite and borate were not applied. The dose of nitrogen was also reduced by various quantities ranging from 50 to 100 lb for different fields. Prilled urea was used as a source of nitrogen on a field scale in certain fields.

Table 3 gives the yield per month for each field together with the type of nitrogen and the quantity of fertilizer applied.

The financial aspects of the working of St Coombs for 1968, as compared with previous years are given in Table 4.

TABLE 3 — Monthly yields of fields from January to December 1968

Field No.	Type of nitrogen fertilizer*	Total N (lb) per annum	Monthly yields (lb per acre)												Total per acre
			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	Urea	200	175	93	57	243	181	168	123	156	159	198	288	190	2031
2	S/A	200	165	53	34	156	112	86	62	124	96	137	219	107	1351
3	—	—	212	58	—	—	—	—	—	—	—	—	—	—	270
4	Urea	250	79	71	87	130	130	108	77	109	121	153	117	173	1355
5	—	—	67	25	32	110	208	35	—	—	—	—	—	—	477
6	Urea	250	114	59	47	208	91	160	97	127	222	226	264	248	1863
7	S/A	250	262	111	108	286	323	223	198	184	239	222	342	259	2757
8	S/A	250	241	99	76	401	221	339	130	236	295	354	331	315	3038
9	CAN	200	83	55	53	140	140	118	87	96	132	145	168	132	1349
10	S/A	200	55	84	105	183	149	208	98	150	169	255	251	178	1885
10 (clonal)	CAN	250	194	97	109	250	375	213	146	188	219	253	269	250	2563
11	S/A	250	158	72	120	225	147	214	84	173	181	183	194	153	1904
12	Urea	200	186	72	76	214	211	180	107	120	186	159	244	178	1933
13	Urea	200	169	92	81	229	237	144	91	112	172	141	179	152	1799
14	CAN	200	127	87	103	197	126	230	66	126	161	137	236	171	1767
15	Urea	200	153	109	87	264	255	250	97	199	238	238	243	178	2311
16	CAN	250	195	104	95	341	156	209	111	178	206	210	223	216	2244
17	S/A	250	227	152	132	338	310	245	137	161	181	260	303	189	2635

* CAN = Calcium ammonium nitrate
 S/A = Sulphate of ammonia
 Urea = Prilled urea

TABLE 4—*Working of St Coombs Estate for the year 1968 in comparison to previous years*

Year	Total crop (lb made tea)	Yield (lb made tea per acre)	Nett sale price (cents per lb)	Cost of production (cents per lb)		Gross profit (Rs)	TRI contribution (Rs)	Actual profit (Rs)
				Estimated	Actual			
1968	475,502*†	1813	229*	185	165*	282,115*	Nil	282,115*
1967	457,727	1553	203	181	183	90,402	Nil	90,402
1966	431,697	1663	218	161	170	189,302	Nil	189,302
1965	419,338	1510	224	153	148	287,862	63,763	224,009
1964	306,717	1430	243	153	157	252,074	61,065	191,009

* Subject to verification by the Auditors

† Includes 77,608 lb crop, secured on bought leaf

Cultural Operations

All fields were under fungicidal protection against Blister Blight during both monsoons.

Field No. 1

Seedling tea area	— 1A-3R-35P
VP tea area	— 18A-0R-5P
Clones planted	— TRI 777, 2016, 2022, 2023, 2024, 2025, 2026
Land under rehabilitation	— 2A-0R-0P
Last pruned	— 1964 and 1967 (8A)
Yield per acre 1967	— 1917 lb
Yield per acre 1968	— 2031 lb
Type of N	— Prilled urea
Quantity of N 1968	— 200 lb
Shade	— <i>Erythrina lithosperma</i> , <i>Grevillea roubsta</i>
Experiments	— PH1 (0.5A), N7 (0.25A), N15 (0.25A), N21 (0.25A)

Eight acres in this field completed their fourth year from the last prune, and were continued to be plucked further. All species of *Acacia* on this field were removed during the year after they had been ring barked and were quite dead. In a few isolated poor areas, the VP tea succumbed to the severe drought experienced this year. Various soil conservation measures were intensified in these areas before they were replanted again with VP tea during the year. These measures included the construction of terraces in steep areas, and the removal of stones in rocky areas.

The *Grevillea robusta* shade was thinned out by ring-barking every other tree during 1967. Felling was, however, not done as these trees were not quite dead.

Field No. 2

Seedling tea	— Nil
VP tea area	— 7A-1R-23P
Clones planted	— TRI 740, 777, 2023, 2024, 2025, 2026, 2039, 2142, DT 1, DT 95 & E 7/27
Planting year	— 1964
Last pruned	— Not pruned so far
Yield per acre 1967	— 1239 lb
Yield per acre 1968	— 1351 lb
Type of N	— Sulphate of ammonia (T200)
Shade	— Nil
Experiments	— PH3 (1.78A), PH12 (0.5A), VP12 (0.2A),

This field also completed its fourth year from pruning this year, but was continued to be plucked further.

Field No. 3

Seedling tea area	— 4A-2R-0P (Experimental)
Shade	— Nil
VP tea area	
1965 planting	— 10A-0R-15P
Clone	— DT 1
Yield per acre 1967	— 1021 lb
Yield per acre 1968	— 270 lb
1966 planting	— 4A-2R-12P
Clones	— TRI 740, 2024, 2025, 2142, 62/3, 62/5, E 7/27, CY 9 and KEN 16/3
Yield per acre 1968	— 1011 lb
1967 planting	—
Clones	— TRI 2023, 2025 and TC 9
1968 planting	— 4A-2R-12P
Clones	— TRI 26, 2023, 2025, 2027, 2043, 2142, 62/9, DT 1, TC 9, NL 3/1 and KEN 16/3
1968 planting	— Without rehabilitation but after fumigation with methyl bromide
Area	— 2A-0R-20P
Clones	— DT 1, TC 9 & TRI 2027
Land under rehabilitation	
Experiments	— A1

An area of 4A—2R—12P where the old tea had been uprooted in 1966 and which had been rehabilitated with Guatemala grass since then, was replanted with VP tea during the south-west monsoon.

An area of 7A—0R—22P of old low-jat seedling tea was uprooted for replanting during the year. The uprooting was done using two power-operated winches, a five-ton Hessford and a ten-ton Hercules. The area was trenched after the uprooting to a depth of about two feet and most of the remaining roots were removed. Of the area uprooted an area consisting of approximately 3A—0R—20P was fumigated with methyl bromide at the rate of $\frac{1}{2}$ lb per 100 sq. ft and replanted without rehabilitation with grass. The balance area of 5A—0R—02P was planted with Guatemala grass. Planting of the fumigated area was done as far as possible on the contour, in blocks of 50 plants per block. The plants were spaced $1\frac{1}{2}$ ft apart in the rows and the rows were four ft apart.

As an experiment, an area of about one acre was planted with potatoes in October. This area will be planted with VP tea without rehabilitation, and without fumigation during the south-west monsoon of 1969. The tea planted during 1967 was bent twice and was later cut across. It is now being gradually plucked.

Field No. 4

Seedling tea area	— 30A—2R—0P
VP tea area	— In ravines only
Last pruned	— 1967
Yield per acre 1967	— 817 lb
Yield per acre 1968	— 1355 lb
Type of N	— Prilled urea
Quantity of N	— 250 lb in 5 applications
Shade	— Nil
Experiments	— PH25 (0.8A) and P20

Towards the latter part of 1967 parts of this field were sprayed with dieldrin by the Entomology Division to induce an attack of Tortrix for experimental work. Following this, the whole of this field suffered from a severe attack of Tortrix early in the year. The attack was controlled in areas outside the experimental plots by spraying DDT at 4 pints per acre. A severe loss of crop over a period of two months resulted from the attack.

Field No. 5

Seedling tea area	— 1A—0R—38P
VP tea area	— 2A—2R—10P
Planted	— 1968
Clones	— TRI 2043, NL 3/1, KEN 16/3 and K 145
Shade	— <i>Erythrina lithosperma</i>

Old seedling tea (16A—2R—7P in extent) was uprooted during the course of the year for replanting. Uprooting was done using winches. Certain areas of this field which were steep and not accessible to tractors were uprooted manually. The uprooted areas were trenched and most of the roots were removed. An area of 1A—0R—38P of seedling tea which was also due for uprooting was retained for experimental work by the Nematology Division. The entire uprooted area has been planted up with Guatemala and Mana grass and is due to be replanted over the next two years.

A new road was cut through the field to facilitate access to experiments and to make supervision more thorough. An area of 2A—2R—10P which was uprooted during 1967 was planted this year. The planting done during the year was for experiments.

Field No. 6

Seedling tea area	— 9A-0R-0P
VP tea area	— 0A-1R-35P
Last pruned	— 1966
Yield per acre 1967	— 1557 lb
Yield per acre 1968	— 1863 lb
Type of N	— Prilled urea
Quantity of N	— 250 lb
Shade	— <i>Grevillea robusta</i>
Experiments	

An abandoned ravine comprising of 0A-1R-35P was cleared, drained and planted during the course of the year. Most experiments were concluded on this field in 1968. *Grevillea robusta* trees which had been ring-barked earlier and which were quite dead were felled this year.

Field No. 7

Seedling tea area	— Nil
VP tea area —	
1962 planting	
Clones	— TRI 740, 777, 2023, 2024, 2025, 2026, 2043, 2142, 2151, DT 95, and TK 45.
Last pruned	— 1966
Yield per acre 1967	— 2417 lb
Yield per acre 1968	— 2757 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 250 lb in 5 applications
Shade	— Nil
1964 planting	
Clones	— TRI 740, 777, 2016, 1023, 2024, 2025, 2026, 2039, 2142, DT 1, DT 95 and E 7/27
Last pruned	— Not pruned so far
Shade	— Nil
Experiments	— VP2 (1.5A), P18 (1A), A8 (2.4A)

6A-0R-18P acres in No. 7 Field completed four years from the time of planting during this year. This was, however, not pruned.

Field No. 8

Seedling tea area	— Nil
VP tea area	— 8A-3R-2P
Clones	— TRI 777, 1114, 2024, DT 1 and DT 95
Yield per acre 1967	— 2585 lb
Yield per acre 1968	— 3038 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 250 lb in 5 applications
Shade	— Nil
Experiments	— A8 (2.4A), A9 (1A), W1 (0.8A), W2 (0.5A), W6 (0.5A), VP1 (1.75A), VP2 (1.5A), VP11 (0.05A) and VP19 (1.75A)

Field No. 9

Seedling tea area	— 26A (Estate plucking 15½A)
VP tea area	— Nil
Last pruned	— 1967
Yield per acre 1967	— 954 lb
Yield per acre 1968	— 1349 lb
Type of N	— Calcium ammonium nitrate
Quantity of N 1968	— 200 lb in 4 applications
Shade	— <i>Grevillea robusta</i> , <i>Erythrina lithosperma</i>
Experiments	— A2 (2.4A), and A4 (0.4A), PH26 (0.01A), VP10 (0.17A), VP14 (0.05A), W7 (0.01A), P14 (1A), P19 (7A), P31 (0.1A), P32 (7A), P56 (0.3A), P11 (0.01A), and P57 (0.2A)

Field No. 10

Seedling tea area	— 12A-2R-0P (Estate Plucking)
Last pruned	— 1967
Yield per acre 1967	— 1212 lb
Yield per acre 1968	— 1885 lb
Type of N 1968	— Sulphate of ammonia
Quantity of N 1968	— 200 lb
Shade	— <i>Grevillea robusta</i> and <i>Erythrina lithosperma</i>
VP tea area	— 5A-2R-2P
Clones	— TRI 23, 740, 777, 2016, 2021, 2023, 2024, 2025, 2026, 2027, KEN 16/3, NL 3/1, TC 9 and 2043
Pruning	— Clonal areas constantly pruned for taking cuttings
Yield per acre 1967	— 2565 lb
Yield per acre 1968	— 2563 lb
Type of N	— Calcium ammonium nitrate
Quantity of N 1968	— 250 lb
Shade	— Nil

An area of 0A—3R—02P in which the old tea had been uprooted earlier was fumigated with methyl bromide and completely planted during the north-east monsoon of this year. Fumigation of this area was done using varying doses of methyl bromide ranging from $\frac{1}{2}$ lb to 2 lb per 100 sq. ft in order to determine quantity of fumigant required for the control of Couch grass. Testing of two different types of polythene was also done during the fumigation of this area. Planting was done as far as possible on the contour in blocks for experiments.

Field No. 11

Seedling tea area	— 17A-0R-0P
VP tea area	— Nil
Last pruned	— 1966
Yield per acre 1967	— 1255 lb
Yield per acre 1968	— 1904 lb
Type of N 1968	— Sulphate of ammonia
Quantity of N 1968	— 250 lb
Shade	— Nil
Experiments	— A16 (1.7A), PH22 (0.17A), VP15

This field suffered from a tea tortrix attack early in the year, as a result of dieldrin spraying by the Entomology Division. This resulted in some loss of crop. A further quarter acre of this field was uprooted by the Agricultural Chemistry Division for an experiment on rehabilitation.

Field No. 12

Seedling tea area	— 29A-3R-0P (Estate plucking)
VP tea area	— Nil
Last pruned	— 1965
Yield per acre 1967	— 1986 lb
Yield per acre 1968	— 1933 lb
Type of N	— Prilled urea
Quantity of N 1968	— 200 lb
Shade	— Nil
Experiments	— PH13 (1.78A), PH21 (0.04A), P20 (0.05A), P20

Windbreaks around experimental plots continued to be maintained during this year.

Field No. 13

Seedling tea area	— 18A-1R-0P (Estate plucking 15A)
VP tea area	— Nil
Last pruned	— 1964
Yield per acre 1967	— 2140 lb
Yield per acre 1968	— 1799 lb
Type of N	— Prilled urea
Quantity of N	— 200 lb
Shade	— Nil
Experiments	— A5 (0.7A), A7 (0.7A), A12 (1.7A), A16 (1.7A), PH5 (1.44A), P20 & P26 (1A)

This field completed four years from its last prune in September this year. No pruning was done and the field continued to be plucked into its fifth year.

Field No. 14

Seedling tea area	— 12A-2R-0P
VP tea area	— In cleared ravines only
Last pruned	— 1966
Yield per acre 1967	— 1218 lb
Yield per acre 1968	— 1767 lb
Type of N	— Calcium ammonium nitrate
Quantity of N 1968	— 200 lb
Shade	— Nil
Experiments	— VP15, P20

Nickel chloride was used on this field for blister blight control in an experiment on disease forecasting conducted by the Plant Pathology Division.

Field No. 15

Seedling tea area	— 2A-1R-0P
VP tea area	— Nil
Last pruned	— 1966
Yield per acre 1967	— 2050 lb
Yield per acre 1968	— 2311 lb
Type of N	— Prilled urea
Quantity of N 1968	— 200 lb
Shade	— <i>Grevillea robusta</i>
Experiments	— Nil

All the *Grevillea robusta* trees on this field have been ring-barked, and trees which were quite dead were felled during the course of the year.

Field No. 16

Seedling tea area	— Nil
VP tea area	— 4A
Clones	— TRI 2024
Last pruned	— 1965
Yield per acre 1967	— 2817 lb
Yield per acre 1968	— 2244 lb
Type of N	— Calcium ammonium nitrate
Quantity of N 1968	— 250 lb
Shade	— Nil
Experiments	— P29 (0.6A), P30 (0.6A) & P58 (0.2A)

No phosphate or potash was applied on this field for the third year since pruning ; no serious setback was noticed so far. Manufacturing experiments were conducted utilizing leaf obtained from experimental plots in this area, resulting in some loss of crop from this field. The area of 200 clones planted on this field was bent, cut across and lightly plucked in during the course of this year. This area which had been fumigated with methyl bromide, at the dose of 2 lb per 100 sq. ft for control of Couch grass showed no regrowth of Couch grass during the year.

Field No. 17

Seedling tea area	— Nil
VP tea area	— 4A-3R-0P
Clones	— TRI 777, 2024 & 2025
Last pruned	— 1965
Yield per acre 1967	— 2828 lb
Yield per acre 1968	— 2635 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 250 lb
Shade	— Nil
Experiments	— Nil

Acknowledgements

At the end of 1967, Mr C. W. C. Mossop of Waltrim Group, Lindula ceased to overlook St Coombs. His services to St Coombs and the Institute are recorded with appreciation.

Publication

DE SILVA, R. L. & SEEVARATNAM, L. A. (1968). The importance of soil air for tea root growth. *Tea Q.* **39**, 42—49

REPORT ON ST JOACHIM ESTATE

Superintendent — G. S. Muttettuwegama

General

Mr G. Navaratnam was transferred from St Coombs to St Joachim in June as Assistant Factory Officer in place of Mr R. Navaratne who was the Assistant Factory Officer at St Joachim up to end of March. Mr V. Petchimuthu the Factory KP took over the estate stores from the Head Factory Officer, Mr M. S. W. Wijeratne. All other staff appointments remained unchanged.

The rainfall recorded for the year was low and February was stricken with a very severe drought lasting for three continuous weeks. A minor flood was experienced in June. Work on raising the Hidellana-St Joachim PWD road above flood level continued at a very slow pace.

Acreage as at 31st December 1968

	A	R	P
Seedling tea in bearing	219	0	14
VP tea in bearing	41	1	00
VP tea not in bearing	50	0	24
Land under rehabilitation	5	0	00
Nurseries	1	3	11
Other land (Paddy, buildings, roads, line-gardens, ravines and waste land, encroachments etc)	98	3	17
	<u>416</u>	<u>0</u>	<u>26</u>

Crop

An excess of 4,665 lb of made tea was recorded against the estimate of 272,000 lb for the year. The yield per acre for the year was 1,102 lb.

The very fine standard of plucking (about 65 to 75% of two leaves and a bud) which was achieved in the previous year by maintaining the plucking rounds strictly every five days and by discarding all coarse leaf and even soft banji, was discontinued in September 1968. This type of fine plucking did not pay the dividends that were expected. Thereafter, the plucking rounds were maintained at five and six days, and soft banji was not discarded. A leaf standard of 45 to 50% two leaves and a bud was maintained. This changeover, immediately increased the intake per plucker. The cost of plucking was thereby reduced.

The yield per acre per month for St Joachim from 1964 to 1968, the total rainfall, number of wet days and the average quantity of nitrogen applied for each year are given in Table 1. Table 2 gives the yield per acre per month for each field, together with the type and quantity of fertilizer applied.

TABLE 1 — Yield per acre per month for St Joachim from 1964 to 1968, total rainfall, number of wet days and average quantity of N applied each year

Month	1968	1967	1966	1965	1964
January ...	119	77	92	94	117
February ...	48	96	103	57	70
March ...	107	66	104	121	115
April ...	83	82	126	88	109
May ...	84	92	108	100	113
June ...	80	70	44	101	114
July ...	81	72	16	91	94
August ...	86	82	3	102	85
September ...	97	77	97	101	87
October ...	109	107	70	116	91
November ...	110	125	83	110	89
December ...	98	119	90	110	83
	1,102	1,065	936	1,191	1,167
Total rainfall (in.)	146.52	147.06	132.78	166.15	185.28
No of wet days	229	236	222	223	208
Average N per acre per annum (lb)	148.68	144.20	133.75	143.80	140.16

The high cost of production for the two years was the result of fine plucking which has already been mentioned earlier in this report. The cost of production in the subsequent months after the fine plucking was dispensed with, came down considerably as given below :

Month	COP (cents)
September	166.38
October	151.91
November	147.73
December (final COP)	180.03

The cost of production up to end of August was 188.75 cents.

Profits

It would have been possible to make a good profit on St Joachim had fine plucking been discontinued at the beginning of the year and if only orthodox teas meant for the Middle East market were manufactured. During the first half of the year, mainly CTC teas were manufactured and Orthodox teas were manufactured only in the latter half. The comparative prices obtained for CTC teas and Orthodox teas are given below.

	lb made tea sold	Average nett price per lb (cents)
Orthodox	195,437	175
CTC	74,095	168

TABLE 2 — Monthly yield of fields from January to December 1968

Field No.	*Type of nitrogen Fertilizer	Total N (lb) per acre	Monthly yields (lb per acre)												Total per acre
			Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1	S/A	110	96	41	86	34	4	1	24	58	92	87	105	105	733
2	S/A	110	121	37	98	77	41	—	26	61	76	95	93	104	829
3	S/A	110	90	44	102	69	90	99	96	87	88	94	85	59	1,003
3A	T200 & 900+ mixture	T200 @ $\frac{1}{4}$ oz per plant per application in 3 applications 900 mixture 40 lb N per acre per application in 3 applications	80	21	93	99	78	120	128	158	109	177	167	158	1,388
4	S/A	147	144	65	138	110	146	158	174	131	140	159	150	128	1,643
5	S/A	147	106	46	101	83	97	105	124	106	94	115	96	84	1,157
6	S/A	147	105	37	110	97	104	42	—	29	77	85	88	95	869
7	CAN & S/A	166	157	72	93	114	97	115	113	112	121	101	130	92	1,317
8	—	—	Old tea uprooted for replanting												
9	T200	@ $\frac{1}{4}$ oz per plant	—	—	—	—	98	181	128	123	81	139	121	78	949
10A	900 mixture	200	117	29	188	60	120	125	27	17	24	96	107	116	1,026
10B	900 mixture	200	157	40	161	88	168	182	152	138	122	193	180	156	1,737

* S/A — Sulphate of ammonia

CAN — Calcium ammonium nitrate

+	900 mixture is composed of		
	Sulphate of ammonia	20.6%	700 Parts
	Saphosphosphate	27.5%	100
	Muriate of potash	60.00%	100
			<u>100</u>

The financial aspects of the working of St Joachim for 1968 as compared with previous years are given in Table 3.

TABLE 3 — *Working of St Joachim Estate for the year 1968 in comparison with previous years*

Year	Total crop (lb made tea)	Yield (lb made tea per acre)	Nett sale price (cents per lb)	Cost of production (cents per lb)		Gross profit (Rs)	TRI contribution (Rs)	Actual profit (Rs)
				Estimated	Actual			
1968	276,665*	1102	173*	193	180*	— 26,152*	Nil	— 26,152*
1967	272,907	1065	161	148	180	— 60,869	Nil	— 60,869
1966	251,457	936	145	160	175	—118,651	Nil	—118,651
1965	331,974	1191	168	152	41	+ 77,381	7,911	+ 69,470
1964	—	1167	—	—	—	— 47,955	Nil	— 47,955

* Subject to verification by the Auditors

Cultural Operations

It was possible to complete all cultivation work according to the programme laid out.

Field No. 1

Seedling tea area (infilled with VP tea)	— 40A
Last pruned	— April 1968
Yield per acre 1967	— 1,205 lb
Yield per acre 1968	— 733 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 110 lb per acre in 3 applications
Shade	— No shade, except in 6 acres retained for experimental work
Weeding	— Gramoxone spraying in 30A done in January and March—Diuron spraying in 30A done in May, August, October & December—Contract (hand weeding) 10A done monthly From November, 6A were done by the research section
Experiments	— LA3 (2.50A); LW22 (0.6A); LW23 (0.06A); LW25 (0.07A); LPH5 (0.5A)

Zinc sulphate was applied as a foliar spray in September and December at 5 lb per acre per round. Recovery after pruning was not good. This field had not recovered fully from the effects of the drought in February by the time the pruning commenced.

Field No. 2

Seedling tea area (infilled with VP tea)	— 28A-1R-0P
Last pruned	— May, 1968
Yield per acre — 1967	— 1,238 lb
Yield per acre — 1968	— 829 lb
Type of N	— Sulphate of ammonia
Quantity N — 1968	— 110 lb per acre in 3 applications
Shade	— Nil
Weeding	— Gramoxone spraying in 26½A in February and April—Diuron spraying in 26½A done in June, August, October and December—Contract (Hand weeding) 2A done monthly
Experiments	— LW12 (1.2A); LW13 (0.8A); LW17 (0.004A).

Zinc sulphate was applied as a foliar spray in March, September and December at 5 lb per acre per round. Recovery after pruning was good.

Field No. 3

Seedling tea area (infilled with VP tea)	— 20A-1R-0P
Last pruned	— May, 1967
Yield per acre — 1967	— 698 lb
Yield per acre — 1968	— 1,003 lb
Type of N	— Sulphate of ammonia
Quantity of N — 1968	— 110 lb per acre in 3 applications
Shade	— Nil
Weeding	— Gramoxone spraying in 20½A in January and March—Diuron spraying in 20½A done in May, August, October and December
Experiments	— LA7 (0.5A); LA8 (0.13A); LA9 (0.87A) LA18 (0.14A); LA34 (0.73A); LW16 (0.25A); LW18 (0.2A); LVP7 (0.75A)

Zinc sulphate was applied as a foliar spray in October and December. The uprooting of old tea in an area 13A 2R 23P of this field was commenced with in October/November for replanting in 1969.

New clearings

Both clearings were on old tea land

Field No. 3A

Seedling tea area	— Nil
VP tea area	— 9A-1R-0P
Planted	— 1966

This clearing made very satisfactory progress and was gradually brought into bearing from January, the yield per acre being 1,388 lb. Fertilizer applied was T200 mixture in the first half of the year at the rate of $\frac{3}{4}$ oz per plant per application in three applications and 900 mixture in the second half at 250 lb of the mixture per acre per application in three applications.

Field No. 3B — Planted in 1967

Seedling tea area	— 1A-2R-32P
VP tea area	— 18A-3R-08P
Planted	— 1967

This clearing has made very satisfactory progress and 15 $\frac{1}{2}$ acres were brought into bearing in November, the yield for November and December being 81 lb per acre. The fertilizer applied was T200 mixture at $\frac{3}{4}$ oz per plant given in six applications.

Filed No. 4

Seedling tea area (infilled with VP tea)	— 28A-1R-0P
Last pruned	— June, 1967
Yield per acre 1967	— 940 lb
Yield per acre 1968	— 1643 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 147 lb per acre in four applications
Shade	— Nil
Weeding	— Gramoxone spraying done in 28 $\frac{1}{2}$ A in February and April — Diuron spraying done in 28 $\frac{1}{2}$ A in June, August, October and December
Experiments	— LA17 (0.68A); LW5 (0.92A); LPH4 (0.6A)

Zinc sulphate was applied as a foliar spray in March, June, September and December at the rate of 5 lb per acre per round.

Field No. 5

Seedling tea area (infilled with VP tea)	— 35A-1R-0P
Last pruned	— April, 1967
Yield per acre 1967	— 666 lb
Yield per acre 1968	— 1,157 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 147 lb per acre in 4 applications
Shade	— Nil
Weeding	— Gramoxone spraying done in 29 $\frac{1}{2}$ A in January and March—Diuron spraying done in May, July, September & November—Contract (Hand weeding) 6A done monthly
Experiment	— LA5 (1A)

Zinc sulphate was applied as a foliar spray in March, June, September and December at the rate of 5 lb per acre per round.

Field No. 6

Seedling tea area (infilled with VP tea)	— 29A-3R-0P
Last pruned	— June, 1968
Yield per acre — 1967	— 1,391 lb
Yield per acre — 1968	— 869 lb
Type of N	— Sulphate of ammonia
Quantity of N 1968	— 147 lb per acre in 4 applications
Shade	— Nil
Weeding	— Gramoxone spraying done in 20½A in February and April—Diuron spraying done in 20½A in June, August, November—Contract (hand weeding) done monthly
Experiments	— Nil

Zinc sulphate was applied as a foliar spray in March, September and December at 5 lb per acre per round. Recovery after pruning was good.

Field No. 7

Seedling tea area (infilled with VP tea)	— 42A-1R-0P
Last pruned	— September, 1966
Yield per acre — 1967	— 1,497 lb
Yield per acre — 1968	— 1,317 lb
Type of N	— Calcium ammonium nitrate and sulphate of ammonia
Quantity of N — 1968	— 166 lb per acre in 4 applications
Shade	— <i>vide</i> remarks given below
Weeding	— The weeding of the entire field was done by the research section
Experiments	— XLPH1 (42½A); LW24 (0.5A)

Zinc sulphate was applied as a foliar spray in March, June, September and December at the rate of 5 lb per acre per round. This field has been divided into six blocks. In three of these blocks the shade trees (*Gliricidia maculata*) have been retained and in the other three blocks they have been up-rooted. This field received three applications of CAN at 200 lb per acre per application and one application of sulphate of ammonia at 200 lb per acre. The application of sulphate of ammonia had to be given because of the non-availability of calcium ammonium nitrate in the market.

Field No. 8

<i>Replanted in 1968</i>	
Seedling tea area	— Nil
VP tea area	— 42A-0R-0P

This clearing has made satisfactory progress and has been planted out with the following clones. Fertilizer applied was T200 mixture at the rate of ½ oz per plant per application, given in three applications.

Clone	No. of plants
TRI 2023	98,556
TRI 2025	81,144
TRI 2026	52,146
CW 21	972
	<u>232,818</u>

*Experiments — LA36 (0.5A) and LW20 (0.2A)***Field No. 9**

Seedling tea area	— Nil
VP tea area	— 3A-2R-32P
Date of planting	— 1966

The tea in this clearing was planted in old rubber land and was gradually brought into bearing from June. Fertilizer applied was T200 mixture at $\frac{2}{4}$ oz per plant bimonthly, the yield per acre being 949 lb.

Field No. 10A

Seedling tea area	— Nil
VP tea area	— 10A
Planted	— 1964
Last pruned	— June, 1968
Yield per acre — 1967	— 925 lb
Yield per acre — 1968	— 1,026 lb
Type of N	— Sulphate of ammonia
Quantity of N — 1968	— 200 lb per acre in 5 applications
Shade	— Nil
Weeding	— Hand weeding done monthly
Experiments	— LA14 (0.47A); LA11 (0.7A); LVP6 (0.8A)

Zinc sulphate was applied as foliar spray in March, September and December at 5 lb per acre per round. The fertilizer applied was 900 mixture.

Field No. 10B

Seedling tea area	— Nil
VP tea area	— 6A-2R-0P
Planted	— 1965
Last pruned	— March 1967 at 14"
Yield per acre 1967	— 656 lb
Yield per acre 1968	— 1,737 lb
Type of N	— Sulphate of ammonia
Quantity of N — 1968	— 200 lb per acre in 5 applications
Shade	— Nil
Weeding	— Hand weeding done monthly

Zinc sulphate was applied as a foliar spray in March, June, September and December at 5 lb per acre per round. The fertilizer applied was 900 mixture.

Pests & Diseases

There were no major outbreaks of any pest or disease. Even the very mild attacks of Blister Blight which occur normally along boundaries with over-hanging trees during November and December were not noticed.

Factory

CTC manufacture which started on a commercial scale at the end of 1967 was discontinued with in June after poor prices were realised for this type of tea. No new machinery was installed in the factory during the year.

METEOROLOGICAL OBSERVATIONS—1968

THE TEA RESEARCH INSTITUTE OF CEYLON, ST COOMBS, TALAWAKELE

MONTH	TEMPERATURES(°F)					RELATIVE HUMIDITY		SUNSHINE		RAINFALL		RAINY DAYS		
	Maximum Dry	Maximum Wet	Minimum Dry	Minimum Wet	Minimum Grass	From maximum Temperature	From minimum Temperature	Mean hours per day	Diff. from Ave (25 yrs)	Inches	Diff. from Ave (25 yrs)	Days	Diff. from Ave (25 yrs)	
January	76.0	72.5	44.0	43.5	40.5	64	96	8.18	+1.55	2.12	-0.99	8	-2.08	
February	80.0	75.5	42.5	37.0	36.5	40	58	9.00	+1.84	1.93	-0.56	2	-5.32	
March	79.5	78.0	44.5	42.5	39.5	53	85	5.77	-1.85	4.25	-0.49	10	-1.60	
April	80.5	76.0	49.5	47.5	43.0	34	83	6.27	-0.45	6.07	-0.74	16	-0.96	
May	78.5	76.0	47.5	46.5	44.5	59	93	8.00	+2.65	8.94	-0.59	11	-7.90	
June	77.5	69.0	57.5	56.0	54.5	63	91	2.83	-0.68	12.71	+0.09	26	+1.84	
July	73.5	66.5	57.5	56.5	52.0	69	100	2.70	-0.72	18.16	+7.48	27	+1.86	
August	74.0	67.0	57.0	57.0	54.0	66	94	3.52	-0.05	13.20	+4.06	24	-0.36	
September	75.0	68.5	52.5	52.5	49.5	58	100	2.28	-2.15	13.99	+5.29	25	+0.64	
October	86.0	71.5	51.5	51.5	47.5	35	74	4.47	-0.39	11.07	+1.12	25	+3.40	
November	79.0	70.0	51.5	51.5	46.5	53	97	6.30	+0.83	4.72	-3.19	18	-1.48	
December	78.5	68.5	41.5	41.5	37.0	52	64	6.10	+0.86	3.90	-1.90	14	-1.80	
	78.2	71.6	50.2	48.6	45.4	—	—	5.45	+0.12	101.06	+9.58	206	-13.76	
	MEANS							TOTALS						

METEOROLOGICAL OBSERVATIONS—1968
THE TRI LOW-COUNTRY STATION, ST JOACHIM, RATNAPURA

MONTH	TEMPERATURE °F					RELATIVE HUMIDITY		SUN-SHINE	RADIATION	RAINFALL	RAINY DAYS
	Maximum Dry	Maximum Wet	Minimum Dry	Minimum Wet	Minimum Grass	From Maximum temperature	From Minimum temperature	Mean hours per day	Mean per day °F	Inches	
January	89.8	78.2	68.4	67.0	66.7	57.6	93.0	7.20	154.7	4.60	12
February	93.7	78.0	67.1	65.7	61.0	47.6	92.7	9.00	154.3	4.06	7
March	92.4	80.2	71.6	70.4	69.0	57.3	94.2	5.50	155.6	8.89	19
April	91.9	81.3	71.7	70.6	69.6	61.8	94.4	6.10	155.9	9.87	18
May	91.8	78.6	72.5	70.9	68.7	61.6	92.1	7.12	154.9	15.00	18
June	87.1	79.6	72.4	71.1	69.7	71.6	94.1	3.41	147.4	31.23	26
July	85.6	78.3	72.1	70.6	70.0	71.3	93.1	3.60	144.2	17.19	26
August	87.4	78.8	72.5	71.0	71.4	66.9	93.3	5.93	150.3	8.59	26
September	85.9	78.9	72.1	70.5	70.8	72.7	92.5	3.64	150.0	17.70	26
October	88.7	79.6	72.3	70.6	70.9	65.9	92.6	4.96	153.6	14.12	25
November	88.8	79.2	72.0	70.1	70.5	64.5	91.1	4.92	152.7	10.13	17
December	88.9	78.9	71.1	69.2	68.3	62.9	90.3	5.00	154.4	8.23	13
	89.3	79.1	71.3	69.8	68.9	63.5	92.8	5.53	152.3	149.61	233
MEANS										TOTAL	

METEOROLOGICAL OBSERVATIONS—1968

THE TRI MID-COUNTRY STATION, KANDY

MONTH	TEMPERATURE °F		SUNSHINE		RAINFALL		RAINY DAYS	
	Maximum Dry	Minimum Dry	Mean hours per day	Difference from average (5 yr)	Inches	Difference from average (20 yr)	Days	Difference from average (20 yr)
January	74.4	65.5	7.1	+0.6	2.7	-2.0	6	-5
February	76.8	65.0	9.5	+2.3	1.1	-2.8	2	-6
March	76.7	69.8	5.9	-1.3	6.7	+2.0	11	+2
April	79.5	68.4	6.8	-0.4	1.8	+3.1	8	-8
May	80.1	68.7	7.8	-0.7	2.6	-4.8	6	-9
June	70.5	68.9	5.3	-1.1	10.0	+2.4	20	0
July	70.3	67.5	3.9	-2.2	14.3	+6.9	20	0
August	70.7	66.9	6.5	+0.6	5.0	-0.4	18	-1
September	70.3	67.3	4.6	-1.4	8.2	+1.9	23	+6
October	70.3	68.1	5.4	-0.5	9.5	-3.5	20	0
November	68.7	66.4	6.5	+0.9	13.1	+1.7	13	-6
December	69.4	67.1	5.7	+0.7	9.5	+1.6	15	-1
	73.1	67.5	6.2	-0.1	94.5	+6.1	162	-28
	MEANS				TOTALS			

METEOROLOGICAL OBSERVATIONS—1968

THE TRI UVA STATION, DEBEDDE

MONTH	TEMPERATURE °F				SUNSHINE		RAINFALL		RAINY DAYS	
	Maximum Dry	Maximum Wet	Minimum Dry	Minimum Wet	Mean hr. per day	Difference from Ave. (25 yrs)	Inches	Difference from Ave. (25 yrs)	Days	Difference from Ave. (25 yrs)
January	75.4	71.5	61.6	58.9	3.1	-0.9	3.4	-5.8	12	-5
February	76.2	71.9	61.3	57.2	6.1	+1.5	0.4	-5.9	2	-9
March	76.0	71.0	64.0	61.0	3.1	-2.8	6.8	-0.3	15	+3
April	75.8	71.4	62.3	59.0	4.0	+1.9	6.6	-4.2	17	-2
May	78.0	73.0	68.7	63.2	6.0	+2.6	3.5	-2.5	8	-6
June	79.7	72.8	67.3	63.0	4.0	-3.6	3.3	+0.9	11	+4
July	77.2	71.0	65.2	62.1	3.0	-5.7	0.5	-3.6	7	-4
August	81.1	73.6	64.4	60.7	7.0	+4.8	0.9	-5.1	9	-3
September	79.3	70.6	64.6	60.8	3.0	-1.5	7.1	+1.8	15	+4
October	78.0	71.3	65.0	61.8	3.1	+0.6	13.7	+2.7	18	-1
November	74.4	69.4	63.4	60.2	3.1	+2.1	7.4	-4.6	18	-4
December	73.4	69.3	62.8	69.3	4.0	+3.0	8.5	-6.9	16	-5
							62.5	-30.3	148	+34

**FIELD EXPERIMENTS TRIALS AND FACTORY
EXPEREMENTS CONDUCTED BY THE
TEA RESEACH INSTITUTE OF CEYLON IN 1968**

All field and factory experiments carried out by the TRI in 1968, at St Coombs, St Joachim the TRI Stations at Debedde, Kandy and Kottawa, and on other estates are listed below. The following letters indicate the nature of the experiment :

- A** — Agricultural Chemistry and Agronomy
- VP** — Plant Propagation
- PH** — Plant Physiology
- P** — Plant Pathology
- N** — Nematology
- E** — Entomology
- B** — Biochemistry
- T** — Technology
- S** — Statistics
- W** — Experiments on weeds and herbicides
- X** — Extension experiments

Experiments on St Coombs and other estates in Dickoya, Dimbula, Nuwara Eliya and elsewhere will have no additional letters, if they are supervised by officers of the TRI at St Coombs. The centre from which each experiment is supervised is indicated by a preceding letter as follows :

- L** — Low Country (The Low-Country Station, St Joachim, Ratnapura, the Kottawa Substation and estates in the low country)
- M** — Mid-Country (The Mid-Country Station, Kandy, and mid-country estates in the Central Province)
- U** — Uva (The Uva Station, Debedde, and estates in the Uva Province)

An extension experiment in Plant Physiology at the Uva Station for example, will have the letters **XUPH**, or an Agronomy experiment at St Joachim will carry letters **LA**. For further details of the experiments, refer Part 2 of the Annual Reports of the TRI for 1965, 1966, and 1967.

REFERENCE TO EXPERIMENT NUMBERS IN PART II OF ANNUAL REPORTS

SERIES	EXPERIMENT NUMBER	YEAR	SERIES	EXPERIMENT NUMBER	YEAR	
A	1 — 10	1965	N	1 — 11	1965	
	11 — 13	1966		12 — 16	1966	
	14 — 16	1967		17 — 24	1967	
	17 — 22	1968		25 — 32	1968	
LA	1 — 17	1965	LN	1	1965	
	18 — 32	1966		2	1966	
	33 — 34	1967	MN	1	1966	
	35 — 36	1968		2	1968	
MA	1	1966	UN	1	1966	
UA	1	1965		E	1	1965
AYT	1 — 13	1965		25 — 40	1966	
	14 — 20	1966		41 — 56	1967	
	21 — 23	1967		57 — 71	1968	
LAYT	1 — 2	1965	ME	1	1965	
W	1	1965		2 — 5	1966	
	2 — 10	1966		6	1967	
LW	11 — 14	1968	B	1	1965	
	1 — 5	1965		T	1 — 17	1965
	6 — 8	1966			18 — 25	1966
	9 — 18	1967			26 — 32	1967
MW	19 — 31	1968		33 — 36	1968	
	1	1966	LT	1 — 3	1966	
	2 — 3	1968		4 — 8	1967	
	VP	1 — 16		1965	9 — 11	1968
LVP	17	1966	MT	1 — 3	1966	
	18 — 21	1967		4 — 7	1967	
	22 — 24	1968	UT	1 — 3	1966	
	1 — 7	1965		4	1967	
MVP	8 — 10	1966	<i>Extension Experiments</i>			
	1 — 5	1965	XA	1 — 5	1965	
	6	1966		6 — 8	1966	
UVP	7	1967	XLA	1 — 17	1966	
	1 — 7	1965		18	1968	
PH	1 — 19	1965	XMA	1 — 3	1966	
	20 — 28	1967	XUA	1 — 13	1965	
LPH	1	1965		14 — 15	1966	
	2 — 3	1966	XPH	1 — 4	1965	
	4	1967		5 — 12	1966	
	5	1968	XLPH	1	1965	
MPH	1	1965		XMPH	1 — 3	1966
UPH	1 — 6	1965	XP	1 — 7	1965	
	P	1 — 24		1965	XUP	1 — 2
LP	25 — 54	1966	XE	1 — 8	1967	
	55 — 69	1967		XLE	1 — 7	1965
	70 — 82	1968				
	UP	1 — 6	1965			
UP	1 — 8	1965				
	9	1966				

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