

**The Tea Research Institute of Sri Lanka  
Annual Report 2006**

**TEA RESEARCH INSTITUTE  
OF  
SRI LANKA**

**ANNUAL REPORT  
FOR THE YEAR  
2006**



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## **THE MISSION OF THE TEA RESEARCH INSTITUTE**

To raise the productivity of the tea holdings in both in the estate and smallholder sector through the advocacy of

1. Appropriate technologies for improving tea productivity and quality
2. Forward-looking human and resource management practices that will facilitate all-round development of the tea industry including the quality of life of all Sri Lankan people

In striving to achieve its mission, the goals of the Institute shall be;

1. To accelerate development of location-specific planting material with desirable attributes for the provision of estate and smallholder nurseries
2. To rationalise and optimise fertilizer and dolomite use in tea lands
3. To manage pests and diseases using rational , integrated methods
4. To minimize economic losses during the rehabilitation of tea soils
5. To optimize land use through intercropping and crop diversification
6. To improve the quality of made tea and develop value-added tea products.
7. To automate and computerize tea manufacture and reduce energy and other costs
8. To establish factory hygiene through adherence to 'food factory concept' and attain ISO standards
9. To increase worker productivity and reduce drudgery by mechanization
10. To foster wellness and dignity in workers and increase their productivity through Ergonomics
11. To disseminate appropriate technologies after necessary economic and impact assessments
12. To train the trainers of tea estate personnel and smallholders
13. To contribute to on-and off-site conservation of the environment in tea-growing areas

## **REPORT OF THE CHAIRMAN TEA RESEARCH BOARD**

The undersigned assumed duties as Chairman, Tea Research Board, on May 22, 2006. During the year under review, the Director, TRI, retired from the service in early August, and a new Director/CEO assumed duties from November 23, 2006.

The positions of Deputy Director (Administration), Senior Accountant, Publication Officer, Librarian, Resident Engineer and Technical Assistants remained vacant during 2006, affecting overall performance of the Institute

During 2006, the tea industry faced many economic challenges due to increase in cost of fertilizers, worker wages and cost of energy. The Tea Research Board effectively monitored these challenges, and appropriate scientific recommendations were made to the stakeholders to mitigate the effects of increased fertilizer cost and energy cost.

Tea exports to Japan faced a serious challenge in mid-2006, due to a temporary withdrawal of major Japanese tea buyers, arising from the detection of certain pesticide residues in made tea.

The Institute's scientists were very effective in negotiating and convincing the Japanese authorities of the knowledge, the research skills and the industry strength, to resolve the issue, and our ability to produce the world's safest and cleanest tea. The Tea Research Institute designed new experiments and generated new research information, required to safeguard tea exports to Japan.

The Ministry of Plantation Industries drafted a policy for the plantation sector, with the assistance of the Institute's scientists. The Institute's scientists were involved with the National Council for Economic Development (Tea Cluster) of the General Treasury, in the development of proposals to enhance the present income from tea of Rs 80 billion to Rs 150 billion by the year 2010.

As in the past, the Institute's research programmes are conducted in a multi-disciplinary mode, and research projects were formulated initially to accommodate activities within the expected budget of Rs 225 million (30% of the cess), and were later revised according to the revised budget of Rs 195 million (26% of the cess). Despite the restricted cess funds, the Institute carried out all vital research

activities that had been planned, although maintenance and capital investment programmes were seriously affected. However, in June, Government introduced an additional cess of Rs 1.50 kg<sup>-1</sup>. This additional cess brought an extra Rs 30 million to the Institute, of which Rs 27 million was used for the purchase of capital items.

In order to bring about changes to meet the emerging challenges by revising the research agenda, the strategies for technology transfer and the management of the Institute's two estates, the Consultative Committees on Research, and on Estates and Advisory Services, were re-constituted to include experts in the fields of energy management, farm-machinery designs, extension, communication and technology transfer.

The Tea Research Board of Management, through the Consultative Committees established for the purpose of monitoring and reviewing the progress of research, the two estates, and the Advisory and Extension Division, brought about many changes. St Coombs Estate at Talawakelle continued to show improved profits during 2006, and recorded the highest-ever annual yield of 2702 kg/ha and the highest profit of Rs 9.5 million during the year 2006, in spite of a go-slow and strike by workers during November and December. The management of the St Joachim Estate was changed during 2006, and new targets were given for improvement.

With the appointment of the new Director, the Board strongly felt the need of an organizational review, and a Peer Review of the Institute was proposed. As the Institute's Corporate Plan, prepared in 1999, was reaching its maturity in 2007 after two four-year terms, reviewing of the Corporate Plan's achievements was the main focus of the peer review. Furthermore, the Tea Research Institute has not been reviewed since 1993. The Board of Management of the Tea Research Institute appointed a high-powered Peer Review Committee, comprising highly-qualified senior scientists from national research organizations, universities, and stakeholder representatives from the regional plantation companies and the tea small holder sector.

The Tea Research Institute prepared an action plan to implement the recommendations of the Peer Review Committee, including the preparation of a new Corporate Plan from 2007.

The Tea Research Board emphasized the importance of effective technology-transfer programmes through an efficient advisory service to the corporate sector, and an effective linkage mechanism with the Tea Small Holder Authority to train the trainers to effectively transfer knowledge to the extension workers who serve the tea small holder. In this respect, the main TRI Station at Talawakelle, the Low-Country Station at Ratnapura, and the Advisory Centres at Deniyaya, Kottawa, Passara and Hantane, effectively carried out special programmes to transfer technology through “Crop Clinics”, a concept which was very effective in enhancing grower-participation. Requests for training programmes continued to come from the tea small holder sector, and the Institute’s Centres at Ratnapura, Kottawa and Deniyaya, at great inconvenience, carried out these training programmes in the field and in the Regional Advisory and Extension Centres, since these programmes were very effective in transferring knowledge.

The Mother Bush Project, which is designed to multiply new cultivars at various locations, comes under the purview of the TRI and the TSHDA. Issuing of cuttings from the mother bushes managed by the TRI and registered nurseries were monitored regularly by the TRI Co-ordinator of the Mother Bush Project. A total of 7.5 million cuttings of improved tea cultivars of the TRI 3000 and 4000 series were issued from TRI and TSHDA mother-bush sites during 2006.

The Tea Research Board of Management encouraged TRI scientists to establish linkages with local and foreign institutions, by promoting collaborative research in many fields. As a result, during the year under review, Tea Research Institute scientists carried out many collaborative programmes with foreign institutions in the UK and the USA, and with local Universities and Institutes, and these collaborative research programmes have led to many useful findings in the fields of biological control and nematology, in the identification of molecular markers for studying pest- and disease-resistance in tea, in establishing the potential therapeutic value of the tea extract, and in making designs of new machines useful to the tea industry.

The Tea Research Board continued to acknowledge and recognize the outstanding contributions of TRI scientists, by commending the achievements of scientists. Two TRI scientists received national awards.

Details of research achievements, and awards and patents received, are given in the TRI Director’s Report.

The Board emphasized the importance of efficient and transparent administrative and financial management, for maintaining good governance and efficient utilization of state resources. The Audit and Management Committee recommendations effectively guided the Board in making decisions on financial and administrative matters. The Board also closely monitored the progress of legal cases, to the benefit of the Institute, while paying continuous attention to the internal and general audit reports, facilitating the overall administration of the Tea Research Institute by the Director/CEO.



**Dr S S B D G Jayawardena**  
**Chairman**  
**Tea Research Board**

# **REVIEW OF THE DIRECTOR TEA RESEARCH INSTITUTE**

## **1. Tea Sector Policy**

The Ministry of Plantation Industries appointed a committee in 2006 to formulate a National Plantation Policy. The TRI was represented on this committee, and necessary technical inputs were provided to identify policy requirements. Investment needs for the ten-year period from 2007 were calculated for the tea sector, in order to implement the identified policies. Expected policy gains were also computed in order to justify proper implementation of the policies. The tea sector component of the plantation policy has been drafted and forwarded to the Ministry of Plantation Industries.

## **2. Peer Review and Corporate Plan**

The last review of the TRI was done in the year 1993, and therefore a review of TRI activities is long overdue. To re-focus and streamline TRI activities, the Tea Research Board appointed a review committee comprising eminent personnel from universities, national policy institutes and stakeholder organizations. This step was very timely as the TRI Corporate Plan is due for revision in 2007, and the recommendations and suggestions by the review committee would be extremely useful when formulating a Corporate Plan for 2008-2012.

## **3. Cess Allocation**

The tea cess was increased from Rs 2.50/kg to Rs 4.00/kg in April 2006. Accordingly, Rs 249.84 million was allocated for the TRI. With the balance due from the year 2005, the total receivable amount for 2006 was Rs 300.08 million. The estimated budget of the TRI for 2006 was Rs 306.9 million. However the total money received was Rs 221.68 million. This situation forced the Institute to restrict capital investment, and a significant amount of its maintenance and repair work.

## **4. Research Highlights**

### **4.1 Tea crop improvement**

Potential cultivars of the TRI 5000 series were released for commercial evaluation, in partnership with end-users. The genetic contribution of the ancestral lines used to develop improved cultivars in Sri Lanka was estimated, using the coefficient of parentage/co-ancestry method for the first time in tea, and also for the first time in tree crops. The outcome of the analysis facilitates

identification of tea cultivars for large-scale planting, without affecting the genetic diversity in the tea plantations. In addition, this will provide a clear picture of the genetic potential to be tapped in future breeding programmes, for broadening the genetic base of the tea crop, which is a critical issue at present.

An *in-vitro* protocol for synthetic seed-production was developed for cold storage of isolated zygotic embryos. This method would facilitate the preservation of valuable seed material, until such time as they are needed for use in the evaluation programme.

Inter-specific hybrids, generated via crosses between *C. sinensis* and *C. sasanqua*, were recovered for the first time, using an *in-vitro* technique. This would enhance the scope for tea-crop improvement while broadening the genetic base.

An Express Sequence Tag (EST) library was constructed to identify the genes responsible for flavanoid pathways, and also to develop EST-SSRs to identify a molecular marker for blister-blight resistance.

#### **4.2 Identification of factors for yield decline in low-grown VP tea**

Ill-drained conditions resulting in a high clay content, together with poor soil management, have restricted root growth and aggravated bush debilitation. Soil-borne pathogens, especially plant-parasitic nematodes (*Pratylenchus loosi*), have also contributed to bush debilitation and yield decline.

#### **4.3 Economic evaluation of the revision of the fertilizer subsidy scheme**

The urea subsidy was revised in April 2006, and as a result the cost of fertilizer application per hectare of tea, in the corporate sector, increased within the range 60 – 93%, whereas in the smallholder sector the increase was within the range 42 -72%. The effect of the subsidy removal was studied, and it was found that the cost of production per kg of made tea had increased by Rs 4.70 - 6.21 in the corporate sector, and that in the smallholder sector the cost of green-leaf production had increased by Rs 0.52 – 1.07 per kg.

The report prepared by the TRI was sent to the policy makers, and also to the end-users to enable them to take appropriate measures to minimize negative impacts.

A computer programme to estimate fertilizer requirements on a site-specific basis was developed.

#### **4.4 A population - dynamics model for Shot-hole Borer (SHB)**

A model was developed with the view to capture population dynamics of Shot-hole Borer. Designed to be driven by climate (mainly temperature), the simulated population dynamics closely matches with the observed dynamics of the beetle in relation to the pruning cycle. This model generates population phenologies (events that occur with time) for different climates in tea-growing areas, and it is a rough approximation of the observed population abundance. This model is being used to improve decision making in relation to various control options.

A local strain of the entomopathogenic fungus, *Beauveria bassiana*, was isolated, and it was found to be very effective in controlling shot-hole borer.

#### **4.5 A test-rig for withering fans**

A collaborative project with the Energy Conservation Fund was initiated to fabricate a testing facility for withering fans, according to the standard, ISO 5801. This will help to establish performance curves, and thereby help in saving electrical and thermal energy during withering.

#### **4.6 Energy plantation crops for tea drying**

Trials conducted using *Gliricidia* and *Calliandra* revealed that specific fuel wood consumption is in the range of 0.53-0.66 kg firewood per kg of made tea. The moisture content of the firewood should be about 25%. The cost of drying could be reduced to Rs 1.72 – 2.11 / kg of made tea using these trees, which are easily available in the plantations, as firewood.

#### **4.7 Tea and health**

Ischemic cerebrovascular disease, or stroke, is one of the leading causes of death and long-term disability. Studies have shown that the generation of reactive oxygen species (ROS) plays an important role in the pathogenesis of cerebral ischemia. A collaborative project was initiated, with the University of Sri Jayawardenapura (USJP) and the National University of Singapore (NUS), to study the effect of black tea and green tea on stroke using an *in vitro* brain-cell model.

The effect of tea on cell viability was evaluated under hypoxic conditions (restricted oxygen supply as in stroke), using an *in vitro* cell line. It was found that tea could significantly reduce cell death under hypoxic conditions, indicating that tea could have beneficial effects. The influence of tea on other important chemical parameters, under hypoxic conditions, will also be studied.

## **5. Pesticide residues and MRLs**

In February 2006, Japanese tea importers conveyed their concerns on the compliance of Sri Lankan tea with new Japanese food sanitation laws to be introduced in May 2006. Their concerns were mainly in regard to weedicides, 2,4-D and glyphosate.

An action plan was prepared and implemented to overcome the challenges in the Japanese market and other destinations for Sri Lankan tea.

Field-trials were carried out for 2,4-D and glyphosate. The results showed that both 2,4-D and glyphosate could be used without exceeding the MRLs, provided TRI recommendations were followed.

A technical delegation was sent to Japan to hold discussions with officials of the Japanese Health Ministry on the issue. Meetings were held with members of the Japanese Tea Association (JTA), and leading tea importers, to inform them on the measures taken by Sri Lanka to comply with proposed Japanese MRLs. An application was submitted for increasing the MRL for 2,4-D.

Awareness programmes were conducted for stakeholders on proper methods of pest control and on the usage of pesticides. This was done through dissemination of information by means of TRI publications, posters, leaflets and seminars.

The TRI was very closely involved in the work of the IGG Sub Committee on Pesticide Residues, and the ETC International Working Group on Pesticides, for resolving issues with tea-importing countries.

Three surveys, in the Akuressa, Kegalle and Ratnapura areas, were conducted to collect preliminary information on the use of pesticides in tea smallholdings.

## **6. The ADB Mother Bush Project**

The Mother Bush Project was designed to supply new cultivars of the TRI 3000 and 4000 series. It continued to issue cuttings to stakeholders during 2006. The total number of cuttings issued during 2006 was approximately 8 million. Non-achievement of the estimated target of 15 million cuttings was mainly due to the lack of demand for cuttings, as the weather conditions prevailing during the issuing season (August-December) was not favourable for planting.

## **7. Stakeholder interactions**

Interactions with the stakeholders were effected mainly through Extension and Experiment Forums (3), Crop Clinics (3), Regional Scientific Committees (6), and Regional Technical and Extension Forum workshops (7). The main theme for most of the interactive forums, during 2006, was the safe use of pesticides and new international quality standards to address the issue of MRLs.

## **8. Performance of the TRI Estates**

### **St Coombs Estate**

The yield of 2702 kg/ha in 2006 is the highest recorded in St Coombs Estate. This surpasses the previous highest, 2527 kg/ha, recorded in 2005. St Coombs Estate made a profit of Rs 9,207,114.02 during 2006.

Labour wages increased with effect from 01<sup>st</sup> November, 2006.

### **St Joachim Estate**

The nett sale average to the end of December, 2006 was Rs 175.90. St Joachim Estate made a profit of Rs.120,690.18 as at 31 December 2006, compared to a trading loss of Rs 680,437.42 in 2005.

## **9. Patents and Awards**

The process for the preparation of tea wines was patented

Dr MA Wijeratne received the Science and Technology Award 2006 from the National Science Foundation, and the General Research Committee Award 2006 from the SLAAS, for his outstanding contribution to scientific research in Sri Lanka

Dr PAN Punyasiri was awarded the Kandiah Memorial Award, by the Institute of Chemistry, for the best piece of research in the Chemical Sciences carried out in a Sri Lankan research institute

## **10. Publications**

Sri Lanka Journal of Tea Science. Vol 71 Part 1, March 2006.

TRI Update, Volume 10, Part 2, December 2005.

TRI Update, Volume 11, Part 01, 2006

Tea Info Monthly, Volume 1, Issues 1-7.

Posters on "Soil Conservation with Vetiver Grass" (Sinhala, English, Tamil) and "Sri Lankan Tea" (Sinhala).

"Suwarekumata Thei" (Sinhala Translation of "Tea for Health")

Leaflet on “Tea Seeds as Planting Materials and Establishment of a Seedling Nursery”.

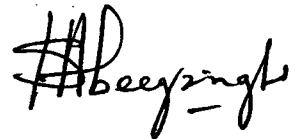
Sinhala and Tamil translations of Advisory Circulars.

A CD on Insect Pests of Tea and their Management (“TEA BUG”)

#### **11. Collaborators (Non-TRI)**

The Institute worked in collaboration with the following institutions on multidisciplinary research projects:

- **Biological Pest Control Project**  
Department of Chemistry, University of Peradeniya.
- **Use of DNA Markers for Molecular Characterization of Tea**  
Department of Molecular Biology and Biochemistry, Faculty of Medicine,  
University of Colombo  
Coconut Research Institute
- **Effect of Black Tea on Oral Health**  
Faculty of Dental Science, University of Peradeniya
- **Biological effects of tea consumption**  
Department of Zoology, University of Colombo  
Department of Anatomy, Faculty of Medical Sciences, University of Sri  
Jayewardenepura, Nugegoda  
Department of Pharmacology, National University of Singapore, Singapore,
- **Fabricating a test-rig for withering fans**  
Energy Conservation Fund
- **Genomic approach to improvement of disease resistance in tea**  
Samuel Roberts Noble Foundation, USA



**Dr. I Sarath B Abeysinghe**  
Director / Chief Executive Officer

## **ADMINISTRATION DIVISION**

### **1. Introduction**

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

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

### **2. Functions of the Tea Research Board**

The specific functions of the Tea Research Board are:

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

2.2 To conduct, assist and encourage research into the economic viability of the tea industry in Sri Lanka, including future economic trends in such industry.

2.3 To establish and maintain relations with research institutions in Sri Lanka and abroad:

2.4 To conduct, in the discharge of its functions, joint study programme, seminars or symposia, with foreign research institutions and research institutions in Sri Lanka.

### **3. Tea Research Institute Head Office at Talawakelle**

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

**4. Members of the Tea Research Board upto December 2006**

- |                                 |   |
|---------------------------------|---|
| 1. Dr. S S B D G Jayawardena    | Chairman (May 2006 to date)                                       |
| 2. Mr. Amarananda Weerasinghe   | Chairman (Up to May 2006)   |
| 3. Dr. I S B Abeysinghe         | Director, TRI (From November 2006)                                |
| 4. Dr. M T Ziyad Mohamed        | Director, TRI (Up to August 2006)                                 |
| 5. Mrs. Ranjani K de Alwis      | Senior Assistant Secretary  |
| 6. Mr. Sri Weerasinghe          | Working Director, TRI   |
| 7. Mr. J M B J Bandara          | Sri Lanka Federation of Tea Small Holdings                        |
| 8. Dr. D S A Samaraweera        | Director Operations, Tea Small Holders Factories Ltd              |
| 9. Mr. D.V Seevaratnam          | Executive Deputy Chairman, Kahawatte Plantations Ltd.             |
| 10. Mr. A B Leelasena           | Director (Planning), Ministry of Plantation Industries            |
| 11. Mr. R M S P S Bandara       | Assistant Director, Ministry of Finance & Planning                |
| 14. Mr. N Padmasiri Kariyawasam | Chairman, Tea Small Holdings Development Authority                |
| 13. Dr. A Anandacoomaraswamy    | Deputy Director Research (Production), TRI (Convenor / Secretary) |

**5. Members of the Consultative Committee on Research (Up to November 2006)**

- |                              |          |   |
|------------------------------|----------|---|
| 1. Dr. D S A Samaraweera     | Chairman | Director Operations, Tea Smallholders Factories Ltd.          |
| 2. Dr. S S B D G Jayawardane | Member   | Chairman TRB  |
| 3. Mr. D V Seevaratnam       | Member   | Executive Deputy Chairman, Kahawatte Plantations Ltd          |
| 4. Dr. D T Wettasinghe       | Member   | Ex DD(R), TRI   |
| 5. Prof. W A J M de Costa    | Member   | Department of Crop Science, University of Peradeniya          |
| 6. Mr. S K L Obeysekera      | Member   | Director/ Chief Executive Officer, Balangoda Plantations Ltd. |
| 7. Mr. N Pilapitiya          | Member   | Proprietor, New Vitanakanda Tea Factory                       |
| 8. Mr. Russell Tennakoon     | Member   | General Manager, Ceylon Tea Brokers Ltd.                      |

9. Mr. Ananda Fernando	Member	Director, Operations, RPC Management Services (Pvt) Ltd.
10. Mr. M B Cyril	Member	Actg. Deputy General Manager (Development), Tea Small Holdings Development Authority
11. Mr. Parakrama Jayasinghe	Member	Haycarb (Pvt) Ltd.
12. Dr. A Anandacoomaraswamy	Convenor / Secretary	Deputy Director Research (Production), TRI
<b>6. Members of the Consultative Committee on Advisory Services and Estates</b>		
1. Mr. D V Seevaratnam	Chairman	Executive Deputy Chairman, Kahawatte Plantations Ltd.
2. Dr. S S B D G Jayawardana	Member	Chairman, TRB (from May 2006)
3. Mr. Amarananda Weerasinghe	Member	Chairman TRB (up to May 2006)
4. Dr. I S B Abeysinghe	Member	Director, TRI (From November 2006)
5. Dr. M T Ziyad Mohamed	Member	Director, TRI (up to August 2006)
6. Dr. A. Anandacoomaraswamy	Member	Deputy Director Research (Production), TRI
7. Mr. Mohan Ganapathy	Member	General Manager, Kelani Valley Plantations
8. Mr. R.K. Nihal Bopearachchi	Member	General Manager, Madulsima Plantations
9. Mr. S.D Nandasena	Member	General Manager, Tea Small Holdings Authority
10. Mr. Asoka Somaratne	Member	63B, Wttarantenna Passage, Kandy
11. Dr. D S A Samaraweera	Member	Director Operations, Tea smallholders Factories Ltd.
12. Mr. R K Nathaniel	Member	21- 1/2, 8 <sup>th</sup> Lane, Colombo 3
13. Mr. Dhyan Madawala	Member	Chief Executive Officer, Hapugastenna Plantations
14. Mr. B A D Samansiri	Convenor / Secretary	Head, Advisory and Extension Division, TRI

**7. Members of the Audit & Management Committee**

- |                          |                      |
|--------------------------|----------------------|
| 1. Mr. R M S P S Bandara | Chairman             |
| 2. Mr. A B Leelasena     | Member               |
| 3. Mr. J M B J Bandara   | Member               |
| 4. Mr. R Kariyawasam     | Convenor / Secretary |

**8. Senior Management Staff during the year 2006**

- |   |                          |
|---|--------------------------|
| 1. Director (Up to August 2006)                   | Dr. M T Ziyad Mohamed    |
| 2. Director (From 23 <sup>rd</sup> November 2006) | Dr. I S B Abyesinghe     |
| 3. Deputy Director Research (Production)          | Dr. A Anandacoomaraswamy |
| 4. Deputy Director (Technology)                   | Vacant                   |
| 5. Deputy Director (Administration)               | Vacant                   |

**9. Executive Staff (Grade I & II) as at 31<sup>st</sup> December, 2006**

**Administration Division**

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 1. Deputy Director (Administration) | Vacant                             |
| 2. Ms. S Anusha                     | Administrative Officer             |
| 3. Mr. K G Piyasena                 | Public Relations / Welfare Officer |

**Finance Division**

- |                         |                  |
|-------------------------|------------------|
| 1. Mr. M V Mohan        | Accountant       |
| 2. Ms. D M R Disanayake | Accountant       |
| 3. Mr. K D H Pathirana  | Stores Executive |

**Internal Audit Division**

- |                      |                  |
|----------------------|------------------|
| 1. Mr. R Kariyawasam | Internal Auditor |
|----------------------|------------------|

**Engineering Division**

- |                      |        |
|----------------------|--------|
| 1. Resident Engineer | Vacant |
|----------------------|--------|

**Library**

- |              |        |
|--------------|--------|
| 1. Librarian | Vacant |
|--------------|--------|

**Publications Unit**

- |                                     |        |
|-------------------------------------|--------|
| 1. Publications / Publicity Officer | Vacant |
|-------------------------------------|--------|

**Agronomy Division**

- |                         |                         |
|-------------------------|-------------------------|
| 1. Head                 | Vacant                  |
| 2. Ms. M S D L de Silva | Senior Research Officer |

### **Agricultural Economics Division**

1. Ms. J A A M Jayakody Head / Senior Research Officer
2. Ms. H W Shyamalie Research Officer (On Overseas study leave)

### **Biochemistry Division**

1. Head vacant
2. Dr. A M T Amarakoon Senior Research Officer
3. Dr. P A N Punyasiri Senior Research Officer
4. Ms. J Jayasundera Research Officer
5. Ms. W A S N S T Gunatileke Research Assistant
6. Mr. K M Mewan Research Officer

### **Entomology / Nematology Division**

1. Mr. R S Walgama Actg. OIC (from June) / Research Assistant
2. Dr. M M Keerthi Senior Research Officer
3. Ms. R M D T Pallemulla Research Officer

### **Plant Physiology Division**

1. Dr. (Mrs) A J Mohotti Senior Research Officer
2. Ms. T L Wijeratne Research Assistant

### **Plant Pathology Division**

1. Dr. A Balasuriya Head / Senior Research Officer
2. Ms. N H L Pradeepa Research Assistant
3. Ms. B A P Cooray Research Assistant (on overseas study leave)

### **Plant Breeding Division**

1. Dr. (Ms) M T K Gunasekare Head / Senior Research Officer
2. Mr. R.M.M Rathnayake Research Officer
3. Mr. M A B Ranatunga Research Assistant
4. Ms. H A C K Ariyaratne Research Assistant

### **Soils & Plant Nutrition Division**

1. Dr. L S K Hettiarachchi Head / Senior Research Officer
2. Ms. S Anandacumaraswamy Senior Research Officer
3. Mr. G P Gunaratne Senior Research Officer

**Technology Division**

- |                           |                               |
|---------------------------|-------------------------------|
| 1. Mr. K Raveendran       | Actg. OIC / Chemical Engineer |
| 2. Mr. W S Botheju        | Research Officer              |
| 3. Mr. S Koneswaramoorthy | Mechanical Engineer           |

**Advisory & Extension Services Division**

- |                        |  |
|------------------------|--|
| 1. Mr. B A D Samansiri | Head / Senior Advisory Officer             |
| 2. Mr. V S Sidhakaran  | Advisory Officer (on overseas study leave) |

**TRI Low Country Station, Ratnapura**

- |                             |   |
|-----------------------------|---|
| 1. Dr. M A Wijeratne        | Officer-in-Charge / Senior Research Officer |
| 2. Dr. K G Premathilake     | Senior Research Officer                     |
| 3. Mr. G L C Galahitiyawa   | Research Officer                            |
| 4. Mr. N P S N Bandara      | Research Assistant                          |
| 5. Mr. M K S L D Amaratunga | Advisory Officer                            |
| 6. Mr. S R W Pathirana      | Research Assistant                          |

**TRI Sub - Station, Hantane**

- |                         |  |
|-------------------------|--|
| 1. Dr. A K N Zoysa      | Officer-in-Charge / Senior Research Officer (from February 2006) |
| 2. Mr. J C K Rajasinghe | Senior Advisory officer  |

**TRI Sub-Station, Kottawa**

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

**TRI Sub- Station Deniyaya**

- |                            |  |
|----------------------------|--|
| 1. Mr. K G J P Mahindapala | Actg. Officer-in-Charge / Advisory Officer |
|----------------------------|--|

**Biometry Unit**

- |                     |                                 |
|---------------------|---------------------------------|
| 1. Ms. T U S Peiris | Research Assistant (Biometrics) |
|---------------------|---------------------------------|

**Estates**

- |                        |                              |
|------------------------|------------------------------|
| 1. Mr. J U Hulangamuwa | Superintendent (St. Coombs)  |
| 2. Mr. A U Weerasinghe | Superintendent (St. Joachim) |

**10. Other Administrative, Scientific, Research & Advisory Staff  
Grade III-V as at 31<sup>st</sup> December 2006**

**Directors Office**

- |                        |                           |
|------------------------|---------------------------|
| 1. Ms. S M Jeyasingham | Secretary to the Director |
| 2. Mr. R J Rayappan    | Office Attendant          |

**Administration Division**

- |                            |                                 |
|----------------------------|---------------------------------|
| 1. Mr. R Nandasena         | Administrative Assistant        |
| 2. Mr. W P A N Jayasinghe  | Chief Clerk                     |
| 3. Ms. S Shunmuganathan    | Stenographer / Typist (English) |
| 4. Mrs. W M S R Wanasinghe | Clerk / Typist                  |
| 5. Mrs. W.M.G.R Jayasinghe | Clerk / Typist                  |
| 6. Mr. K.R.M Priyantha     | Clerk / Typist                  |
| 7. Ms R.M.D.K Ratnayake    | Clerk / Typist                  |
| 8. Ms. C Jeyaram           | Clerk / Typist                  |
| 9. Mr. I W Nihal Kumara    | Office Attendant                |
| 10. Mr. S Dharmalingam     | Office Attendant                |

**Engineering Division**

- |                         |                        |
|-------------------------|------------------------|
| 1. Mr. C J B Abeykoon   | Works Supervisor       |
| 2. Mr. W C K Fernando   | Chief Plumber Mechanic |
| 3. Mr. J G Gamage       | Filter Plant Assistant |
| 4. Mr. V Shanmuganathan | Clerk / Typist         |
| 5. Mr. P T Perera       | Clerk / Typist         |
| 6. Mr. U D W Ratnasiri  | Filter Plant Attendant |

**Finance Division**

- |                           |                                      |
|---------------------------|--------------------------------------|
| 1. Mr. C B Koswatte       | Senior Accounting Assistant          |
| 2. Mr. S G Punchibanda    | Accounting Assistant                 |
| 3. Ms. V Pahalage         | Accounts Clerk                       |
| 4. Ms. B.K.S. Herath      | Accounts Clerk                       |
| 5. Mr. Saman Hewasiliyan  | Accounts Clerk                       |
| 6. Ms. A A A P Amaratunga | Accounts Clerk                       |
| 7. Mr. K T U Kulatunga    | Asst. Store Keeper                   |
| 8. Mr. W A Nishantha      | Data Entry Operator / Accounts Clerk |
| 9. Mr. R Godage           | Clerk / Typist                       |
| 10. Mr. H P W Gunasekara  | Stores Assistant                     |
| 11. Mr. H B Talgahagoda   | Cashier cum Accounts Clerk           |
| 12. Mr. M G Weeratillake  | Cashier                              |
| 13. Mr. H N Dharmapala    | Office Attendant                     |

**Internal Audit Division**

- |                           |                        |
|---------------------------|------------------------|
| 1. Mr. P S Wickramasinghe | Internal Audit Officer |
| 2. Ms. N C Jayaweera      | Internal Audit Clerk   |
| 3. Ms. W N K I Ariyaratne | Internal Audit Clerk   |

**Motor Garage**

- |                       |                      |
|-----------------------|----------------------|
| 1. Mr. G G E H Gamage | Chief Motor Mechanic |
| 2. Mr. W G Wijeratne  | General Mechanic     |

**Electrical Division**

- |                           |                    |
|---------------------------|--------------------|
| 1. Mr. U A Wickramasinghe | Electrical Foreman |
| 2. Mr. J M R K Bandara    | Electrician        |
| 3. Mr. R W Rengasamy      | Electrician        |

**Telephone Exchange**

- |                              |                                     |
|------------------------------|-------------------------------------|
| 1. Mr. K M Seneviratne Banda | Telephone Operator                  |
| 2. Ms. P K N Damayanthi      | Telephone Operator cum Receptionist |
| 3. Mr. S Karuppiyah          | Telephone Linesman                  |

**Purchasing Unit**

- |                         |                    |
|-------------------------|--------------------|
| 1. Mr. B Tilakaratne    | Purchasing Officer |
| 2. Mr. P D S L de Silva | Clerk / Typist     |

**Transport Division**

- |                        |                   |
|------------------------|-------------------|
| 1. Mr. M L H Perera    | Transport Officer |
| 2. Mr. S H Chandrasena | Clerk / Typist    |
| 3. Ms. Ramani de silva | Clerk / Typist    |

**Mechanical Workshop**

- |                           |                         |
|---------------------------|-------------------------|
| 1. Mr. A Nandasiri        | Chief Workshop Mechanic |
| 2. Mr. P D L B de Silva   | General Mechanic        |
| 3. Mr. M C Gabriel        | General Mechanic        |
| 4. Mr. D L J Weerasooriya | General Mechanic        |

**Library**

- |                            |                   |
|----------------------------|-------------------|
| 1. Ms. R W M S K Amunugama | Library Assistant |
|----------------------------|-------------------|

**Publications Unit**

- |                      |                                 |
|----------------------|---------------------------------|
| 1. Ms. A P V Kalyani | Stenographer / Typist (English) |
|----------------------|---------------------------------|

### **Agronomy Division**

1. Mr. A R Amarasekara Experimental Officer
2. Mr. U P Abeysekara Experimental Officer
3. Ms. L A S P Jayasinghe Experimental Officer

### **Agricultural Economics Division**

1. Mr. W M J C Bandara Experimental Officer

### **Biochemistry Division**

1. Mr. G A A R Perera Experimental Officer
3. Ms. G H Thotawattage Experimental Officer
4. Mr. P K P Muthukumarana Experimental Officer
5. Mr. P J C Priyantha Technical Assistant
6. Mr. M W Silva Skilled Mechanic

### **Entomology / Nematology Division**

1. Mr. D D Liyanage Experimental Officer
2. Mr. N Nawaratne Experimental Officer
3. Ms. R D P Dharmalatha Experimental Officer
4. Ms. P G D S Amarasena Experimental Officer
5. Mr. M M Jayathilake Experimental Officer
6. Ms. B Sureshkumar Experimental Officer
7. Ms. S S C J de Seram Technical Assistant

### **Plant Pathology Division**

1. Mr. J W K Jayasundara Experimental Officer
2. Mr. R M A Ratnayake Experimental Officer

### **Plant Physiology Division**

1. Ms. D M S Nawaratna Experimental Officer
2. Ms. V Sidhakaran Experimental Officer
3. Ms. M M N Damayanthi Experimental Officer

### **Plant Breeding Division**

1. Mr. R Paskaradevan Experimental Officer
2. Mr. J D Kottawa Arachchige Experimental Officer
3. Mr. K K Ranaweera Experimental Officer

**Soils & Plant Nutrition Division**

- |                            |                      |
|----------------------------|----------------------|
| 1. Mr. C S K A Rathnayake  | Experimental Officer |
| 2. Mr. O G K A Gunaratne   | Technical Assistant  |
| 3. Mr. D M B N Dissanayake | Technical Assistant  |

**Technology Division**

- |                           |                      |
|---------------------------|----------------------|
| 1. Mr. L Jayasinghe       | Experimental Officer |
| 2. Ms. S H P Waduge       | Experimental Officer |
| 3. Mr. U D Alagiyawadu    | Experimental Officer |
| 4. Ms. W M S Weerawardana | Experimental Officer |
| 5. Mr. A M M V Abeykoon   | Experimental Officer |
| 6. Mr. P K S P Dayananda  | Experimental Officer |

**Advisory & Extension Services Division**

- |                           |                                   |
|---------------------------|-----------------------------------|
| 1. Ms. M A H Nishanthi    | Extension Officer                 |
| 2. Mr. A L R U Kumara     | Extension Officer                 |
| 3. Mr. C P Malawige       | Extension Officer                 |
| 4. Mr. H Jayaweera        | Extension Officer                 |
| 5. Ms. C S K Kiribathgoda | Stenographer / Typist (English)   |
| 6. Mr. K G R Niroshan     | Photographer                      |
| 7. Mr. J T Thevadasan     | Photography / Dark Room Attendant |
| 8. Mr. N S Ekanayake      | Audio Visual Attendant            |

**TRI Low-Country Station, Ratnapura**

- |                            |                      |
|----------------------------|----------------------|
| 1. Mr. T G N Mahinda       | Extension Officer    |
| 2. Mr. H S N Peiris        | Experimental Officer |
| 3. Mr. E R Perera          | Experimental Officer |
| 4. Mr. P D Upali           | Experimental Officer |
| 5. Mr. W M U A B Marapana  | Experimental Officer |
| 6. Mr. A K Prematunge      | Experimental Officer |
| 7. Mr. A G Gamage          | Experimental Officer |
| 8. Ms. B S N Vithana       | Experimental Officer |
| 9. Mr. J H N Piyasundara   | Experimental Officer |
| 10. Ms. E W T P Prematunga | Experimental Officer |
| 11. Mr. D W Vitana         | Experimental Officer |
| 12. Ms. K B N Sripalika    | Experimental Officer |
| 13. Mr. M G S Liyanage     | Experimental Officer |
| 14. Mr. M A Chamindra      | Experimental Officer |
| 15. Mr. A K Mudalige       | Experimental Officer |

16.Mr. K A D Mervin	Accounting Assistant
17.Ms. P V G Karunanayake	Stenographer / Typist (English)
18.Mr. K A S Kumarapperuma	Clerk / Typist
19.Ms. H K Seetha	Accounts Clerk
20.Mr. K Gunawardana	Works Supervisor
21.Mr. J S K de Silva	Electrician
22.Mr. M A B de Silva	General Mechanic
23.Mr. N A Bowie	General Mechanic
24.Mr. U W K Munasinghe	Asst. Plumber Mechanic

**TRI Mid-Country Station, Hantane**

1. Mr. K R W B Kahandawa	Extension Officer
2. Mr. H J M de Silva	Extension Officer
3. Mr. T M Sarathchandra	Experimental Officer
4. Mr. A P D A Jayasekara	Experimental Officer
5. Mr. U B Herath	Experimental Officer
6. Mr. S Wijetunga	Experimental Officer
7. Ms. S N Wijesekara	Experimental Officer
8. Ms. P L K Tennakoon	Experimental Officer
9. Ms. P V A R Abeysekera	Experimental Officer
10.Mr. G P Udumulla	Experimental Officer
11.Ms. C N K Edirisinghe	Station Assistant
12.Ms. G A S Gunasekera	Accounts Clerk
13.Mrs. D Rathnayake	Stenographer / Typist (English)
14.Mr. K Palathanthrige	Works Supervisor

**TRI Sub-Station, Kottawa**

1. Mr. P K Jayawickrama	Experimental Officer
2. Mr. S P Ratnayake	Extension Officer
3. Ms. P V D Chandrakanthi	Accounts Clerk
4. Mr. M Sarath	Field Supervisor

**TRI-Sub Station, Passara**

1. Mr. M A J Farnando	Actg. OIC / Extension Officer
-----------------------	-------------------------------

**TRI Sub-Station, Deniyaya**

1. Mr. C J Liyanarachchi	Extension Officer
2. Mr. O W Jayawardana	Station Assistant
3. Mr. P S Kulasiri	Field Supervisor

**Walahanduwa Laboratory Complex**

- |                          |                      |
|--------------------------|----------------------|
| 1. Mr. W T B Priyantha   | Experimental Officer |
| 2. Mr. S M Dissanayake   | Experimental Officer |
| 3. Mr. J R Y Abeywardana | Experimental Officer |

**11. Retirements during the year**

- |                      |                             |
|----------------------|-----------------------------|
| 1. Mr. P B Ekanayake | Officer-in-Charge, Hantane  |
| 2. Mr. R Gabriel     | General Mechanic (Deceased) |
| 3. Mr. P M T Bandara | Bus Conductor               |

**12. Resignations during the year**

- |                                  |  |
|----------------------------------|--|
| 1. Mr. W M P Wijekoon            | Deputy Director (Administration)<br>(15 <sup>th</sup> January 2006)    |
| 2. Ms. R W M W K Illanganthilaka | Librarian (01 <sup>st</sup> February 2006)                             |
| 3. Ms. D W Manawadu              | Resident Engineer (06 <sup>th</sup> March 2006)                        |
| 4. Mr. M H C Perera              | Electrical Engineer (07 <sup>th</sup> April 2006)                      |
| 5. Mr. H K M S Kumarasinghe      | Extension Officer (09 <sup>th</sup> March 2006)                        |
| 6. Mr. R G A Wijayawardana       | Experimental Officer (02 <sup>nd</sup> July 2006)                      |
| 7. Mr. T C N Peiris              | Experimental Officer (30 <sup>th</sup> July 2006)                      |
| 8. Dr. M T Ziyad Mohomed         | Director (04 <sup>th</sup> August 2006)                                |
| 9. Mr. R M A Ratnayake           | Experimental Officer<br>(05 <sup>th</sup> September 2006)              |
| 10. Ms. S G N C Kumari           | Information / Documentation Officer<br>(16 <sup>th</sup> October 2006) |

**13. Staff Recruitments during the year**

- |                            |   |
|----------------------------|---|
| 1. Dr. I S B Abeysinghe    | Director (23rd November)                                  |
| 2. Dr. A K N Zoysa         | Officer-in-Charge, Hantana (01 <sup>st</sup><br>February) |
| 3. Mr. K G J P Mahindapala | Advisory Officer (14th July)                              |
| 4. Mr. K M Mewan           | Research Officer (14th July)                              |
| 5. Ms. H W Shyamalie       | Research Officer (14th July)                              |

**14. Overseas Training / Seminars / Conferences etc.**

Ms. H W Shyamalie, Experimental Officer attached to the Agricultural Economics Division Proceeded to India, to follow a Ph.D training programme in the discipline of Agricultural Economics for a period of 03 years commencing from 27.01.2006, under ICAR and CARP work plan.

Mr. N P S N Bandara, Research Assistant, TRI, Low Country Station, Ratnapura, proceeded to University of Adelaide, Australia to follow a Ph.D Training programme commencing from 06.02.2006, for a period of 03 years

Dr. A M T Amarakoon, Senior Research Officer, Biochemistry Division, attended the National convention on South India, teas from 10<sup>th</sup> to 14<sup>th</sup> March 2007 in India.

Dr. M T Ziyad Mohamed, Director TRI, and Dr. A M T Amarakoon, Actg. Head, Biochemistry Division were members of a delegation with Japanese Authorities on Maximum Residue Limits (MRLs) on 17.04.2006, in Japan.

Dr. M A Wijeratne, Senior Research Officer, TRI, Low Country Station Ratnapura, attended the Annual Conference of the Technical sessions of the Planters' Association of Tamil Nadu from 08<sup>th</sup> to 10<sup>th</sup> September 2006 in India.

Dr. L S K Hettiarachchi, Head, Soils and Plant Nutrition Division, proceeded to China to investigate the factory where the Xenia Amino Phenol Fertilizer is produced, from 09<sup>th</sup> –13<sup>th</sup> November 2006.

Dr. A Anandacoomaraswamy, Deputy Director Research (Production) attended the workshop under the memorandum of understanding (MOU) of the 08<sup>th</sup> session of the Joint Commission for Economic Co-operation (JCEC) between Sri Lanka and Iran from 18.11.2006 to 22.11.2006 in Iran.

Dr. A M T Amarakoon, Senior Research Officer, Biochemistry Division attended the Nairobi International Tea Business Conference from 26.11.2006 to 01.12.2006 in Nairobi.

## Maintenance Divisions

### Engineering

#### General

Total work undertaken by the divisional staff were:

Road/Building repairs /Maintenance - 315 Nos

### Building Maintenance

#### a. Details of colour washing under annual programme

Type of Bungalow	Internal	External	Kitchen & Toilet	Roof
A	2,3,4,7,14	11	-	-
B	-	13	3	-
C	12,24,28,46,48	6	-	-
	16,18,25,51,52,	-	47	-
D	34,32,48,49,52	-	8,46	55,56
E	14	-	All quarters	-
Hostels	Camellia	-	Camellia	Camellia

Divisions –Plant Physiology, Transport, Portion of Administration

All repair work, plumbing /carpentry / masonry were carried out under the colour washing program

Long pending work of roof replacement of Plant Breeding Glass House was completed.

Renovation of Glass House of Plant Physiology Division was completed.

**Special work attended by divisional staff under building maintenance program in connection with the visit of Honourable former Deputy Minister and new Minister of Plantation Industries.**

1. Refurbishing of surrounding & layout of the Institute.
2. Repairs to road from Mattekelle junction to TRI
3. Repairs to side drains within the institute
4. Face lift of New building/Auditorium /Admin block /Museum/Chairman's Office/Sports Club & Guest House
5. Repairs /repaint of barriers, humps and name boards

## **Water Supply & Maintenance**

Cleaning of Filtration plant and sedimentation & storage tanks of different locations were undertaken

Water supply repairs prior to allocation of B 13, C 12 & C 28 bungalows were completed

Repairing of the boiler (old model) of A 14 bungalow was carried out.

A new water storage tank has been installed at Duke's bungalow

Repairs to senior staff water sump which was cleaning has been completed

Water supply line to new building was completed

A new Water pump has been installed for St. Coombs Estate for the workers

## **2. Maintenance Work**

- a. Balance work of the main water supply line (abandoned by the contractor) has been completed
- b. Cleaning of water and sedimentation tanks of the filtration plant has been carried out twice during the year.
- c. Plumbing, Tiling renovation work at AI hostel initiated (work pending due to non availability of budget provision)
- d. Replacement of Gutters of B & C type quarters were initiated
- e. Fixing new ceiling for Pathology Division
- f. Fixing Aluminium beading to library steps
- g. Cushioning of Settee of A type bungalows (which was long overdue) were completed
- h. Rattaning of chairs in bungalows and offices was in progress
- i. Replacing damaged asbestos roofing sheets of SPND chemical stores (WIP)
- j. Repairs to the Fire Hydrant System- completed
- k. Assisted the St. Coombs Estate in Civil Engineering work

## **Work carried out at TRI Sub Stations**

- a. Renovation work at TRI Kottawa Guest House, Office, D & C type quarters
- b. New water supply system provided for Kottawa Tea Nursery
- c. Renovation of Water Supply System attended at TRI Passara Station
- d. Renovation of water Supply System attended at TRI Colombo Guest House
- e. Repairing roof leak at TRI Colombo Guest House

**Construction work at Talawakelle**

- a. Construction of steps and footpath to the Summer Hut.
- b. Construction of main water line from filtration Plant – civil work completed.
- c. Construction of Pavement near Auditorium - completed
- d. Construction of steps leading to visitors toilets
- e. Construction of Tea boutique at Museum (work pending due to budget provision)
- f. Installed new water supply system at Observatory-Agronomy Division
- g. Installed pipe line to drip irrigation system –Agronomy Division
- h. Assisted in Experimental trials –irrigation system in Estates-Agronomy Division
- i. Installed water supply system in the New Summer Hut
- j. Installation of Fire Fighting System
- k. Conversion of 'B' type Bungalow No.15 as Senior staff Ladies Hostel
- l. Fixing mesh for the Tennis Court/Basketball Court of TRI Sports Club

**General****Electrical Division**

1. Electrical Division completed 240 jobs during the year 2006, as follows

Maintenance of TRI Bungalows	177
Maintenance of Laboratory, office building etc	58
Maintenance at Sub-Stations	02
Maintenance of Estate	03

**Completed the following at TRI, Talawakelle**

- I. Re-construction work at D-type Bungalows O.H. Line & street lights
- II. Re-wiring and fixed new 3 KW water /Geyzers to D-Type Bungalows

**Completed the following at TRI Stations**

Wiring street light O.H. Line at TRI Station, Passara

**Motor Garage**

Attended the following jobs during the year:

I. Servicing and changing oil	141
II. Changing Tyres and Tubes	83
III. Engine repairs	03
IV. Other various repairs	324
V. Total	551

## **Telephone Exchange & Test Room**

Attended the following during the year:

### **New Telephone Lines given to the Divisions and Bungalows.**

Bungalows	07 nos
Divisions	04 nos

Maintenance jobs	49 nos
Divisions	21 nos
Bungalows	28 nos

Repairing and servicing of defected Telephone Instrument and replacing with a new Telephone Instrument.

General Maintenance of the Telephone Line in underground and overhead lines.

Repairing and replacing of a Telephone Line and installing a Telephone Instrument and 206 BAPX system at Passara Station.

## TEA RESEARCH BOARD

## STATEMENT OF FINANCIAL POSITION AS AT 31st DECEMBER, 2006

<b>ASSETS</b>	<b>2006</b>	<b>2006</b>	<b>2005</b>	<b>2005</b>
	<b>Rs.(000)</b>	<b>Rs.(000)</b>	<b>Rs.(000)</b>	<b>Rs.(000)</b>
<b>Non-current assets</b>				
Property, plant and equipment	787,062 (Annex I-I )		720,898	
Less:- Accumulated Depreciation	<u>(461,591) (Annex I-I )</u>		<u>(427,396)</u>	
	325,471		293,501	
Capital work-in-progress	5,166 (Annex II )		60,749	
Other Assets	<u>22</u>		<u>23</u>	
		<b>330,659</b>		<b>354,273</b>
<b>Current Assets</b>				
Inventories/Stocks	16,314 (Annex III )		15,791	
Trade and other receivables	159,084 (Annex IV,V,VI )		165,620	
Prepayments	2,572 (Annex V )		1,392	
Cash and cash equivalents	81,895 (Annex VII,VIII)		48,722	
Others	<u>560 (Annex IX,X )</u>	<u>260,425</u>	<u>619</u>	<u>232,144</u>
<b>Total Assets</b>		<b>591,084</b>		<b>586,418</b>
<b>LIABILITIES</b>				
<b>Current Liabilities</b>				
Payables	13,160 (Annex XI )		21,035	
Accrued Expenses	<u>27,052 (Annex XI )</u>		<u>17,917</u>	
		40,212		38,951
<b>Non-Current liabilities</b>				
Provision for Gratuity	69,615 (Annex XIII)		59,503	
Petrol Deposit Refundable	<u>17 (Annex XIV)</u>		<u>15</u>	
		69,632		59,518
<b>Total Liabilities</b>		<u>109,844</u>		<u>98,469</u>
<b>Total Net Assets</b>		<u>481,240</u>		<u>487,949</u>
<b>NET ASSETS/EQUITY</b>				
Tea Research Fund		337,161		288,007
Grants & Reserves	(Annex XII )	<u>144,079</u>		<u>199,942</u>
<b>Total Net Assets/Equity</b>		<u>481,240</u>		<u>487,949</u>

  
 .....  
 Chairman-TRB

  
 .....  
 Director-TRI

  
 .....  
 Accountant  
 for Senior Accountant

## TEA RESEARCH BOARD

STATEMENT OF FINANCIAL PERFORMANCE FOR THE YEAR ENDED  
31st DECEMBER 2006

		2006 Rs. '000	2005 Rs. '000
<b>Operating Revenue</b>			
Recurrent Grant- Cess	Annex. XV	249,838 **	192,423
Other Income	Annex. XV, XVII, XVIII	23,792	14,384
Other Income- Deferred Income	Annex. XV	3,899 *	
		<u>277,529</u>	<u>206,808</u>
<b>Operating Expenses</b>			
Personal Emoluments	Annex. I	118,605	113,192
Travelling	-do-	4,944	6,247
Supplies and consumable used	-do-	18,100	23,875
Maintenance	-do-	17,939	20,799
Contractual Services-Security / Insurance	-do-	11,886	9,914
Electricity & Heating	-do-	14,033	15,394
Communications	-do-	4,069	4,474
Research and Development	-do-	12,321	11,578
Depreciation	-do-	28,376	46,361
Other operating expenses	-do-, XVI	15,172	16,693
		<u>245,445</u>	<u>268,525</u>
<b>Total operating expenses</b>			
Surplus/(Deficit) from operating activities	-do-	32,084	(61,718)
<b>Finance Cost</b>			
Gain on sales of property plant and equipment	Annex XV	<u>2</u>	<u>1</u>
Total non operating revenue (expenses)			
<b>Net surplus/(Deficit) before extra ordinary items</b>		32,086	(61,716)
Extra ordinary items			
Prior year Adjustments	Annex. XIX	<u>17,068</u>	<u>-</u>
<b>Net surplus/(Deficit) for the period</b>		<u>49,154</u>	<u>(61,716)</u>

\* Depreciated value for Capital Reserve as per SLAS 24 with the TRB approval

\*\* Tea Cess receivable as at 31st December, 2007 - Rs.78,405,918.64

## TEA RESEARCH BOARD

## CONSOLIDATED CASH FLOW STATEMENT FOR THE YEAR ENDED 31st DECEMBER 2006

<u>Cash Flow from Operating Activities</u>	2006 Rs'000	2005 Rs'000
Surplus/(deficit) from ordinary activities	29,428	(63,942)
<b><u>Non- Cash movments</u></b>		
Depreciation	32,907	51,073
Increase in provision for Bad Debts	(11)	
Increase in Payables	1,275	1,864
Increase in provisions relating to employee costs	10,113	12,933
Gains sale of fixed assets	(2)	(1)
Increase in other current assets(stocks) depo/prepay	(3,636)	5,775
Assets writ-offs		740
Increase in receivables	8,528	8,058
Prior Years Adjustments	17,068	
Accounting adjustment in capital reserve	(56,756) *	
<b>Net Cash Flow from operating activities</b>	<b>38,914</b>	<b>16,501</b>
<b><u>Cash Flow from Investing activities</u></b>		
Purchase of fixed assets	(66,165)	(100,449)
Interest on investments	2,656	2,225
(Increase)/Decrease Capital working-in-progress	55,584	12,641
Proceeds from sale of fixed assets	2	1
<b>Cash Flow from Investing activities</b>	<b>(7,923)</b>	<b>(85,582)</b>
<b><u>Net Cash Flow from Financing activities</u></b>		
Capital Grants- PHDT	1,867	
NSF	315	
- NRC	-	61
ADB	-	41,793
<b>Net Cash Flow from Financing activities</b>	<b>2,182</b>	<b>41,853</b>
<b>Net Increase/(decrease) in Cash and cash equivalents</b>	<b>33,173</b>	<b>(27,228)</b>
<b>Cash and cash equivalents at beginning of period</b>	<b>48,722</b>	<b>75,950</b>
<b>Cash and cash equivalents at end of period</b>	<b>81,895</b>	<b>48,722</b>

\* Adjustment made for Capital Reserve as per the SLAS 24 with the TRB Approval

**TEA RESEARCH INSTITUTE  
OPERATING EXPENDITURE**

<b>EXPENDITURE</b>		<b>Administration Finance and Common Service</b>	<b>Advisory, Extensions &amp; Publicity</b>	<b>Substation Ratnapura Hantane</b>	<b>Research</b>	<b>Total</b>
01	Personnel Emoluments	32,771,579.34	9,537,145.82	12,421,749.17	41,478,079.37	96,208,553.70
08	Pensions and Retirement Benefits	2,948,015.79	1,013,537.85	1,320,300.12	4,474,544.46	9,756,398.22
08	Gratuity Provision	12,639,935.16				12,639,935.16
02	Travelling	1,764,033.79	670,531.75	622,880.79	1,886,621.55	4,944,067.88
03	Supplies and Requisites	5,877,398.30	3,453,099.28	1,631,549.60	7,138,257.53	18,100,304.71
04	Repairs and Maintenance of Capital Assets	12,197,743.12	1,109,149.37	3,449,436.91	1,182,378.73	17,938,708.13
05	Security Services	6,658,820.61	1,330,213.91	3,393,113.96	503,584.73	11,885,733.21
05	Electricity & Heating	9,974,137.51	457,650.62	3,438,031.22	162,942.42	14,032,761.77
05	Communications	1,703,643.17	1,082,253.77	1,181,223.32	102,170.53	4,069,290.79
10	Research & Development- Media/Publicity & Gifts	290,701.24	866,599.32	107,305.78	7,040.62	1,271,646.96
11	Cultivation Field Trials		4,123,190.20	2,071,954.79	2,131,150.83	8,326,295.82
12	Training Local	103,485.75	78,839.50	12,450.00	275,695.00	470,470.25
12	Training Overseas	2,251,677.03				2,251,677.03
04	Depreciation of Fixed Assets	5,027,688.69	1,603,878.99	6,141,522.14	15,603,161.24	28,376,251.06
05	Other Operating Expenses-Transp. ,Utility & Other Servis	5,791,402.62	933,269.74	1,899,674.19	132,778.86	8,757,125.41
07	Contributions, Grants and Su	2,473,014.89	124,098.02	83,412.77	259,743.00	2,940,268.68
	Debit Tax payments	526,382.45				526,382.45
12	Other Miscellaneous Expens	1,324,729.76	21,575.00	9,525.00	1,592,773.18	2,948,602.94
	<b>Total Expenditure</b>	<b>104,324,389.22</b>	<b>26,405,033.14</b>	<b>37,784,129.76</b>	<b>76,930,922.05</b>	<b>245,444,474.17</b>

**TEA RESEARCH BOARD**

**ST.COOMBS & LAMILIERE ESTATES WORKING ACCOUNT FOR THE  
PERIOD 1ST JANUARY TO 31ST DECEMBER 2006**

<u>2005</u>		<u>INCOME</u>	<u>2006</u>	
<u>Rs.</u>	<u>Kg.</u>		<u>Kg.</u>	<u>Rs.</u>
60,507,594.46	328,765	Tea Sales Gross Proceeds		
5,048,256.53	27,467	Tea Sales Ex Brokers(Gross)	339,581	74,649,783.49 (Note 1)
65,555,850.99	<u>356,232</u>	Tea Sales Local & Graties	38,896	7,400,165.03
			<u>378,477</u>	<u>82,049,948.52</u>
				82,049,948.52
		Add-		
73,403.60		Tea Lost (417Kg)Mr.E.M.Dayaratne		
70,905.68		Miscellaneous Income		92,019.67
		Deferred Income	**	132,488.50
<u>65,700,160.27</u>		Total Income		<u>224,508.17</u>
				<u>82,274,456.69</u>
		<b>EXPENDITURE</b>		
		<u>Less: Estate Expenditure</u>		
17,341,005.37		General Charges		15,404,094.60
6,171,066.96		Field work & Cultivation		7,701,638.25
33,464,661.88		Production		42,238,638.03
1,260,458.77		Bought Leaf(including transport charges)		<u>1,715,959.95</u>
<u>58,237,192.98</u>				67,060,330.83
		<u>Administration &amp; Finance</u>		
3,181,287.41		Bonus and Holiday pay		2,783,260.78
1,833,305.96		Depreciation	*	<u>1,535,956.57</u>
<u>5,014,593.37</u>				4,319,217.35
		<u>Sales Tax &amp; Distribution Expenses</u>		
1,291,291.48		Brokerage,Handling chgs.,& Sales Expenses		<u>1,316,023.82</u>
64,543,077.83		Total Expenditure		<u>72,695,572.00</u>
1,157,082.44		Profit/(loss) for the year		<u>9,578,884.69</u>
202,329.91		Less: Over valued tea last year		<u>(546,012.26)</u>
<u>954,752.53</u>				<u>9,032,872.43</u>
		<u>P.Y.A.- Deferred Income</u>	**	<u>596,827.51</u>
		Depreciation	*	<u>(422,585.92)</u>
		Profit/(loss) transferred to TRI Operating A/c		<u>9,207,114.02</u>

Notes:- 1. 3500 Kgs unsold Teas valued NSA @ 215.95

2 \*\* Total Deferred Income Rs.729,316.01

\* Total depreciation Rs.1,858,542.48

**TEA RESEARCH BOARD**  
**ST. JOACHIM ESTATE WORKING ACCOUNT FOR THE**  
**PERIOD 1ST JANUARY TO 31ST DECEMBER 2006**

<u>2005</u>		<u>INCOME</u>	<u>2006</u>	
<u>Rs. cts.</u>	<u>Kg.</u>		<u>Rs. cts.</u>	
111,388,419.82	624,200	Tea Sales Gross Proceeds	100,292,773.48	(Note 1)
1,139,521.39	8,420	Tea Sales Ex Brokers(Gross)	678,669.33	
<u>112,527,941.21</u>	<u>632,620</u>	Tea Sales Local & Graties	100,971,442.81	100,971,442.81
		<b>Add:</b>		
605,709.75		Nursery Working A/c(Net) & Sale of Cuttings		
54,304.91		Miscellaneous Income	36,306.60	
1,308,341.00		Income from Rubber	2,565,868.75	
		Deferred Income	348,742.57	** 2,950,917.92
<u>114,496,296.87</u>		<b>Total Income</b>	<u>103,922,360.73</u>	
		<u>EXPENDITURE</u>		
		<b>Less: Estate Expenditure</b>		
1,525,429.54		General Charges	1,610,841.14	
1,514,138.55		Field work & Cultivation	1,823,961.82	
3,880,068.80		Production	3,929,725.87	
808,457.58		Expenditure on Rubber	1,247,525.09	
101,413,576.78		Bought Leaf(including transport charges)	89,108,846.43	97,720,900.35
<u>109,141,671.25</u>			<u>97,720,900.35</u>	
		<b>Administration &amp; Finance</b>		
964,738.69		Bonus and Holiday pay	736,427.26	
2,819,146.90		Depreciation	298,629.58	* 3,722,719.84
		<b>Sales Tax &amp; Distribution Expenses</b>		
2,382,094.80		Brokerage, Handling chgs., & Sales Expenses	2,387,358.29	2,387,358.29
<u>115,307,651.64</u>		<b>Total Expenditure</b>	<u>103,830,978.48</u>	
(811,354.77)		<b>Profit for the year</b>	91,382.25	
(261,667.79)		<b>Less- Under Provision 2005</b>	29,307.91	
<u>(1,073,022.56)</u>		<b>Profit/(Loss) FOR THE YEAR</b>	<u>120,690.16</u>	
		<b>P.Y.A. Deferred Income</b>	578,577.11	**
		Depreciation	(576,235.31)	* 2,341.80
		<b>Profit (Loss) transferred to T.R. Operating A/C</b>	<u>123,031.96</u>	

Note:- (1) 2506.5 Kgs unsold Teas valued NSA @ Rs.175.96

Note:- (2) Total Deferred Income Rs. 948,179.52

Note:- (3) Total Depreciation Rs. 3,562,527.89

# AGRICULTURAL ECONOMICS DIVISION

Head – J A A M Jayakody

## 1. Project D 35 Tea Sector Studies

### D 35.1. Economic evaluation of the revision of the fertilizer subsidy scheme.

Urea fertilizer used by the entire agriculture sector in Sri Lanka was available at a subsidized price of Rs. 600 per 50 kg, until April 2006 when the subsidy was revised. The subsidy was then available only to the paddy sector, and to small holders in the plantation sector who owned less than 5 ac of land. The paddy sector is given all fertilizers, namely urea, MOP and ERP, at a subsidized price of Rs 350 per 50 kg.

For the small holders in the plantation sector (tea, rubber and coconut) only, urea is available at a subsidized price of Rs 1200 per 50 kg. All large plantations have to purchase urea fertilizer at the market rate of Rs 1800 per 50 kg. The cost of urea, and urea-based tea fertilizers, were doubled after this change. Table 1 gives the changes in tea fertilizer prices for the large plantations, before and after revision of the subsidy.

Table 1. Cost of tea fertilizer for the corporate sector, before and after revision of the subsidy.

Mixture	New price (without subsidy) Rs /1000 kg	Old price (with subsidy) Rs /1000kg	Increase Rs/1000 kg	Increase as a %
VPLC	33,198	17,187	16,011	93
VPUM	33,243	17,821	15,422	87
VP Uva	33,172	18,369	14,803	81
STLC	30,564	17,547	13,017	74
STUM	30,682	18,926	11,756	62
ST Uva	30,733	20,027	10,706	53
Urea	36,000	12,000	24,000	200

Table 2 shows the impact of this subsidy revision on tea fertilizer prices for the tea smallholder sector.

Table 2. Cost of tea fertilizer for the smallholder sector, before and after revision of the subsidy.

Mixture	New price (after revision) Rs /1000kg	Old price (before revision) Rs/1000kg	Increase Rs/1000kg	Increase as a %
VPLC	29,000	17,187	11,820	69
VPUM	30,700	17,821	12,880	72
VP Uva	30,300	18,369	11,940	65
STLC	28,100	17,547	10,560	60
STUM	28,900	18,926	9,980	53
ST Uva	28,500	20,027	8,480	42
Urea	24,000	12,000	12,000	100

As a result, fertilizer application costs per hectare of tea in the corporate sector have increased within the range 60 – 93%, whereas in the smallholder sector the increases are within the range 42 -72%. The wider ranges are due to price variations in the-regional fertilizer mixtures.

The effect of the subsidy removal was studied to evaluate its impact on COP, and to assess possible impact on tea production. It was found that the cost of production per kg of made tea, in the corporate sector, had increased by Rs 4.70 – 6.21. In the smallholder sector, the cost of green leaf production had increased by Rs 0.52 – 1.07 per kg.

Since this change occurred at the end of the first quarter of the year, the chances for reduction of fertilizer application were high as the cost had increased by nearly 100%.

The Agricultural Economics Division, and the Soils and Plant Nutrition Division, of the TRI produced a report for policy makers, in order to bring these facts to the notice of the higher authorities in the Finance Ministry. Also an article was published in the TRI Update (Volume 11, part 2, December 2006), informing end users to undertake appropriate measures to minimize the negative impacts.

#### **D 35.2. The St. Coombs Study**

A case study was undertaken at St Coombs Estate in order to study “Management Aspects of Up-Country Tea Plantations and the Use of Geographic Information Systems as a Managerial Tool”. This study was carried out as a partial

fulfillment of the industrial training of a student, S Karunaratne, of the Faculty of Agriculture (Plantation Management), University of Wayamba.

In the first part of the study, all agricultural operations in the estate, and factory operations, were studied in detail. In the second part, application of GPS & GIS technologies to generate and manage tea information was studied, using the St Coombs Estate data.

The major agricultural operations studied were plucking, fertilizer application, pruning and post prune operations, weed management, pest and disease management, shade management, soil conservation, and special operations such as drought mitigation. Only information from the lower Division of the Estate was collected for studying field operations.

All factory operations in the up-country, orthodox tea manufacturing system, and the ISO quality certification system, in the St Coombs factory, were studied. Tea tasting, marketing procedure through the auction, and the books and record-keeping system of the Estate, were also studied.

Using the GPS (Global Positioning System) to generate necessary digital data for developing the GIS (Geographic Information System) database, for a tea plantation, was successfully completed.

### **D 35.3 Tea Smallholder Sector Studies**

#### **Tea smallholder sector development needs**

A study was undertaken to identify development needs and potentials in the smallholder sector, using the data generated by the Tea Smallholder Census of 2005. Using Arc View software, tea smallholder data distribution within District levels was analysed. Appropriate maps were prepared with technical assistance from the GIS unit of the CARP. Writing a final report based on the findings of the analysis is in progress.

#### **Smallholder sector survey**

The Tea Small Holding Development Authority has initiated a sample survey to be carried out in the smallholder sector, with the participation of the Sri Lanka Department of Census and Statistics. The Agricultural Economics Division of the TRI is taking part in this project.

Necessary technical inputs were given in the planning stage of the survey, mainly in questionnaire development. The field survey is to be started in early 2007.

#### **D 35.4 Tea Sector Policy**

The Ministry of Plantation Industries appointed a committee to formulate the National Plantation Policy. The TRI was represented on this committee, and necessary technical inputs were provided to identify policy requirements.

The investment needs for the ten-year period from 2007 were calculated for the tea sector, in order to implement the identified policies. Expected policy gains were also computed in order to justify proper implementation of policies. The tea sector policy, for inclusion in the plantation policy, has been drafted and forwarded to the Ministry of Plantation Industries for necessary action.

#### **B1. Economic Evaluation of Rational Land Use**

The productivity of the tea lands in Sri Lanka is much lower than in the other major tea-producing countries. The low productivity is more obvious in the corporate sector than in the smallholder sector. The declining workforce in the plantation sector has become another constraint for the future development of the sector. Therefore it has become necessary to follow the strategy of confining tea cultivation into the most productive tea lands, and to improve the productivity of such tea lands, especially in the corporate sector.

It is necessary to identify total tea lands by age, type of tea and the level of productivity, in order to develop future plans for improving existing tea, tea replanting, and diversification of unproductive tea lands.

A postal survey has been undertaken to gather necessary information at the micro level. Data analysis will be completed in early 2007, and the results will be discussed at the 214<sup>th</sup> E & E Forum to be held in January 2007.

#### **B5. Cost of Tea Cultivation**

With the increase of worker wages in December 2006, revision of the “Manual on Cost of Tea Cultivation – from Nursery to the Field” was initiated. The revised version will be available in digital form in 2007, as development of software packages to estimate the cost of tea cultivation was initiated. Developing the first module, “Cost of Tea Nursery Management”, has been started.

### **Project Monitoring and Evaluation**

The INFORM data base for the year 2005 was compiled, and submitted to the Council for Agricultural Research Policy.

### **Publication**

Hettiarachchi, L S K and Jayakody, J A A M (2006). Some agronomic measures in tea cultivation for circumventing impact of the revision of urea subsidy. TRI Update, Volume 11, part 2, December 2006.

### **Seminars and Meetings**

Mrs J A A M Jayakody and Mr J C Bandara attended the Crop Clinic, held at the TRI Kottawa Regional Station, Galle, on 23<sup>rd</sup> January 2006.

Mrs J A A M Jayakody presented a paper on "Economic Analysis of Soil Conservation in Tea Lands", at the 212<sup>th</sup> E & E Forum, held on 27<sup>th</sup> January 2006, at TRI, Talawakelle.

Mrs J A A M Jayakody represented the TRI at the tea cluster meetings of the NCED (National Council for Economic Development), Ministry of Finance, held in the Treasury Auditorium, at monthly intervals from June 2006.

Mrs J A A M Jayakody represented the TRI at the Plantation Policy Formulation Committee meetings, held by the Ministry of Plantation Industries, at regular intervals from June 2006.

Mrs J A A M Jayakody represented the TRI at a meeting on "Land Degradation", organized by the Ministry of Environment on 3<sup>rd</sup> August 2006.

Mrs J A A M Jayakody represented the TRI at the NCED tea cluster meetings, held with His Excellency the President, at Temple Trees on 7<sup>th</sup> August 2006.

Mrs J A A M Jayakody delivered a lecture on "Tea Industry of Sri Lanka and Socio-Economic Issues" on 20<sup>th</sup> December 2006, at the TRI, Talawakelle, for a group of students from the advanced programme in Agriculture Economics and Extension, Faculty of Agriculture, University of Ruhuna.

Mrs J A A M Jayakody attended the Tea Sector Review meetings held at the Ministry of Plantation Industries in 2006.

## AGRONOMY DIVISION

Head - A Anandacoomaraswamy

### Research Activities

#### 1. Thrusts A 9 – A 11.

**Project A 9.1 Evaluating soil rehabilitation techniques (Up)**

**Project A 10.1 Evaluating soil rehabilitation techniques (Mid)**

**Project A 11.1 Evaluating soil rehabilitation techniques (Low)**

**Project A 11.2 Evaluating soil rehabilitation techniques (Low)**

**Project A 11.3 Determining the minimum period required for soil rehabilitation techniques (Low)**

**Project A 11.4 Evaluating soil rehabilitation techniques (Low)**

**Development of an economically viable system to eliminate/reduce the soil rehabilitation period, prior to replanting, in the up-country, mid-country and low country.**

There are eight experiments located at high-, mid- and low elevations. The approach was to enrich the soil with organic amendments such as compost, coir dust and refuse tea at the time of planting tea, *in situ* soil rehabilitation with grass after planting tea, *in situ* soil rehabilitation with grass before up-rooting the tea, planting economic crops such as 'thur dhal', cowpea, sweet corn, and lemon grass, planting in trenches with organic amendments, and planting different cultivars.

Only two experiments, one in the low country and the other in the mid-country showed that improvement of organic carbon by incorporating compost, coir dust and refuse tea, either in the planting hole or trenches could match the traditional soil reconditioning with grass for a period of two years. However, in the other six experiments, none of the alternative techniques could match the traditional soil reconditioning with grass over two years.

In the up-country trial, the influence of soil rehabilitation was seen even at the end of the second cycle. The soil rehabilitation did not have any influence with the different cultivars.

In the mid-country, two experiments were conducted under these Thrusts. In one experiment, the yield of directly-planted tea after incorporation of the organic materials is about 50% of the control yield. The influence of soil

rehabilitation was seen even at the end of the second cycle. In the second experiment, addition of organic materials, even at 3 kg per planting hole, did not improve the performance of directly-planted tea. The first-cycle results showed that yields under directly-planted tea, after incorporation of coir dust, compost and refuse tea, were comparable to soil reconditioning with grass. Four experiments were conducted under these Thrusts in the low country. Three experiments have completed two cycles, while one experiment has completed one cycle. There was no difference in yield between direct planting of tea alone, and direct planting of tea after incorporation of compost in planting holes and trenches, compared to soil reconditioning. In another experiment, direct planting of tea, after incorporation of compost in the planting holes, gave comparable yield with that of traditional soil rehabilitation.

Planting of cash crops has not given any economic benefit. *In situ* soil rehabilitation with mana, after planting tea, gave the lowest yield.

## 2. Thrusts A 12 – A 14

### **Project A 12.1 Evaluating the most compatible crop combinations**

**Development of intercropping systems for tea lands with minor export crops, pepper, coffee, vanilla and plantation crops, and with rubber and coconut for the mid- and low-country corporate sector and small holder sectors.**

The objectives of the studies are: (1) to evaluate the compatibility of pepper, coffee and vanilla with cultivated tea in the mid-country small holder and corporate sectors, and (2) to evaluate the compatibility of rubber and coconut with cultivated tea in the low-country small holder and corporate sectors.

### **Project 14.1. Evaluating the most compatible crop combinations.**

#### **i Effect of intercropping tea and rubber on productivity, RRI, Kuruwita (1990).**

This experiment is being conducted in collaboration with the Rubber Research Institute (RRI) of Sri Lanka. There are 6 treatments in 4 replicates (blocks). The treatments are monocropping of tea ( $T_1$ ), monocropping of rubber (18' x 12') ( $T_2$ ), tea (rehabilitated) under rubber (27' x 8') ( $T_3$ ), tea (rehabilitated) under rubber (40' x 8') ( $T_4$ ), tea (unrehabilitated) under rubber (27' x 8') ( $T_5$ ), and tea (unrehabilitated) under rubber (40' x 8') ( $T_6$ ). Unrehabilitated tea and rubber was planted in 1990, while rehabilitated tea was planted in 1992.

Plucking and assessments continue. Unrehabilitated tea plots were pruned in July 2006.

The experiment is in progress.

**ii. Effect of intercropping tea and rubber on productivity, St. Joachim Estate, TRI, Ratnapura (1990).**

The feasibility of intercropping tea in rubber is being tested at St Joachim Estate. There were three treatments, viz. tea alone (stand of tea 100%), tea (stand of tea, 75%) under rubber (40' x 8'), and rubber alone (20' x 12'), in three replicates. The rubber was planted in 1990 and the tea was introduced in 1993.

The yield in the monocropped tea plots was significantly higher than that in the intercropped plots ( $p < 0.05$ ). The average yield was 1.179 kg/yr/bush, whereas in intercropped plots, it was 0.480 kg/yr/bush. The rubber yields showed no significant difference between monocropped and intercropped plots at the 0.05 probability level. Rubber in monocropped system gave an average latex yield of 1139 ml/tree/yr, whereas under the intercropped system it was 1402 ml/tree/yr.

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

Field practices of the demonstration plot were continued during the year 2004.

**iii. Effect of intercropping tea and rubber on productivity, (Observation Block) St. Joachim Estate, TRI, Ratnapura. (1995).**

There are four plots in this observation trial. They are: rubber (20' x 12'), tea, tea in rubber (40' x 8'), and tea in rubber (60' x 8' x 8'). Rubber rows were located in the east-west direction.

Harvesting was continued and yield records of tea and rubber were maintained. The tea bushes were rested in March and pruned in June, 2006.

**iv. Effect of intercropping tea with rubber, rambutan, durian and cinnamon, on productivity, RRI, Kuruwita (2003).**

This experiment was commenced in collaboration with the RRI, the Department of Agriculture, and the Export Crop Department. Rubber was intercropped with tea, rambutan, durian and cinnamon under 4 systems of planted rubber

(double-hedge rows). Planting of tea under rubber was done with, and without, rehabilitation.

The experimental plots were pruned in May, and plucking operations started again in September 2006. An assessment on the effect of shade caused by the rubber trees was also done, where leaf weight/plant, the number of banji buds/plant, and the number of active buds/plant, were measured in relation to different shade levels, that is from the rubber row to different tea rows.

The statistical analysis of yield records showed no significant difference between the treatments.

**v. Intercropping of tea and coconut**

One experiment is in progress at Citrus Estate. The objectives of the trial is to study the feasibility of intercropping tea with coconut at different spacings (12' x 30' and 12' x 40'), with and without soil rehabilitation. This experiment is conducted as an observation trial, owing to the unavailability of an adequate area of land for replication. Tea yields were greater in rehabilitated plots than in unrehabilitated plots. There was an early bearing of coconut planted on rehabilitated plots.

**3. Thrust A 19. Development of water management for young and mature tea in drought-prone areas to minimise casualties and for enhancing yields.**

**Project A 19.1. Determining quantity of water and frequency of application for drought-susceptible clones**

**Project A 19.2. Evaluating existing technologies for water application in tea.**

**Project A 19.3. Evaluating the microclimate in irrigated tea.**

**Project A 19.4. Water harvesting in tea lands.**

**Project A 19.5. Climatic forecasting for cultural operation in tea lands.**

Under these projects, five experiments were commenced in the low country, up-country and the Uva.. The focus was mainly on evaluation of fertigation in relation to the frequency, amount of water and nitrogen, and the responses of the cultivars.

The objectives of the low-country trials was to study the effect of fertigation on the growth and yield of two tea cultivars, TRI 2023 and TRI 3025, under two systems of planting, viz. on raised beds, and on flat beds as control, from young to mature stages.

This experiment has completed the first cycle. Response to fertigation depended (1) on the cultivar, TRI 2023 responding to fertigation more than TRI 3025, and (2) on the system of planting, raised beds giving higher yields.

There were two experiments in the up-country, one at Somerset Estate and the other at St Coombs Estate. The objective of the study at Somerset Estate and St Coombs Estate is to estimate the optimum nitrogen-requirement for fertigation for a high-yielding mature VP cultivar, TRI 2023, and a moderately-yielding cultivar, TRI 2025.

The N requirement varies between 120 and 180 kg ha<sup>-1</sup> annum<sup>-1</sup>, depending on the fertility status. This amount needs to be applied in 300 days. Though response to fertigation was substantial (200 %) during the first cycle at Somerset Estate, it was only 25 % during the third year of the second cycle.

The response at St Coombs Estate was also about 20 %.

#### **4. Thrust A 20. Development of harvesting devices to overcome labour shortages.**

**Project 20.2. Evaluating harvesting devices**

**Project 20.3. Modifying harvesting intervals**

**Project 20.5. Modifying bush management**

#### **Balangoda Estate (1998)**

This experiment was commenced in 1998 in collaboration with Balangoda Estate. Four spacing systems at planting are being tested at Balangoda Group Estate, Balangoda, using two clones. The different spacings are 0.6 x 1.2 m (100%), 0.6 x 0.9 x 1.5 m (100%), 0.6 x 0.6 x 1.5 m (114%), and 0.9 x 0.45' x 1.5 m (133%). The two clones are TRI 2026 and DG 39. The tea bushes were pruned in November 2003.

All cultural practices, and an assessment on yield and bush spread, were carried out. The experiment is in progress.

**Hapugastenna Estate, URG Division**

A new trial was started at the URG Division, Hapugastenna Estate, to evaluate the performance of a new K-Tech electrically-driven tea plucking machine, along with the Kawasaki NV 60H machine and manual plucking, in August 2006.

The experiment has six treatments in four replicates. The treatments are: T<sub>1</sub> – manual normal rounds (7 day intervals), T<sub>2</sub> – manual extended rounds (14 day intervals), T<sub>3</sub> – mechanical harvesting (K-Tech), only in the rush crop season, T<sub>4</sub> – mechanical harvesting (Kawasaki), only in the rush crop season, T<sub>5</sub> – mechanical harvesting continuously with the K-Tech machine, T<sub>6</sub> – mechanical harvesting continuously with the Kawasaki machine.

Plucking operations started in August 2006, after pre-plucking, weeding and other field practices were done.

According to the yield records, manual harvesting is significantly superior to mechanical harvesting. It was found that the harvesting efficiency with K-Tech machine was 4-5 mandays/ha, and the coarse leaf percentage was 30-50. Also the efficiency with the Kawasaki machine was found to be 1-3 mandays/ha, with 20-40% of coarse leaf.

**Project 20.2. Evaluating harvesting devices**

**Project 20.4. Modifying fertilizer application**

**Galaboda Estate**

An experiment was started to test whether a high rate of Zn application would minimize yield loss under machine harvesting.

**Treatments**

Methods of harvesting: Manual harvesting  
Mechanical harvesting (Kawasaki NV 60H)

Levels of Zn application: Recommended rate (4 applications/year)  
Double the recommended rate (8 applications/year)

Replications: 4

Clone: TRI 2027

The yields did not show significant differences between treatments, but the highest yield was reported under manual harvesting and Zn application at the recommended rate, followed by machine harvesting and the recommended Zn application.

Measurements on the percentage of banjies showed no significant variation between the different treatments.

The experiment is in progress.

## **5. Thrust A 24. Development of weed management strategies in tea.**

### **Screening of the new herbicides, Rapid and Master™ (20.5%)**

#### **5.1. Rainfastness of Trigger™ and Rapid**

The visual injury score and the weed dry weight, 14 and 21 days after application, showed that the rainfastness of Rapid and Trigger was 2-3 hrs and 3 hrs, respectively.

#### **5.2.a. Control of Getakola, Morning Glory, Illuk and *Clidemia hirta* weeds at Hantana Estate, Kandy.**

Good control in Getakola weed was observed with Rapid at 4.4 - 5.5 L / ha and with Trigger at 6.6 L/ha. However, *Clidemia hirta* was not killed even at higher dosages of both herbicides.

Illuk (*Imperata cylindrica*) and Morning Glory (*Ipomoea leeri*) were properly controlled by Rapid @ 6-10 ml/L + activator @ 1 ml/L. There was only a partial control of *Clidemia hirta*.

#### **5.2.b. Effect of Trigger and Rapid on the control of *Clidemia hirta* weed at Welandura Estate, Kahawatte.**

There was a control of *C. hirta* (80%) with a high dosage of Rapid, viz. @ 25 ml/L, but the root system was not affected. With Rapid @ 20 ml/L, or Glyphosate @ 15 ml + 4 g SA, almost 75% damage was observed. However, damage of < 60% was reported with Trigger @ 15-20ml +4 g SA, and very poor control with 2,4-D @ 6 ml/L alone.

A final report on the screening of Carfentrazone Ethyl (Trigger™) was submitted to the ACMSC.

The experiments were terminated.

### 5.3. Glyphosate and 2,4-D residue analyses in made tea

#### a. Declining trials and field investigations at regional level.

Field studies to investigate the residues in made tea following application of 2,4-D and glyphosate herbicides at the recommended doses, and double the recommended doses, were commenced at St Coombs Estate on 26<sup>th</sup> Feb. and 6<sup>th</sup> March, respectively. The trials were undertaken adhering to FAO guidelines on pesticide residue studies.

Residue levels of 2,4-D and glyphosate in made tea at different harvesting intervals, viz. at 3-21 DAA, were below the MRL of <0.01 and <0.1 for 2,4-D, and 1 and 2 ppm for glyphosate, which have been set by Japan and the EU, respectively.

#### b. Studies on 2,4-D and glyphosate residue levels at regional level.

Two studies at St Joachim and Hantana Estates showed that the 2,4-D residue levels at 0 and 7 DAA were <0.01 ppm, and the glyphosate residue levels at St Joachim and Hantana were <0.05 and <0.1 ppm, respectively.

### 5.4. Study on the weed-controlling efficacy, and economy of application of lower dosages of glyphosate, in mature tea at (a) New Peacock and (b) Balangoda Estates (2005).

The treatments are: T<sub>1</sub> – glyphosate (36%), 1.1 L/ha; T<sub>2</sub> – glyphosate 1.1 L + SA 1.1 kg/ha; T<sub>3</sub> – glyphosate 1.65 L/ha; T<sub>4</sub> – glyphosate 1.65 L/ha + SA 1.7 kg; T<sub>5</sub> – glyphosate 2.2 L/ha; T<sub>6</sub> – Paraquat 1.1 L/ha; T<sub>7</sub> – Rapid 4.4 L+ activator 0.55 L/ha.

Plots were treated three times with glyphosate at these rates. Hard-to-kill weeds were not controlled but hand-pulled.

There was no significant difference between herbicidal treatments in the made-tea yields, at both locations.

### 5.5 Management of problem weeds

#### a. Use of cover crops, mulching materials and herbicides for the suppression of growth of Passali seedlings, Balangoda Estate (2004).

The impact of ground-cover management and herbicidal treatments, on the growth of Passali over the tea canopy, was studied. There was no significant difference between treatments in the yields of the Passali

shoots collected from the tea canopy. This was because the Passali yams, seedlings and vines, found within tea bushes and underneath tea bushes, were not affected by the treatments. Hence, manual weeding is also important in removing such unattended Passali vines.

This experiment was terminated by the end of 2006. It will be re-started using different herbicidal treatments in 2007.

b. Testing of various cultural methods to manage couch weed, Venture Estate (2004).

Cover crops, such as *Arachis pintoii*, *Brachiaria brizantha* and *Wedelia trilobata*, were established as a strategy to suppress the growth of couch, and avoid slash weeding using wire cord and a knife. Couch grass has been gradually suppressed by invasions of *A. pintoii* and *B. brizantha*. Control by *Wedelia* failed half way. On the other hand, there was proper control with slash weeding, but wire-cord control could not be continued owing to breakdown of the machines.

c. Experiment on the impact of four different mulch sources on the growth of weeds and tea, Welandura Estate (2003).

Though there was no significant difference in weed weight, there was a suppression of weed growth, and a higher tipping weight of tea, under *Flemingia congesta* leaf-mulch treatment. This was attributed to the high durability of *Flemingia* mulch. The experiment was terminated in July 2006.

d. Studies on plant extracts. Effect of the seed extracts of *Michelia champaka* on the control of Passali kodi seedlings in pots.

There was leaf-fall and death of all the above-ground parts with the use of a 25.0% aqueous solution alone, four days after treatment. The use of a 12.5% solution, with or without incorporation of 0.4% sulphate of ammonium, urea or 1% ethanol, resulted in only a few burnt patches on leaves, and a fast recovery from bulbils was soon observed.

e. Impact of soft herbs on the growth of tea and occurrence of weeds, pot experiment, Low Country Station, TRI (2006).

The soft herbs, *Centella asiatica*, *D. heterophyllum*, *Hedyotis corymbosa*, *Peperomia fraseri*, *Evolvulus nummularious* and *Axonopus compressus* were used as treatments, with *Cymbopogon* mulch as the control.

Though not significant, a poor growth of tea was recorded in pots planted with *Axonopus* grass. Excess growth of herbs was managed by cutting them five times, and adding the biomass to the same pot. The highest and the lowest weights added were from *D. heterophyllum* and *P. fraseri*, respectively. The experiment is in progress.

f. Impact of soft herbs and *Arachis pintoi* on the growth of tea, St Joachim Estate (2006).

The occurrence of weeds was suppressed by almost 50% with *A. pintoi*, within 9 months after establishment. Though not significant, the fresh weight of the first cut of tea, after planting, was the highest in plots planted with *A. pintoi*. The lowest weed weight was with the control. However, tea plant height, collar thickness, number of leaves and branches were not affected.

g. Study on the potential of use of *Diyapara* as a mulching source in tea fields (January 2006).

Of three treatments tried, weed growth was significantly suppressed by *Diyapara* mulch to the extent of 45%, when compared to suppression by mana mulch. Weed weight under both mana and *Tithonia* (wild sunflower) mulches was comparable. Tea growth was not affected by any of the mulches.

h. Effect of various forms of hydrated lime on tea-shoot growth, and prevention of moss, ferns and lichens in low-grown tea.

With all three hydrated-lime forms, moss and ferns were controlled, while tea shoot growth was enhanced. Of the lime forms, Kesara lime performed very well. Liming can be practised as an alternative to the practice of 'mossing and ferning', which is highly costly.

## 6. Divisional Activities (Project D/AGRY)

### 6.1 Testing of deep fertilizer applicator, Hapugastenna Estate (2006).

A new trial was started at the LRG Division, Hapugastenna Estate, Ratnapura, in March 2006, to study the performance of the deep fertilizer applicator and its effect on the growth of young tea.

The experiment was arranged in an RCBD design in three replicates. The three treatments applied were:  $T_1$  – half-rate of recommended fertilizer and deep application;  $T_2$  – recommended rate of fertilizer and deep application; and  $T_3$  – recommended rate of fertilizer and manual application.

Assessments of growth (plant height, number of branches, number of leaves, girth, and root weight) showed no significant differences among the treatments. The application efficiency of the applicator was estimated to be 8-9 man days/ha.

The trial is in progress.

### 6.2 Study of the effect of dolomite application on growth of *Gliricidia*.

An experiment was started to evaluate the effect of different rates of dolomite application at planting, on the growth of *Gliricidia*. There were five treatments:  $T_1$  – 56.25 g/hole;  $T_2$  – 112.5 g/hole;  $T_3$  – 225 g/hole (control);  $T_4$  – 450 g/hole; and  $T_5$  – 900 g/hole.

The soil pH, and assessments of growth of *Gliricidia* stumps, were recorded. The soil pH was checked at weekly intervals, during the period of the experiment.

### 6.3 Study of the effect of applying *Gliricidia* loppings on tea yield.

A new observation trial was commenced, in September 2005, to evaluate the effect of *Gliricidia* loppings on tea yield. The two treatments tested are application of *Gliricidia* loppings and control (no *Gliricidia* loppings). Each treatment had four replicates. The experiment was laid out in Field Number 03, St Joachim Estate.

The soil pH, C%, K (ppm) and N% were analyzed before imposing the treatments and harvesting. Growth assessments, and sampling of soil for analysis of soil nutrients, continued.

The experiment is in progress.

#### **6.4 Assessment of different methods of raising nursery plants.**

Observations are being carried out on raising cuttings in seedling trays instead of polythene bags. The trials are being carried out with different sizes of trays, and different sources of cuttings viz. mother bushes and tea fields in plucking.

### **7. Other Activities**

#### **7.1 Patents**

From a series of investigations undertaken, it was found that aqueous solutions of 'ginisapu' seeds can be used as a natural herbicide. Thus, an application (Application Registration No. 14253) was submitted to the Patent Office in September for obtaining a Patent Certificate for this novel technology.

Dr. M.A. Wijeratne received Science & technology Awards 2006 for the development of suitable devices for improving worker productivity and quality of made tea. He also received the General Research Committee Award 2006 from the Sri Lanka Association for the Advancement of Science for his outstanding contributions to the Scientific Research in Sri Lanka.

#### **7.2 Research Publications and Communications**

- a. Prematilake, K G (2006). Safe use of herbicides in tea. Proceedings of the 213<sup>th</sup> Experiments and Extension Forum, 28<sup>th</sup> July, The Tea Research Institute, Talawakelle.
- b. Prematilake, K G (2006). New herbicide formulations for effective control of 'Passali kodi' and 'Getakola'. Proceedings of the 212<sup>th</sup> Experiments and Extension Forum, 27<sup>th</sup> Jan., The Tea Research Institute, Talawakelle, p. 23-32.
- c. Prematilake, K G and Liyanage, S (2006). Two new herbicide formulations for effective control of 'Passali kodi' and 'Getakola'. TRI Update, 10 (2), The Tea Research Institute, Talawakelle, p. 3-4.
- d. Kahatapitiya, H., Wijeratne, M.A. & Pathiranage, S (2006) Use of Selective Tea Harvester: A Success Story" TRi Update" Vol 11, No.2: 1-3

### 7.3 Papers Accepted

- a. Prematilake, K G Scenario of detection of herbicide residues in exported tea, its repercussion, possible causes and way out. Submitted to the NIPM in October for publication in the NIPM Journal (in press).
- b. Prematilake, K G, Liyanage, S, Pinidiya, T and Jayasingha, (2006) Management of U. (*Panicum species*) weed in organic-tea system UPDATE, TRI vol. 11 No. 2 Dec. ISSN 1391-6793, p9-10.
- c. Prematilake, K G, Liyanage, S *Arachis pintoii* - A promising bio-control agent for *Panicum* spp. (A new couch spp). Agricultural Res. News, CARP, Vo; 7. No.3 July-Sep. ISSN 131-5223 p-6'
- d. Prematilake, K G Integrated Weed Management in Tea. *In* Hand Book on Tea, The Tea Research Institute of Sri Lanka, Talawakelle (in press).
- f. Panabokke, C.R., Amarasinghe, I, Pathirange S.R.W., Wijeratne, M.A., Amarathunga, S.L.D. Anandacumaraswamy, A. Land suitability classification and mapping of tea lands in the Ratnapura District (Accepted for publication in the SLJTS)

### 7.4 Projects & Theses Supervised

- a. Impact of various adjuvants on herbicidal efficacy in the control of weeds in tea cultivation. H M M. Malkanthi, University of Ruhuna (2006).
- b. Study on growth, morphology and control of *Clidemia hirta* ('bovitiya') weed. S T Ranasinghe, University of Ruhuna (2006).
- c. Effect of various forms of hydrated lime on tea shoot growth and control and prevention of moss and ferns found on tea frame. L K R D Batagoda (2006),
- d. Studies on the allelopathic effect of *Arachis pintoii* and *Brachiaria brizantha* grass in the suppression of *Panicum* spp (couch grass) and the promotion of field establishment of *Arachis pintoii*. Sisira Ratnapriya, Faculty of Agriculture, University of Peradeniya.

Effect of CO<sub>2</sub> fertilization on growth of tea cuttings. J.K.D.N. Rangi, Faculty of Agriculture, University of Peradeniy (Supervised by Mr. M.A. Wijeratne)

Effect of different methods of weed management on soil erosion in tea lands at low elevations. S.P.K. Amarasinghe, Faculty of Agriculture, University of Ruhuna. (Supervised by Dr. M.A. Wijeratne)

Study on the variation of soil nutrients and growth of tea under tea and rubber intercropping system. A.J.S. Weerasooriya, Faculty of Agriculture, University of Ruhuna (Supervised by Dr. M.A. Wijeratne)

### **7.5 Issuance of Communications and Publications**

Revisions of Advisory Circulars, writing-up short communications, Ready Reckoners, etc.

### **7.6 Seminars, Workshops, Crop Clinics, Field Demonstrations and Training Programmes**

- a. Dr K G Prematilake made nine seminar presentations at RSC Forums for stakeholders in Plantation Management Companies, TSHDA officers and small holders on herbicide residues in made tea at different locations.
- b. Dr K G Prematilake made two oral presentations at the 212<sup>th</sup> and 213<sup>th</sup> E & E Forums of the TRI, in January and July 2006, at Talawakelle, for Senior Officers of Plantation Management Companies on herbicide residues in made tea and new herbicide formulations.
- c. The Division organized field demonstrations at special field days for tea small holders and stakeholders of the corporate sector, at the TRI.
- d. Divisional staff participated actively in 'Crop Clinics', organized by the TRI, for smallholders at Katuwana, in November 2006.
- e. Dr K G Prematilake participated actively in meetings with the CTTA, the steering committee of the Sri Lanka Tea Board, the Tea Association of Sri Lanka and the Tea Brokers Association, in connection with the pesticide residue issue, held in Colombo in 2006.
- f. Dr K G Prematilake organized a one-day workshop on 'Safe and Effective Use of Pesticides', which was conducted and sponsored by 'Crop Life Sri Lanka', in collaboration of the SLAAS, for technical staff of the TRI., in June 2006.

- g. Screening trials for two new herbicide formulations received from agro-chemical companies have been completed. The final report on one herbicide has already been submitted to the ACSM Committee of the TRI. for recommendation.
- h. Dr. M.A. Wijeratne has made more than 23 presentations addressing Chief Executive Officers of plantation companies, estate managers, staff of tea factories and small holders on proper agronomic practices, rush crop management, machanization of field practices, preventing contamination of tea ans climate change impact of on tea plantations. He also made 3 presentations to school children on inventions at seminars organized by the Inventor's Commission.

## BIOCHEMISTRY DIVISION

Acting Head – A M T Amarakoon

### Research Activities

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

This project aims at studying the chemistry and biochemistry of disease-resistance mechanisms in relation to blister blight leaf disease in tea, with the ultimate objective of controlling the disease in an environmentally-friendly manner by exploiting natural disease-resistance traits inherited in the tea plant.

Progress of the project up to 2005 can be summarized as follows.

- (-) Epicatechin could be used as a biochemical marker to identify blister blight-resistant tea cultivars.
- Proanthocyanidins (condensed tannins) in tea leaves were identified as defense-response chemicals to *E. vexans* infection.
- Anthocyanidin reductase, one of the key enzymes in the biosynthesis of proanthocyanidins, was identified in tea for the first time.
- HPLC methods were developed for the analysis of proanthocyanidins in fresh tea leaf and in black tea.
- Assay methods were optimized for pectate lyase, polygalacturonase and cellulose (cell-wall degrading enzymes).

In 2006, attempts were made to isolate different types of proanthocyanidins in gram quantities for use in bioassays to determine the fungitoxicity. The flavonoid fraction was isolated by solvent extraction, and proanthocyanidins were fractionated using LH-20 column chromatography. Proanthocyanidins are then separated using high-speed counter-current chromatography. Characterization of the isolated compounds will be carried out.

Leaves from 300 plants (2043 x 2023) were harvested and stored for chemical analysis of catechin, caffeine, theobromine, total anthocyanin and proanthocyanidin content. At present, analysis for catechin and theobromine is carried out using the ISO 14502-2 method.

## **2. Project B 18. Use of DNA markers for molecular characterisation of tea. Screening of tea cultivars using Random Amplified Polymorphic DNA (RAPD)**

The RAPD (Random Amplified Polymorphic DNA) study, using 39 cultivars in phase I of the study, generated useful information on the genetic diversity of tea cultivars.

Work in the phase II of the RAPD study of tea cultivars prior to 2006 could be summarized as follows.

RAPD-PCR was performed on 46 tea cultivars selected for phase II using five primers. The primers were OPA 9, OPA 11, OPB 4, OPE 9 and OPE 11. The study was continued using 15 additional primers, which were OPA 7, OPA 10, OPA 16, OPB 10, OPB 13, OPB 17, OPB 19, OPC 9, OPC 10, OPC 14, OPC 17, OPD 03, OPD 15, OPD 07 and OPE 06. Analysis of RAPD data for all 20 primers was carried out using Rapdistance software (version 104). A dendrogram was constructed using the RAPD profiles.

In addition, according to the pedigree, 11 tea cultivars were identified as the ancestors of most of the tea cultivars developed at the TRI. These 11 cultivars were subjected to RAPD-PCR analysis. Based on the data matrix constructed using RAPD fragments, genetic distances were calculated, and a dendrogram was constructed to find the genetic relationship between the cultivars. The dendrogram divided the 11 cultivars into two main clusters, one cluster comprising predominantly TRI cultivars and their common ancestor ASM 4/10, and the other cluster comprising estate cultivars and TRI 777.

It was shown that most of the cultivars developed by the TRI originated, directly or indirectly, from ASM 4/10, and that all these cultivars demonstrated close genetic relationships which could lead to in-breeding depression. This indicates the importance of characterizing germplasm genetically, and of using this information in future tea breeding programmes.

Phase II of the project was completed in 2006. Significant findings were that the genetic distance between TRI accessions and estate selections were higher (0.73) than those observed previously, and that the TRI 62 series, derived from ASM 4/10 OP progenies, was genetically different from other TRI accessions.

**The Fairlawn seedling study**

A genetic diversity study in the Fairlawn seedling trial was initiated. A total of 27 tea accessions were selected for the study. DNA was extracted using a mini-prep DNA extraction method for RAPD-PCR amplifications. RAPD-PCR reactions are in progress.

**Inbreeding depression and parentage analysis**

To investigate the applicability and readiness of the RAPDs method for parentage analysis of tea cultivars, a set of cultivars were selected, together with their parents, for initial studies. DNA was extracted using the same mini-prep procedure

**Development of SSR markers for blister blight resistance and genetic mapping**

The development of a genomic SSR library, and the development of SSR primers specific for tea, were initiated. A set of EST-SSR primers, that were developed in the project, was screened for polymorphism using two diverse cultivars (TRI 2023 and TRI 2043) and six individuals from their F1 progeny.

To facilitate future mapping studies, a set of phenotypical, morphological and biochemical characters were identified for the assessment. Preliminary assessment trials were carried out for the F1 population derived from a biconal seed garden, TRI 2043 x TRI 2023.

**3. Project B 19. Biological effects of tea consumption.****Anti-inflammatory activity of Sri Lankan black tea**

The anti-inflammatory potential of Sri Lankan BOPF-grade black tea brew was evaluated using a Wistar rat model.

The anti-inflammatory activity of high grown, mid-grown and low grown BOPF-grade brews were evaluated using a brew with a concentration of 480 mg/L, which is equivalent to 12 cups of tea per day.

The results show that teas from all the elevations possess significant anti-inflammatory activity ( $P \leq 0.05$ ) up to 5 hours after administration. Peak anti-inflammatory activity was seen at the 4<sup>th</sup> hour (high grown 72%, mid-grown 66%, and low grown 64%). However, the anti-inflammatory activity was

significantly lower than that of the reference anti-inflammatory drug, indomethacin (4 mg/kg).

HPLC analysis of tea brews revealed that flavonoid levels vary with the elevation. Determination of anti-oxidant activity of the brews by DPPH assay showed a marked anti-oxidant activity which was highest in the high grown teas, followed by low grown and mid-grown teas. A positive co-relation was evident with the levels of flavonoids and anti-oxidant activity and anti-inflammatory activity. It is possible that the anti-inflammatory activity of tea is mediated, at least partly, by its anti-oxidant activity.

The project was carried out in collaboration with the Department of Zoology, University of Colombo.

**Antinociceptive potential in rats of Sri Lankan BOPF-grade black tea (*Camellia sinensis L.*), produced at different agro-climatic elevations.**

Nociception is a measurable physiological event of a type associated with pain. Therefore, in laymens' language, antinociceptive activity could be defined as that which gives relief from pain.

The antinociceptive activity of several herbal drugs is claimed to be due to polyphenols. Tea contains high levels of polyphenols. Thus it is possible that tea may also have antinociceptive potential.

In this study, the antinociceptive potential of Sri Lankan black tea (high grown, mid-grown and low grown) were evaluated using a Wistar rat model. Three different concentrations of high grown BOPF-grade black tea brew (containing 60, 120 and 480 mg/L of tea solids), and distilled water (as control), were orally administered to healthy, adult male Wistar rats (1mL/100g body weight; n = 9/group), and the antinociceptive potential was evaluated up to five hours at hourly intervals, using the hot-plate and tail-flick techniques. In addition, the antinociceptive potential of mid- and low grown BOPF-grade black tea was assessed at a high dose (480 mg/L, which is equivalent to 12 cups).

The results show that high grown BOPF-grade black tea possesses significant short-acting antinociceptive activity ( $P \leq 0.05$ ), when evaluated by the hot-plate technique but not by the tail-flick technique. This indicates supra spinal antinociceptive activity.

The onset of this activity is quick (within two hours), and was dose-dependent at the 2<sup>nd</sup> and 3<sup>rd</sup> hour post treatment ( $r^2=0.91$ ,  $P < 0.05$ , and  $r^2=0.97$ ,  $P < 0.05$ , respectively).

High doses of mid- and low grown tea brews showed comparable antinociceptive activity to that at the same dose of high grown BOPF. The tea brews did not induce muscle relaxation actions (as judged by the bar-holding test), and muscle in-coordination actions (as evaluated by the bridge test), suggesting that the antinociceptive effect observed is genuine.

The project was carried out in collaboration with the Department of Zoology, University of Colombo.

#### **Effect of black tea on oral anaerobic bacteria**

A project on the effect of Sri Lankan black tea on oral micro-organisms was continued in 2006.

The study was conducted to find the effect of black tea brew on oral anaerobic and facultative anaerobic bacteria. Saliva samples were obtained from patients attending a clinic in the Faculty of Dental Sciences, University of Peradeniya. The samples were cultured on blood-agar plates and incubated under anaerobic conditions. It was found that the growth of anaerobic and facultative anaerobic bacteria was suppressed by catechins and theaflavins.

#### **Effect of black tea on stroke**

Ischemic cerebrovascular disease (stroke) is one of the leading causes of death and long-time disability. Studies have shown that the generation of reactive oxygen species (ROS) play an important rôle in the pathogenesis of cerebral ischemia.

A collaborative project was initiated with University of Sri Jayewardenepura (USJP) and the National University of Singapore (NUS) to study the effect of black tea and green tea on stroke, using an *in vitro* brain-cell model.

Initially (up to 2005), the antioxidant activity of Ceylon black tea was measured *in vitro* using trolox equivalent antioxidant capacity (TEAC) and the pyrogallol red bleaching assay. Ceylon black tea and Chinese green tea had comparable

antioxidant activities, which were slightly lower than that of the positive control, ascorbic acid.

In 2006, the effect of tea on cell viability was evaluated under hypoxic conditions (restricted oxygen supply as in stroke), using an *in vitro* cell line. It was found that tea could significantly reduce cell death under hypoxic conditions.

#### **4. Project D 30. Development of multi-residue methods for the analysis of pesticide residues in tea.**

In 2006, a method was optimized for hexaconazole analysis. This method was used to analyze the samples from the field trial, carried out by the Plant Pathology Division of the TRI, for finding levels of hexaconazole residues under good agricultural practices (as per TRI recommendations).

A method is also being optimized for propiconazole analysis.

#### **5. A 29 Development of value added products**

##### **Project A 29.2. Extraction of proteins from black tea.**

In black tea manufacture, 3% of the harvested tea leaf is discarded as refuse tea. Refuse tea contains 20-30% of crude protein. If this valuable protein were to be utilized in animal feeding, or for direct human consumption, it would reduce, to a certain extent, the widespread protein-energy malnutrition in less developed countries like Sri Lanka. It would also generate additional profits for the tea industry.

This project was carried out with the objective of establishing procedures for the extraction of protein from refuse tea, and for the purification of the protein so extracted.

Previous work has shown that medium-sized particles of refuse tea (RTm) (which pass through a No. 4 mesh) were the most suitable for protein extraction. Conditions were optimized for the extraction of leaf-protein concentrate (LPC) from RTm. The nutritional composition of RTm and LPCs obtained at different stages of purification were compared.

In 2006, studies were carried out to find the mineral composition of the LPCs prepared.

The results are given in Tables 1 and 2.

**Table 1. Macro mineral and aluminium content (ppm)\*.**

Sample	Ca	Mg	Na	K	P	Al
RTm	6543±85	2267±62	160±7	21215±11	3307±85	663±77
LPC-1	790±56	1142±85	35262±189	8770±0	3818±3	969±71
LPC-2	8397±41	600±44	5718±51	3298±1	2956±31	1123±7
LPC-3	12118±14	736±37	2903±35	2720±6	3530±74	1500±16

**Table 2. Trace mineral content (ppm)\*.**

Sample	Zn	Cu	Fe	Mn
RTm	40.89±1.88	33.64±0.65	281.39±5.83	266.48±2.39
LPC-1	47.53±0.15	68.33±2.10	414.53±11.18	237.43±0.40
LPC-2	43.46±1.91	87.43±0.76	226.78±2.13	229.44±11.08
LPC-3	51.37±1.21	108.40±0.23	ND	283.78±0.15

\*Values are means of duplicates ± SD

ND: Not detected

Purified LPC was a rich source of minerals. To avoid high aluminium content in LPCs, instruments made of stainless steel should be used.

### General

- Dr I S B Abeysinghe, Head, Biochemistry Division, was appointed Director, TRI with effect from 23<sup>rd</sup> November 2006.
- Dr A M T Amarakoon was appointed Acting Head, Biochemistry Division, with effect from 23<sup>rd</sup> November 2006.
- Dr A M T Amarakoon was appointed Chairman, National Technical Advisory Committee on Tea, Sri Lanka Standards Institute, in March 2006.
- Dr A M T Amarakoon was appointed Chairman, Technical Working Group on Good Manufacturing Practices of Black Tea, Ministry of Plantation Industries, in August 2006.

- Dr A M T Amarakoon was a member of the Sri Lankan delegation to the 17<sup>th</sup> Food and Agricultural Organization (FAO) Intergovernmental Group (IGG) Meeting on Tea, 26<sup>th</sup> November – 1<sup>st</sup> December 2006, Nairobi, Kenya.
- Dr A M T Amarakoon was a member of a technical delegation to Japan on pesticide residue issues, 17<sup>th</sup> – 20<sup>th</sup> April 2006.
- Mr P A N Punyasiri was awarded the degree of Ph D from the Postgraduate Institute of Science, University of Peradeniya, on 20<sup>th</sup> September 2006. His thesis was entitled “Preformed and induced chemical resistance of tea leaf against *Exobasidium vexans* infection”.
- Dr P A N Punyasiri received the prestigious Kandiah Memorial Award for the best piece of research in Chemical Sciences carried out in a Sri Lankan research Institute, from the Institute of Chemistry, Sri Lanka, in June 2006.
- Mr K M Mewan proceeded to the Samuel Roberts Nobel Foundation, Oklahoma, USA, in October 2006, to carry out a project on “A genomics approach to improvement of disease resistance in tea”, for a period of six months.

#### **Collaborators (Non-TRI)**

1. Prof. V Kumar and Prof. (Mrs) S Kumar, Department of Chemistry, Faculty of Science, University of Peradeniya, in the Biological Pest Control Project.
2. Prof. E Karunanayake, Department of Molecular Biology and Biochemistry, Faculty of Medicine, University of Colombo, on “Use of DNA Markers for Molecular Characterization of Tea”.
3. Mr J M D T Everard, Geneticist/Plant Breeder, Coconut Research Institute, Lunuwila, on “Use of DNA Markers for Molecular Characterization of Tea”.
4. Dr G J Panagoda, Faculty of Dental Science, University of Peradeniya, on “Effect of Black Tea on Oral Health”.
5. Prof. W D Ratnasooriya, Department of Zoology, University of Colombo, on the biological effects of tea consumption.

6. Dr Ranil de Silva, Department of Anatomy, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda on the biological effects of tea consumption..
7. Sherry S H Huang, Department of Pharmacology, National University of Singapore, Singapore, on the biological effects of tea consumption.
8. Yi Zhun Zhu, Department of Pharmacology, National University of Singapore, Singapore on the biological effects of tea consumption.

### Publications

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- Amarakoon, A.M.T., Huang, S.H. and De Silva, R., (2006) Therapeutic Applications of Ceylon Tea: Potential and Trends. *In* Natural Products:: A Must for Human Survival, YZ Zhu, CH Liu, BH Bay and B Tan (eds.), pp. 357-399. World Scientific Press, London.
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# ENTOMOLOGY DIVISION

*Acting Officer-in-Charge - R S Walgama*

The research and development activities undertaken by the staff of Entomology Division are summarized in this report. The research activities were carried out in the up-country, the mid-country, the Uva, and the low country regions, as well as in the Deniyaya and Kottawa areas, which represent the major agro-ecological regions. Some of the research activities were conducted in collaboration with the Plant Breeding, Plant Physiology, Biochemistry and Technology Divisions as stipulated in the Corporate Plan.

The report highlights work under research activities and miscellaneous activities, during the period under review. The research activities are grouped under major headings, viz. cultivar, chemical and biological control work against major pests of tea, miscellaneous entomological and nematological activities, and work on 'organic' and 'biodynamic' tea cultivation.

## Research Activities

### 1. Thrusts A 1 – A7 Cultivar screening and related work

Screening new cultivars and selection of lines for resistance to major pests of tea were carried out in all agro-ecological regions in collaboration with the Plant Breeding Division. The activities are given in Table 1.

**Table 1. Summary of activities in relation to cultivar screening**

Thrust	Project	Experiment/Trial	Location	Pest
2.0	2.1	ME 34 (selections from seedlings)	Madulkelle Estate	SHB
	2.2	Assessments on recommended cultivars	Various locations in Mid-country	SHB
		Assessments on mother bushes	Mid-country Station	SHB
3.0	3.1	Germplasm assessment	Passara Station	SHB
	3.2	Screening lines (UVP 9 & UVP 10)	Passara Station	SHB
4.0	4.1	Germplasm assessment	St Joachim Estate	SHB
	4.2	Screening lines (LE 78, LE 85/LE 101, LVP 75, LVP 76, 77, 78, 79)	St Joachim Estate	SHB LCLWT
7.0	7.2	Seedling assessment	Hapugastenna Estate	SHB

During the period under review, the following activities in relation to Project A 1.6 (Screening new cultivars and lines for resistance against *Pratylenchus loosi* in different locations, Experiment N1A), and Project A 2.5 (Screening new cultivars and lines for resistance against *Radopholus similis* in different locations, Experiment N1B), were carried out.

Population build-up and monitoring of nematodes were in progress at the nematode-screening tanks in Talawakelle and Passara (for A 1.6) and Hantane (for A 2.5).

New cultivars were propagated in the Nematology nursery at Talawakele for screening purpose.

Soil- and root-populations of nematodes in different plots planted to different cultivars, in the Phase II trials, maintained by the Plant Breeding Division, at St Coombs, Talawakele and Cecilton Estate, Balangoda, were determined to generate additional information.

## **2. Thrust 22. Development of cost-effective control methods for integrated management of shot-hole borer**

### **Project A 22.1 Screening of synthetic pesticides for reducing shot-hole borer damage in immature and mature tea**

Screening of pesticides continued for major pests in trials at various locations. The trials were mainly for testing the efficacy of Regent® (Fipronil) as the previous trials on the same chemical were inconsistent.

The experiments **ME 29** (Madulkelle and Nayapana Estates in the mid-country), **LE 99** (Hapugastenna Estate in the low country, and **E 340** (Ury Estate in the Uva) were for testing Regent® against shot-hole borer. Regent at 800 ml and 1000 ml/ha, the recommended chemical Laybicide® (Fenthion) at 4500 ml/ha, and an untreated control, were included in these replicated experiments.

The results suggest that Regent, at both the dosages, give about 20 – 60% control of shot-hole borer (average 40%). The chemical prevented the formation of galleries, but subsequently the population levels were low. This is of practical importance as beetles get killed before the next generation is produced, and therefore the populations are smaller and have less impact on the tea.

Pesticide usage in tea continued to receive same attention as concerns regarding pesticide residues in tea were intensified. Activities of the Division were strengthened to assist tea exporters to meet the stringent requirements.

Meetings and discussions with local agencies and local and foreign representatives (SLTB, TASL, PA, producers, exporters, ROP, importers and buyers) were continued regularly, and issues related to pesticide residues in tea were discussed.

In order to generate information on residue levels of recommended chemicals by the Institute, field trials were initiated in collaboration with the Biochemistry Division, prioritizing the most commonly used pesticides,

**Project A 22.2 Screening of biological control agents for reducing Shot-hole Borer damage in immature and mature tea**

Work was re-started with the cultures of foreign isolates maintained in the laboratory for some time. Mass culturing was done, using a rice medium, in order to obtain spores sufficient enough for field application. Work was started after isolation of local strains of the fungus *Beauvaria bassiana* from two locations, Mattakelle Estate and a home garden from the Welimada area.

Laboratory bioassays using local isolates or strains of the entomopathogenic fungus, *Beauvaria bassiana*, showed that the fungus is highly pathogenic to shot-hole borer, imparting more than 90% of mortality in about 7 days after contamination. Different concentrations of the fungal strains were also tested for efficacy. It was found that all the concentrations tested were effective against the beetle, imparting more than 75% of mortality when compared to controls.

Suitable fields in locations, representing all the agro-ecological regions, have been selected, and experimental plots laid in some of those locations for experiments to test the efficacy of local strains against shot-hole borer.

A survey was carried out around the Kanneliya jungles for a biological control agent of SHB, which had been reported earlier in the late 1960s. The biological control agent was a wasp (Order Hymenoptera, Family Perilampidae) known to attack ambrosia beetles.

Field visits were made to the Kanneliya and Udugama areas in the Galle District for collecting insects to monitor the activity of this wasp species. Tea fields around the Kanneliya jungles were sampled; aerial sampling using light traps was also carried out.

The specimens collected comprised of dipterans, coleopterans, homopterans, and also a few aulacids and eucharitids. Only one specimen belonging to the family Perilampidae was collected. This was however not the species reported earlier, namely *Monocon senex* and *Monocon angustum*.

#### **Project A 22.5. Modifying potassium fertilization for reducing Shot-hole Borer damage**

Experiments, E 289 (Attampitia Estate, Badulla) and E 290 (Hantana Estate, Hantana), on assessing the effect of potassium fertilization on shot-hole borer were continued after the plots had been pruned. Monthly sampling was done, either as branch breakages in the case of recently pruned plots, or as destructive sampling in the case of plots having a growth of about 12 months after prune.

#### **Project A 22.7. Modelling yield-damage relationships for major / primary pests**

The 'SHBMODEL' shows that the population dynamics of shot-hole borer are closely linked to the availability of stems for colonization and breeding. As such, the simulated dynamics was close to the observed dynamics in the field, where the infestation level starts to build up around 8 or 10 months after prune, reaches a peak after around 18 months, and then declines towards the end of the pruning cycle.

Also, the temperature has a more pronounced effect on the population structure as very few generations are produced in cooler areas (upper elevations of the up-country), while many generations are produced in areas where the climate is congenial (for example, the mid-country and the Uva regions).

Experiments ME 32 (Nayapana Estate, Nayapana) and E 393 (Mayfield Estate, Kotagala) have started to give evaluations of yield loss due to shot-hole borer, if there is anything notable within a pruning cycle. These replicated trials have Laybicide® (fenthion) at the recommended dosage of 4500 ml/ha (one application, or repeated applications if necessary), and an untreated control. Yield recording and monitoring for infestations will be done.

### 3. Thrust A 23 Rational control of major pest and diseases of tea with a view to reducing the usage of pesticides

#### Project A 23.8. Integrated management of nematode pests in tea lands

- **Detection of nematode species in tea lands in low elevations**

The results of the extensive survey conducted during 2003-2006 in nurseries, fields and rehabilitation lands of smallholders and corporate tea estates, in the mid- and low-grown tea areas, such as Ratnapura, Rakwana and Kalutara districts, for nematodes. indicated additional nematode-prone and -active areas. The incidence of *Radopholus similis* (a mid- and low-elevation nematode species) seemed to be diminishing, while *Pratylenchus loosi* (an up-country nematode species) was increasing, when compared with previous findings on nematode distribution. The association of *Radopholus similis* with Guatemala grass was found to be increasing.

Strict quarantine measures, nursery fumigation, land rehabilitation with Mana, and prophylactic nematicidal treatments at planting, were made compulsory in all tea-growing areas, in order to control further spread of nematode incidence. Several awareness and demonstration programmes were conducted with the assistance of TSHDA field staff for the benefit of smallholders.

- **MeBr 9. Development of a steam chamber for soil sterilization in nurseries**

The prototype steam chamber is to be used as a model soil-sterilizing unit for nematode control in nursery soils.

- **N 435. Growth, establishment, and nematode incidence, in tea grown on tea soils planted to potato**

An experiment is in progress to study growth and establishment, and nematode incidence, in young tea grown on tea soils planted to potato (source: Delmar Estate), under glasshouse conditions.

- **N 375 c. Evaluation of field establishment of tea plants raised on *Pinus*, *Eucalyptus* and Mana soils**

A field experiment is in progress to study the performance of tea (cultivar DN) plants, raised on *Pinus*, *Eucalyptus* and Mana soils, at Great Western Estate.

#### **4. Thrust A 32. Development of organic farming systems for tea**

##### **Project A 32.3. Biological and non-chemical pest disease management under organic tea cultivation**

Various laboratory and field activities were launched at St Coombs and in different agro-ecological regions, for generating information on scientific validations and feasibility in relation to pest, disease and weed incidence in biological, natural, non-chemical, and biodynamic and organic systems.

- **The Central Biological Laboratory**

Collaborative research programmes were in progress at the central facility using the expertise of CABI Biosciences, UK, the Tokyo University of Agriculture and Technology, Japan, the Wayamba and Sri Jayawardenapura Universities, and ITI, Colombo, in developing and maintaining local biological strains for bio-management of insect and nematode pests in tea.

- **N 446. Evaluation of natural products against tea mites**

The efficacy of (1) lauric acid, 70% EC (a natural product from coconut oil, which is also used as a food additive), (2) an extract of *Adathoda* (*Adathoda vasica*), and (3) turmeric (*Curcuma domestica*), against the recommended acaricide, Propargite, was studied under laboratory and field conditions. Their beneficial effects in terms of mite control and tea quality, and their non-target effects, are being studied.

- **E 339. Evaluation of local materials, having pesticidal and termiticidal properties, as non-chemical alternatives in managing up-country livewood termites on tea lands**

Field studies at Gouravilla Estate, Upcot on non-chemical soil treatments, assuring crop sustenance through termite control and improved green leaf yield in UCLWT-affected tea fields, were monitored. Economic and practical benefits of such alternative methods to the expanded rehabilitation of UCLWT-affected tea lands are being studied.

#### **5. Thrust A 33 Identification of factors for yield decline**

##### **Project A 33.2. Nematological contributions to yield decline and bush debilitation in low-grown tea**

Recent records and analytical reports reveal an increasing trend in the extents affected by yield decline and bush debilitation in the cooperate sector, and in the proprietary- and small-holding sector, in many low-grown areas, such as Balangoda, Rakwana, Ratnapura, Sooriyakanda, Deniyaya and Hapugastenna.

Various studies to determine biological causes for such debilitation and death of bushes were carried out, inclusive of long-term monitoring studies at the Nematology Experimental Area at Talawakele, in affected tea lands in Sooriyakanda and Hapugastenna, and in-depth trials at affected fields in Asamondagamhena Estate, Sooriyakanda.

- **N 433. Identification of factors for yield decline in low-grown VP tea**  
Initially, data on the similarities and differences in symptoms and attributes, connected with other known instances of yield decline in perennial crops, were compared, with a view to proposing corrective measures against yield decline in tea. The crops, for which data were generated, are: tea ('High Forest', 'Deniyaya', TV2 and 'Dimbula'), peach ('Peach Tree Short Life', 'Root Rot' and 'Blight'), and coconut ('Leaf Scorch Decline', 'Coconut Rapid Decline' and 'Tapering Disease').

The association with *Pratylenchus loosi* was clear. Results from glasshouse and micro plot studies gave possible disease complexes related to incidence of the nematode. The spreading pattern in the field seemed to be opposite to the 'Deniyaya Problem' where the damage occurs from bottom to top, indicating possible association with soil-borne pathogens.

The tea root systems were found to be severely affected, and interestingly the root fragments carried significant residual populations of nematodes, warranting precautions at subsequent planting in affected areas.

Since there is no measure for estimating damage levels and damage extents in tea, attempts were made to develop an ADSI (Average Disease Severity Index) in the affected lands, in order to understand the damage level and ADSI-specific management methods to be adopted by growers and tea inspectors in determining the severity of the problem. Further work is in progress for fine tuning, and field applications of this method, as a reliable tool.

The results of bioassays revealed significantly reduced mean root growth after two months' planting in plants grown in sick soils, compared to that in healthy soils. Also, root growth in plants grown in original soils was lower than that in sterilized soils, indicating a biological factor responsible for plant growth. Ill-drained conditions, resulting in high clay content and poor soil management, would have restricted root growth, aggravating bush

debilitation. Soil-borne pathogens, especially plant parasitic nematodes (*Pratylenchus loosi*), were proved to cause yield decline, bush debilitation and death in tea.

- **N 434. Nematode incidence in tea fields with yield decline and death of tea in the low country**

The results of field trials, set up at the Hapugastenna and Asamodagamhena in Sooriyakanda Estates, revealed significant differences ( $Pr > 0.0001$ ) in nematode (*Pratylenchus loosi*) counts between different root sizes and root fragments. The root fragments exhibited significantly higher nematode counts than did other root sizes. The root fragments of severely affected bushes had a greater number of nematodes ( $Pr > 0.0111$ ). The rhizospheres of the very severely affected bushes had the highest values, which differed significantly. There was no significant difference between nematode counts in soil and feeder roots. ADSI and nematode counts in root fragments and soil showed a good correlation.

Root damage caused by ill-drained soils, and from secondary infection by other organisms, could also be observed, and these factors seemed to aggravate the decline symptoms in tea. Therefore, in rectifying the situation of tea being debilitated in this area, soil-improvement methods, such as organic matter addition, forking, soil conservation, proper fertilizer application, etc., are essential. Prophylactic measures, and treatments recommended by the Institute, should be made compulsory to stop further aggravation of the problem.

- **N 447. Demonstration trial on comparative effects of GAP on yield decline and death of tea in the low country**

In order to convince those concerned of the importance of appropriate and timely agronomic and cultural operations (GAPs), in the management of shot-hole borer and low country livewood termite, which were found to be totally neglected, and of the dangers from the inappropriate use of fertilizer, extensive applications of herbicides, and inferior pruning practices, model demonstration sites representing first- and second-year prune fields were monitored with the assistance of TSHDA field staff.

- Institute-recommended practices and estate practices were studied at Victor's Land and Palitha Group in Deniyaya. Preliminary results indicated comparatively superior recovery after pruning, yield and bush vigour.

**6. Project B 30. Biochemical and physiological basis of esistance in tea cultivars towards major pests such as SHB, LWT's and also root-lesion nematodes**

During the period under review, there was less progress in biochemical studies in relation to insect pests and nematodes, owing to staff constraints. Only a few anatomical and morphological studies with nematode-resistant and susceptible tea cultivars were performed.

**7. Project C802. The Nematode Diagnostic Service**

During the period under review, the nematology laboratories at Talawakele, Hantane, Ratnapura and Kottawa analyzed over 140 root- and soil samples, in addition to experimental samples. Nematode diagnostic reports were provided to the growers. The need for Nematology Laboratory facilities in Deniyaya and Passara has been recognized.

**8. Project D 19. Management of Low country live wood termites**

A survey has been initiated for identifying termite damage in the low country. The infestation levels varied between 0 and 84% in the 40 estates sampled. Information is also being collected on the age of the tea, and a possible relationship is being sought between damage levels and advancing age.

A few locations having high damage were further studied to generate information on the distribution of the damage. They will be selected for trials in assessing an approach for damage reduction using dressings (fortified with known termiticides) on prune cuts, which are the entry points for live wood termites.

**9. Project D 20. Identification of safe insecticides, acaricides and designing IPM methods for control of seasonal pests**

With the findings of a study, carried out in the Lindula and the Pundalu Oya areas, on the level of hyperparasitism, and reported in last year's Annual Report, a prototype model of an insect-rearing and releasing cage was developed, in order to rear parasitized tortrix larvae and release the parasites, thus reducing the impact of hyperparasites. A bigger version is being constructed for testing in the field.

Experiments **ME 27** (two experiments at Imboolpitia Estate) and **ME 31** (Hatale Estate), both in the mid-country, were for testing Regent against scavenging termites. All the experiments showed that Regent at dosages of 2.0l and 3.5l/ha give good control, and prevented re-colonization by scavenging termites

for about 8 – 10 months after application of the chemical. Also, Admire® (Imidachloprid), in the second experiment at Imboolpitia, was effective in preventing re-colonization for a similar period.

## 10. Miscellaneous studies

A CD on insect pests of tea and their management (“TEA BUG”) has been developed, especially for educational purposes. This CD contains information on biology, ecology, and control and management of all key pests, as well as other pests of minor importance. References on every pest are also included as a pdf version for general access.

The cultivars, TRI 2025 and DT1, are highly susceptible to shot-hole borer infestation. More hectares in estates in the Kotagala, Dimbula and Patana areas are under these two cultivars (50% – 75% of the total extent). Shot-hole borer infestation levels were assessed in these cultivars. The infestation levels were found to be high.

In the light of these observations, as well as of the extents of the cultivars in these estates, it was decided to formulate an IPM package for the estates in these areas. A few other quality cultivars, viz. CY 9, KO 145, etc., are also being assessed to evaluate their performance in relation to shot-hole borer, and to determine their suitability as alternatives to DT1.

A study to compare shot-hole borer infestation levels in organic and conventional tea fields, representing mid-country, the Uva and up-country, shows that there is no difference between organic and conventional fields.

The infestation levels as expressed by the percentage of infested stems, was on average 89% (range: 47 – 100%) and 97% (range: 88 – 100%), with the corresponding average number of galleries per stem being  $4.9 \pm 1.8$  and  $5.4 \pm 1.8$  for the conventional and organic systems, respectively, in the up-country region. In the two systems in the mid-country dry zone (the Uva region), infestation levels in the conventional system showed an average of 88% (54 – 100%) in terms of the percentage infested stems, and the corresponding average number of galleries per stem was  $5.8 \pm 1.5$ . Infestation levels in the organic system was on average 98% (95 - 100%), in terms of the percentage infested stems, and the corresponding average number of galleries per stem was  $6.3 \pm 1.5$ .

A fly problem arose after the tsunami, and the flies (“tsunami flies”) have become a problem in many locations in Neluwa, Halwitigala, Hiniduma and Kottawa in the Galle District. The flies are attracted to white lights in tea factories, as well as in houses. Flies get attracted in thousands, and hover around lights for some time and die, emanating a foul smell. The fly is a dipteran belonging to the genus *Sciaria* (dark-winged fungus gnats).

### 11. Staff activities

The staff in the Division of Entomology conducted awareness programmes on matters relating to insect pest and nematode management, safe pesticide usage, and problems associated with tea, at workshops, crop clinics, RSCs, and training sessions for small holders and corporate-sector planters, as well as for students from various universities and agricultural schools.

### 12. Publications

During the period under review, eight local and six international publications on entomology, nematology and organic farming were produced.

#### Local:

1. Geeganage, C. D., Bandara, N. and Mohotti, K. M. (2006). Analysis of sewage sludge and its suitability as land application. *Proceedings of the Sixty Second Annual Session of Sri Lanka Association for the Advancement of Science 2006*, 64-65.
2. Mohotti, J. and Mohotti, K. M. (2006). Long Term Application of Neem Oil Cake (II) Effects on Shoot and Root Growth and yield of Tea. *Abstracts of papers presented at the International Workshop on Neem Research and Applications: Current Trends and Future Prospects* held in Colombo on 3-4 August 2006, in press.
3. Mohotti, K. M. (2006). Long Term Application of Neem Oil Cake (III) Disease, Insect, Nematode and Weed Incidences in Tea. *Abstracts of papers presented at the International Workshop on Neem Research and Applications: Current Trends and Future Prospects* held in Colombo on 3-4 August 2006, in press.
4. Mohotti, K. M. and Mohotti, J. (2006). Long Term Application of Neem Oil Cake (I) Effects on Biological, Chemical and Physical Parameters of Tea Soils. *Abstracts of papers presented at the International Workshop on Neem Research and Applications: Current Trends and Future Prospects* held in Colombo on 3-4 August 2006, in press.

5. Wijeratne, S., Seneviratne, H. R., Mohotti, K. M. and Guruge, K. S. (2006). Male reproductive potential in different environmental and occupational settings. *Abstracts of the 39<sup>th</sup> Annual Scientific Sessions of the Sri Lanka College of Obstetricians and Gynecologists*, held in Colombo, Sri Lanka, October 2006,39-40.
6. Mohotti, K. M., Amarasena, P. G. D. S., Navaratne, N., Karunanayake, U. and Abeysinghe, N. (2006). Successful use of *Eucalyptus* and *Pinus* soils as alternatives to *Mana* soil for tea propagation. *TRI Update 11(1)*: 3-5.
7. Walgama, R.S., C De Seram and M.M. Jayathilake (2006). Incidence of *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), the Shot-hole Borer of Tea grown under Organic and Conventional Farming Systems. *Abstracts of the Proceedings of the 26<sup>th</sup> Annual Sessions of the Institute of Biology of Sri Lanka*, Colombo, September 2006.
8. De Seram, C. and R.S. Walgama (2006). Preliminary Investigation on Local Isolation and the Efficacy of the Fungus, *Beauveria bassiana* (Balsomo) Vuillemin, against *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), the Shot-hole Borer of Tea in Sri Lanka. *Abstracts of the Proceedings of the 26<sup>th</sup> Annual Sessions of the Institute of Biology of Sri Lanka*, Colombo, September 2006.

**International:**

1. Amarasena, P. G. D. S., Mohotti, K. M. and Hitinayake, G. (2006). Bioremediation for water purification – A case study at St. Coombs Lake, Talawakelle. *Proceedings of the Eleventh International Forestry and Environment Symposium* held in Wadduwa, Sri Lanka, 22-23 December 2006, 35.
2. Mohotti, K. M., Chithrapala, N. H. M. S. and Subasinghe, S. (2006). Elevation of earthworm biomass by organic cultivation practices: Long-term evidence from tea soils. *Proceedings of the Eleventh International Forestry and Environment Symposium* held in Wadduwa, Sri Lanka, 22-23 December 2006, 23.
3. Nissanka, S. P., Mohotti, K. M. and Wickramaarachchi, W. (2006). Changes of biodiversity of different land use systems of tea and *Pinus* plantations and annual cropping systems compared to natural forests. *International Conference on Humid Tropical Ecosystems: Changes, Challenges and Opportunities* held in Kandy, Sri Lanka, 4-9 December 2006, 15.

4. Walgama, R.S and M.P. Zalucki (2006). Evaluation of Different Models to Describe Egg and Pupal Development of *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), the Shot-hole borer of Tea in Sri Lanka. *Insect Science/Entomologia sinica* 13(2): 109-118.
5. Walgama, R.S. and R.M.D.T. Pallemulla (2006). Shot-hole Borer *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), a Successful Colonizer of Tea: Implications for Control and Management. *Proceedings of the International Symposium 2006 "Issues and Challenges of the 21<sup>st</sup> Century"*, Sabaragamuwa University, Belihul Oya, Sri Lanka, 4-8<sup>th</sup> July 2006.
6. Walgama, R.S., Senanayake, P., De Seram, C. (2006) Exploring Natural Resources for Sustainable Management of Ecosystems: Future Challenges for Control and Management of *Xyleborus fornicatus* Eichh. (Coleoptera: Scolytidae), the Shot-hole Borer of Tea in Sri Lanka. *Abstracts of the Proceedings of the International Symposium on Forestry and Environmental Science – 2006, University of Sri Jayawardenapura, Nugegoda, 22-23<sup>rd</sup> December 2006.*

## PLANT BREEDING DIVISION

*Head – MTK Gunasekare*

Towards meeting the objectives of the Institute's Corporate Plan, the following activities were undertaken by the Division in the year 2006.

### **1. Thrust A 1. Development of VP cultivars for the up country**

The emphasis was placed on four priority areas in the year 2006 programme, in order to streamline germplasm and cultivar development and release:

- Priority I - Interim release of TRI 5000-series cultivars for commercial evaluation on multi-location trials;
- Priority II - Identification of promising seed progenies as an alternative source of planting material;
- Priority III - Strengthening the controlled hybridization programme to obtain new breeding lines having a combination of desirable attributes; and
- Priority IV - Systematic characterization and documentation of genetic resources, conserved in regional gene banks, for the rational utilization of germplasm in the breeding programme.

#### **Project A 1.1 - Evaluation of VP cultivars for the up country**

A total of three hundred and eighty accessions are currently under evaluation in Phase I and Phase II trials, and eight new potential cultivars are under commercial evaluation in the final stage (Phase III), in the up-country region in order to develop region-specific cultivars for the up-country.

- **Evaluation of accessions: Phase I**  
Two hundred and thirteen accessions are currently under evaluation in Phase I trials in the up-country region. Weekly yield recordings, and other trait evaluations, in phase I trials (VP 84 and VP 88) have been continued.
- **Evaluation of accessions: Phase II**  
One hundred and sixty seven accessions in Phase II trails are under evaluation in the up-country region, in order to identify potential cultivars for

further testing on a commercial scale.

First-cycle yield assessments have been continued in five Phase II trials (VP 83, 85, 87, 89 and 91), and second-cycle yield recording was continued with VP 81, together with other trait evaluations, by a multidisciplinary team.

- **Commercial evaluation of cultivars in the process of preparation: Phase III** (Interim release of TRI 5000-series cultivars for commercial evaluation in multi-location trials.)
- **Testing the commercial potential of a new series of cultivars in the agro-ecological zone, WU 3; Mattakelle Estate**  
The commercial evaluation trial established in collaboration with Mattakelle Estate has been continued. Normal cultural practices, including centering and infilling of plants, have been undertaken.

**Project A 1.2 - Screening accessions for resistance to shot-hole borer, blister blight, collar canker and Poria.**

- **Screening for shot-hole borer**  
Screening data were received from the Entomology Division for accessions in VP 75, 76, 78, 80, 81, 82 and 85. According to the Entomologist, since the infestation levels were very low at the location (St Coombs) where the trials had been laid out, a decision could not be made with regard to the SHB resistance/susceptibility of these accessions. Hence, it is not possible to undertake SHB screening in this location.
- **Screening for blister blight**  
Accessions in VP 85 and VP 87 were screened by the Pathology Division. (Refer relevant sections of the Plant Pathology Division report.)
- **Screening for Poria**  
The planting material issued by this Division to the Pathology Division, in 2003, is being screened for Poria.

**Project A 1.3 Evaluating cultivar response to applied nutrients.**

This trial, which was established last year, has been maintained by the Soils and Plant Nutrition Division.

### **Project A 1.5 - Screening accessions for quality**

- VP 85 : Leaf samples of the accessions in this trial together with the standard, DT 1, were supplied in five batches to the Biochemistry Division for testing for quality. (Refer relevant sections of the Biochemistry Division report.)

### **Project A 1.6 - Screening accessions for plant parasitic nematodes.**

Plant materials from accessions in VP 80 were re-supplied for screen for the above trait. Further, Nematology staff carried out root- and soil sampling in VP 80. (Refer relevant sections of the Entomology Division report.)

## **2. Other Activities for Generating Information for Plant Breeding Research Programmes.**

Sixty hybrid plants (including three wide-hybrids) generated from the 2005 programme were field-planted for further evaluation. Seventy-three hybrid seedlings from the 2004 programme, already planted in the field, have been assessed for their growth and other morphological attributes. First- and second centering were done, and centering weights of the hybrid seedlings of the 2004 programme were recorded. . them to the main gene bank in Field No. 9. The field plan of the germplasm in Field No 8 was updated, after the accessions available in that particular gene bank were inventoried.

### **2.1 Controlled hybridization programme, up-country**

A total of 1064 single crosses, involving 22 different parental combinations, including seven wide-cross combinations (*C. sasanqua* as the male parent, and reciprocal) was carried out in the 2006 programme. On an average, a seed-setting success of 16.2% was achieved in intra-specific crosses, while a 0.36% seed-setting success was achieved with inter-specific crosses. A total of 264 hybrid seeds has been harvested and planted in the nursery.

Sixty hybrid plants (including three wide-hybrids) generated from the 2005 programme were field-planted for further evaluation. Seventy-three hybrid seedlings from the 2004 programme, already planted in the field, have been assessed for their growth and other morphological attributes. First- and second centering were done, and centering weights of the hybrid seedlings of the 2004 programme were recorded.

## **2.2 Germplasm**

Forty-three accessions present in the germplasm in Field No. 8 at Talawakelle (which were not available in the main gene bank at Talawakelle) were propagated in the nursery for the purpose of adding them to the main gene bank in Field No. 9. The field plan of the germplasm in Field No 8 was updated, after the accessions available in that particular gene bank were inventoried.

A database was constructed to facilitate easy retrieval of the information relating to accessions, in regional field gene banks and in the main gene bank at Talawakelle.

## **2.3 Exotic germplasm**

Seed stock obtained from Zagatala in Russia was germinated and maintained in the nursery. The Korean seed stock, established in Field No. 10, was propagated in the nursery for inclusion in the main field gene bank

## **2.4 Selection of alternative cultivars of a quality for making silver-tips**

Samples of terminal buds, collected from TRI 2043 and Code No. 243 (Original code No. 406/VP 37), were compared for appearance after silver-tips had been made from them. A few other accessions, selected from the same progeny trial (VP 37), were included in the evaluation programme, in order to find suitable alternative cultivars for TRI 2043 and explore the possibility of finding better cultivars for making silver-tips.

## **2.5 Polyploid breeding**

Monitoring the performance and morphological differences in 17 colchicine-treated TRI 2027 plants have been continued in Field No. 9, St Coombs Estate.

## **2.6 Mutation Breeding**

Weekly yield recordings of individual bushes were carried out. Increased rate of shoot growth was observed in the plants generated from cuttings exposed to gamma rays. Growth measurements are being continued to confirm the changes in irradiated plants.

## **2.7 Estate Cultivar Selection Programme**

Fairlawn selections planted on Fairlawn Estate: Normal cultural practices were carried out by the Estate. The bushes will be brought into bearing next year.

## **2.8 Re-evaluation and confirmation of the performance of recommended tea cultivars**

A study was initiated, in collaboration with various RPC estates, to assess the sustainability of TRI 3000- and TRI 4000-series cultivars planted in commercial evaluation trials.

The following estates were visited to assess the performance of cultivars under estate-managed conditions: Imboolpitiya, Hakgala, Liddesdale, Highforest, Hauteville, Gordon and Luckyland, This study was initiated with the objective of making more specific cultivar recommendations, based on agro-ecologies. The Entomology Division participated in sampling cultivars for assessing SHB resistance.

### **3. Thrust A 2. Development of VP cultivars for the mid-country wet zone.**

#### **3.1 Project A 2.1. Evaluation of cultivars for the mid-country wet zone.**

**MVP 12 (Phase II trial)** : Normal cultural practices were carried out. Tipping was done and weights were recorded. The trial was brought into bearing in August.

### **4. Thrust A 3. Development of VP cultivars for the mid-country semi-dry zone (the Uva).**

#### **4.1 Project A 3.1. Evaluation of cultivars for the mid-country semi-dry zone.**

Fifty-seven accessions in Phases I and II trials, and nine potential cultivars of the TRI 5000-series in observational trials, are currently under evaluation in the Uva region, at various stages. Second-cycle harvesting has been continued in Phases I and II trials.

Selected accessions from UVP 9 (Phase II) were propagated to establish another Phase III trial in 2007. A new Phase III trial was established in partnership with Glen Alpine Estate, Passara, using potential advanced breeding lines selected from UVP 9 (see Phase III trial in the Uva)

**Commercial evaluation of cultivars in the process of preparation; Phase III.** (Interim release of TRI 5000-series cultivars for commercial evaluation in multi-location trials.)

## **Testing the commercial potential of a new series of cultivars in the agro-ecological zone, WI; Glen Alpine Estate**

A new commercial evaluation trial was established in partnership with Glen Alpine Estate, in November 2006. Cultivars with codes 5, 17, 88, 89, 199 and 243, together with control cultivars, TRI 2025 and TRI 4042, were planted in a non-replicated trial, to evaluate the potential of new cultivars under estate-managed conditions.

### **4.2 Project A 3.2. Screening accessions for resistance to shot-hole borer and blister blight**

**UVP 10.** The Entomology Division undertook the first SHB assessment.

**UVP 9.** SHB assessment has been continually carried out by the Entomology Division, at various growth stages in the same pruning cycle. (Refer relevant sections in the Entomology Division report.)

### **Germplasm, the Uva**

The Entomology Division assessed resistance/susceptibility of the accessions in the gene bank at TRI, Passara.

## **5. Thrust A 4. Development of VP cultivars for the low country**

### **5.1 Project A 4.1. Evaluation of cultivars for the low country**

The evaluation of 454 accessions in Phases I, II and III has been continued, in order to develop region-specific cultivars for the low country.

- **Evaluation of Accessions Phases I and II**

Second-cycle harvesting has been continued in one phase I trial (LVP 84) and in nine phase II trials (LVP 75, 76, 77, 78, 79, 80, 81, 82 and 83), while two phase II trials (LVP 85 and 86) have been evaluated in their first cycle.

- **Evaluation of Accessions Commercial evaluation of cultivars in the process of preparation; Phase III.**

(Interim release of TRI 5000-series cultivars for commercial evaluation in multi-location trials.)

Phase III evaluation of TRI 5000-series cultivars were continued in trials at TRI, Kottawa (agro-ecological zone, WL 2), Cecilton Estate, Balangoda (agro-ecological zone, WM 3), and Deniyaya Estate, Deniyaya and Indola Estate, Deniyaya (agro-ecological zone, WM 1), in collaboration with the

estates concerned. First-cycle yield recording was commenced in April in the trial at TRI, Kottawa. Centering and other normal cultural practices were undertaken in three other commercial trials.

## **5.2 Project A 4.2. Evaluation of accessions for resistance to LCLWT, *Macrophoma* and SHB**

### **SHB**

Accessions in Phase II trials of LVP 75, 76-79 and 85 were assessed for SHB by the Entomology Division. (Refer relevant sections in the Entomology Division report.)

### **LCLWT**

The Entomology Division undertook the screening of accessions in LVP 75 and LVP 85 for LCLWT. (Refer relevant sections in the Entomology Division report.)

## **5.3 Other Activities in the Low Country**

### **Controlled hybridization**

One thousand six hundred and forty crosses, involving eight different parental combinations, were carried out during the year. Hybrid plants, generated from crossing programmes carried out in 2004 and 2005, have been evaluated in the field for their growth attributes, and characterized using morphological descriptors.

### **Germplasm**

Germplasm characterization based on morphological descriptors was continued, and part of the results was published. The results revealed that among the 13 descriptors studied, 11 descriptors have contributed significantly to the total phenotypic variation of the germplasm .

### **Hadaraganga selections from Hapugastenna Estate**

Two hundred cuttings from each of 20 promising selections made by the Entomology Division, based on LCLWT resistance (Entomology trial, LE 78), were propagated in the Low Country Plant Breeding Nursery, in order to establish a Phase II trial in the low country for further evaluation.

**Re-evaluation and confirmation of the performance of recommended tea cultivars**

A study was initiated to assess the sustainability of TRI 3000- and TRI 4000-series cultivars, planted in commercial evaluation trials in collaboration with various RPC estates. The following estates were visited to assess the performance of cultivars under estate-managed conditions: Golinda and Greenrock Estates.

**6. Thrust A 5. Development of bicultural and polyclonal seed cultivars for the up-, mid-, and low country regions and the Uva.**

The performance of the seed stocks in the four field trials, established during 2000 in the different regions, was monitored in their second cycle with the aim of developing seed progenies suitable for commercial planting.

**Bicultural seed progeny (TRI 2023 x TRI 2043).** Field No. 13, St. Coombs (2003).

The population was evaluated for blister-blight resistance/susceptibility by the Pathology Division in September. This progeny trial, including the field plan, was taken over by the Biochemistry Division on 6<sup>th</sup> September 2006 in order to collect samples and to undertake phenotypic characterization for mapping studies at the Nobel Foundation, USA.

All the agronomic and cultural practices of the trial were also being undertaken by the Biochemistry Division. Hence, all assessments, including weekly yield recording to assess the seed stock as a potential improved seed progeny, were suspended temporarily.

**Bicultural seed progeny (TRI 4004 x TRI 4006), TRI Hantana.**

A new trial was initiated in July using the bicultural seed progeny of TRI 4004 x TRI 4006, together with parental cultivars as control. Four replicates were planted.

**Mid-Country Wet Zone**

**Commercial evaluation of seed progenies**

(a) Hesal Lanka (Pvt) Ltd, Galaha (2005)

First centering was done in January. The control cultivars, DG 7 and TRI 4046 plots, were infilled. Bushes in this trial were brought into bearing in August.

(b) **Nugagala Estate, Hunnasgiriya**

A new trial was initiated in November, in partnership with a smallholder at Nugagala Estate, Hunnasgiriya, to investigate the suitability of improved seed stocks for infilling purposes in an existing, old seedling field. Six blocks were infilled with plants raised from seed stocks: St Coombs (TRI 2043), Sapumalkande (TRI 2043, TRI 3055 and S 106), Anhettigama (TRI 2027) and Raigama (TRI 4006).

Plants were raised from eight seed stocks, derived from different seed gardens and clonal parents, for establishing new commercial seed evaluation trials, in the Udapussallawa and the Hunnasgiriya areas, in October, 2007. The seed gardens and clonal parents were Rambukkanda 2022, 2025 and KEN 16/3; Salawa 2016 and Ken 16/3; Halpe 2016; Maliboda 2023 and 2043; Kiriporuwa 2016; and Karadupona 2016 and DN.

**The Uva**

**Commercial evaluation of seed progenies**

(TRI, Passara, 2004)

This trial was brought into bearing, and the yield recording commenced in May.

**Low Country**

**Commercial evaluation of seed progenies**

Endana Estate, Kahawatta, 2006

A new commercial, seed-stock evaluation trial was initiated in June, in partnership with Endane Estate. Seed progenies from biclonal seeds gardens (Maliboda and Reucastle), and polyclonal seed gardens (Anhettigama, Sapumalkanda, Kiriporuwa and Rambukkanda), together with standard VP cultivars, TRI 4004 and 4042, were planted in non-replicated trial in Field No. 11 A, Lower Division.

**Seed tea reserves**

Seedlings (nearly 470 plants), raised from the first batch of seeds collected from seed reserves at Gouravilla, were used for block infilling of existing old seedling fields in Field No 4 B at Gouravilla Estate.

**Seed gardens in the low country.**

Follow-up visits were made to Salawa, Maliboda, Anhettigama, Reucastle, Rambukkande, Halpe, Rygama, Sorana, Karadupona, Sapumalkanda, Urumiwella and Kiriporuwa Estates to monitor the seed-setting and flowering

pattern of parental cultivars. Various cultural practices, such as removal of unproductive branches and fertilizer application, undertaken with the assistance of the respective estates, were continued.

## 7. Project D 1. Use of *in vitro* techniques

**Micropropagation :** Experiments on *ex vitro* rooting of micro shoots have been continued, with the promising potting media identified in a preliminary study. Sub-culturing of micro shoots was continued to supply material for the rooting study, and also to assess the rate of multiplication.

**Embryo culture :** Embryos at very immature stages were cultured *in vitro* in order to facilitate the development of a culture protocol for embryo rescue. The effect of dark and light on embryo germination was studied. The preliminary requirements (culture medium composition and culture environmental conditions) necessary for embryo rescue were established. This confirmed the possibility of rescuing embryos and regenerating plantlets from embryos, even at five months.

Seventy-two hybrid seeds, including wide hybrids generated from the 2006 crossing programme, were germinated *in vitro*, as they were not found suitable for conventional propagation. Germination success of over 85% was achieved *in vitro*.

Of the seed stock received from Zagatala in Rassia, 49 seeds were propagated *in vitro* to obtain plants. Plant regeneration of more than 90% was achieved. Sub-culturing at the rate of two-fold multiplication was possible.

## 8. Other Divisional Activities

### 8.1 Research Publications

#### International

Seran T H, Hiriburegama K and Gunasekare M T K (2006). Direct somatic embryogenesis from explants obtained from *in vitro* germinated embryonic axes of *Camellia sinensis* (L.) O. Kuntze, Journal of Horticultural Science and Biotechnology 81, 883-890.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Production of cotyledon-type somatic embryos directly from immature cotyledon explants of tea (*Camellia sinensis* L.). Journal of Horticultural Science and Biotechnology 82, 119-125.

### Local

Gunasekare M T K (2006). Adapting crop varieties to environments and clients through decentralized-participatory approach. Guest Paper, The Journal of Agricultural Sciences 2 (1) (Special Issue), 34-45.

Piyasundara J H N, Gunasekare M T K, Peiris T U S and Wickramasinghe I P (2006). Phenotypic diversity of Sri Lankan tea (*Camellia sinensis* L.) germplasm based on morphological descriptors. Tropical Agricultural Research 18, 237-243.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Somatic embryogenesis from embryogenic leaf callus of tea (*Camellia sinensis* L.). Tropical Agricultural Research 18, 367-375.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Short-term storage of encapsulated zygotic embryonic axes of tea (*Camellia sinensis* L.) at low temperature. Tropical Agricultural Research 18, 358-366.

Goonatilake W A S, Priyantha C, Mewan K M and Gunasekare M T K (2006). Genetic diversity in tea (*Camellia sinensis* L.O. Kuntze) as revealed by RAPD-PCR markers. Proc. International Symposium on the Issues and Challenges of the 21<sup>st</sup> Century, 4-8 July 2006, Sabaragamuwa University of Sri Lanka; p. 28.

### 8.2. Research Communications

Ariyaratne H A C K, Ranaweera K K and Gunasekare M T K (2006). Pedigree-based genetic diversity estimates of parental lines and recommended tea cultivars in Sri Lanka. Proc. 62<sup>nd</sup> Annual Sessions, Sri Lanka Association for the Advancement of Science (SLAAS), Part I, p. 20.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Establishment of *in vitro* plantlets of *Camellia sinensis* L. under *ex vitro* conditions. 5<sup>th</sup> Annual EUSL Research Session, Vol. 5, p. 29.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Induction of somatic embryos from cotyledonary and leaf tissue of tea (*Camellia sinensis* L.). 5<sup>th</sup> Annual EUSL Research Session, Vol. 5, p. 28.

Seran T H, Gunasekare M T K and Hiriburegama K (2006). Effect of sucrose on efficient embryogenic capacity in cotyledonary tissues of tea (*Camellia sinensis* L.). AGRIEAST 5 (In press).

### **8.3. Workshops, Seminars, Training Programmes and Meetings**

Dr M T K Gunasekare was elected as the Chairperson of the National Committee on Plant Breeding and Biotechnology (NCPBB) by the CARP. She chaired seven Committee meetings.

Dr M T K Gunasekare was appointed National Partner for the FAO project on “Establishing a national information sharing mechanism (NISM) on the implementation and monitoring of the global plan of action (GPA) for the conservation and sustainable utilization of plant genetic resources for food and agriculture” (GCP/RAS/186/JPN). She attended six meetings as the TRI representative for the purpose of formulating the GPA.

Ms H A C K Ariyaratne participated in the Graduate Certificate Course in Practical Molecular Biology, conducted by the University of Peradeniya, 13–24 March.

Dr M T K Gunasekare was invited to attend the National Workshop on Curriculum Revision, held on 8<sup>th</sup> November in Colombo, to finalize the undergraduate curricula for Sabaragamuwa University.

Mr. M A B Ranathunga and Ms. C Ariyaratne participated in a short course on using molecular markers for improving the efficiency of plant breeding programmes in Sri Lanka, organized by the CARP in consultation with Michigan State University on 6-8 December.

Dr M T K Gunasekare was invited by the CARP to make a presentation on “Using molecular markers in breeding tea in Sri Lanka: a case study”, at the above short course, on 8 December.

### **8.4. Seminars and Training Programmes Conducted**

Familiarization programmes on plant breeding activities were conducted for the following personnel:

- Laboratory staff, Sri Lanka Tea Board, 20 February.
- Students specializing in Plant Breeding in the Faculty of Agriculture, University of Peradeniya; 27 February.
- Undergraduates following the Tea Plantation Management course in the University of Peradeniya; 1 March.
- Students from Aquinas College; 23 March.
- NGO personnel from Nepal; 21 June.

- Assistant Manager, Frotoft Estate; 21 August.
- Undergraduates specializing in Plantation Management at the University of Wayamba; 29 August.
- Undergraduates from the Faculty of Agriculture, University of Ruhuna; 13 September.
- Assistant Directors from the Department of Commerce: 13 October.

Dr M T K Gunasekare delivered lectures on:

- “Tea Planting Material”, at the NIPM Induction Course for planter trainees, 5 June;
- “Suitability of new improved cultivars for commercial planting”, for managers of the Kelani Valley Plantations, 27 September.

Messrs. M Ratnayake, P D Upali, J D Kottawa Arachchige, J H N Piyasundara and A K Mudalige conducted demonstrations on cultivar identification, and suitability of new tea cultivars for different regions, for the RPCs and small-holders.

### **8.5. Estate Visits**

Apart from visits to collaborative trials conducted on different estates, twenty six visits were made to various estates to help in cultivar identification and on other related matters.

### **8.6. Correspondence**

The Division corresponded 67 times with growers and other stakeholders on various matters.

### **8.7. General**

Mr M A B Ranathunga resumed duties in July after a successful completion of his M.Sc (Biotechnology) training at the Tamil Nadu University, India. The training was funded by the CARP-ICAR programme.

Mr R Paskaradevan completed a part-time course leading to the M.Sc. in Plant Cell and Tissue Culture at the University of Colombo.

Ms T H Seran, Lecturer, Faculty of Agriculture, Eastern University, has successfully completed her Ph D programme, and was awarded the Ph D in May 2006. The project leading to the Ph D was carried out at the Plant Breeding Division, TRI, under the supervision of Dr M T K Gunasekare. The project was entitled: “*In vitro* studies on plant development of tea, with emphasis on somatic embryogenesis.”

# PLANT PATHOLOGY DIVISION

*Head – A Balasuriya*

## Research Activities

1. **Thrust A 1. Development of high yielding cultivars for the up-country**  
**Project A 1.2. Screening for resistance, up-country.**

### **Screening and selection for resistance to blister blight**

- **PP/BB1/03. Assessment of progenies on their resistance/susceptibility to blister blight under nursery conditions.**

**Source of seeds: Maliboda biclonal seed garden.**

The tagged plants in Field No. 13, St Coombs Estate, which are in three replicates, are compared with standards, the VP cultivars TRI 2023 and TRI 2043.

One field performance and one complete round of field disease assessment were completed during the year. The data were submitted to the Plant Breeding and the Biochemistry Divisions.

- **PP/BB3/99. Selection of OST bushes for their resistance to blister blight disease (Diyagama East Estate).**

Only two visits were possible during the year, to monitor the selections 117, 113, 82, X, 71, 107 and 25.

### **Screening for resistance to *Poria***

- **PP/POR1/03. Screening of new cultivars for resistance/susceptibility to *Poria* root disease (St Coombs Estate).**

Plants were treated with regular fertilizers. The inoculum was added to the pits, at two-monthly intervals in the early part of the year in order to strengthen its potential. Casualties were noted.

2. **Thrust A 3. Development of high yielding cultivars for mid-country**  
**Project A 3.2. Screening and selection for resistance, Uva.**

No activity was possible during the year owing to staff limitations.

3. **Thrust A 4. Development of high yielding cultivars for low-country**  
**Project A 4.2. Screening for resistance, low country**

No activity was possible during the year owing to staff limitations.

**4. Thrust A 23. Rational control of major pests and diseases of tea with a view to reducing the usage of pesticides**

**Project A 23.1. Screening and evaluation of biological control organisms.**

**Biological control of root and stem diseases of tea.**

Stock cultures were maintained. The bulking and preservation of the spores of the antagonistic *Trichoderma harzianum* fungus, using talc powder, were continued. Continued assessments were made in the two field trials using *Trichoderma harzianum* fungus, namely in the control of *Poria* root disease in Moray Estate, and in the control of Horse Hair Blight in St Joachim Estate.

**5. Project A 23.3. Role of VAM in reducing root-disease incidence and as a mineral-nutrient improviser.**

**PP/VAM1/04. Nursery inoculation experiment (St Coombs Estate).**

This trial was discontinued owing to a shortage of staff.

**6. Project D 21 (D/LEAFDC). Leaf disease control**

A response to the project proposal entitled 'Risk assessment model for tea diseases', made in collaboration with the Biometry Unit and the University of Peradeniya and submitted to the CARP, was still awaited.

- **PP/BB1/06.** A declining residue trial using Champ DP [Cu(OH)<sub>2</sub>] at two concentrations (0.1 and 0.2 %).

Leaf samples for the residues were collected at 0, 1, 3, 5, 7, 10, 14 and 21 days after spraying. Miniature processing was done in the Technology Division, and the residue analysis in the SPND.

Date commenced: 21 March 2006

Tea cultivar: TRI 2025.

Treatments (3): Champ 0.05%, Champ 0.1% and unsprayed control.

Design: RCBD with two replicates.

A set of samples was also collected, prior to spraying, to establish base copper-levels in the tea leaves, before repeating this residue test trial. One set of four (1, 2, 3, 4) were withered, fired and sealed (without rolling). A second set of four (5, 6, 7, 8) were withered, rolled, fired and sealed.

Sample collections were repeated seven days after spraying. The data await analysis at the SPND.

- **PP/BB2/06.** Testing different concentrations of Champ DP [Cu(OH)<sub>2</sub>] on blister blight incidence, Field No 14, St Coombs Estate.
  - Date commenced: 12 July 2006
  - Tea cultivar: TRI 2025
  - Treatments (5): Champ 0.05%, Champ 0.1%, Champ 0.15%, Champ 0.1% and unsprayed control. Nine spraying rounds and assessments were completed.
  - Design: RCBD with four replicates..
  - Nine spraying rounds and 11 blister assessment rounds were completed, at weekly intervals.

This trial was discontinued.

- **PP/BB3/06.** Comparison of Bitertanol (Baycor) with a standard copper fungicide (Champion) for blister blight, Field No 14, St Coombs Estate.
  - Date commenced: 25 August 2006
  - Tea cultivar: TRI 2025
  - Treatments (3): Champion 0.1%, Bitertanol 0.05% and unsprayed control. Seven spraying rounds and assessments were completed.
  - Design: RCBD with four replicates.
  - Seven spraying rounds and 9 blister assessment rounds were completed, at weekly intervals.

This trial was discontinued.

- **PP/BB4/06.** A declining residue trial using Hexaconazole (Contaf) at two concentrations (0.025 and 0.05%), Field 11, St Coombs Estate.
  - Leaf samples for residues were collected at 0, 1, 3, 5, 7, 10, 14 and 21 days after spraying. Two sets of samples were analysed in Germany (GMBH), and in the Biochemistry Division, respectively. The third set is being analysed at the ITI, Colombo.
  - Date commenced: 29 August 2006
  - Tea cultivar: TRI 2025
  - Treatments (3): Hexaconazole 0.025%, Hexaconazole 0.025% + 0.05% [Cu(OH)<sub>2</sub>], and Hexaconazole 0.05%.
  - Design: RCBD with two replicates..

- **PP/BB5/06.** A declining residue trial using Propiconazole (Tilt) at two concentrations (0.025 and 0.05%), Field 11, St Coombs Estate.
- Leaf samples for residues were collected at 0, 1, 3, 5, 7, 10, 14 and 21 days after spraying. Two sets of samples were analysed in Germany (GMBH), and in the Biochemistry Division, respectively. The third set is to be analysed at the ITI, Colombo.
- Date commenced: 2 June 2005
- Tea cultivar: TRI 2025
- Treatments (3): Propiconazole 0.025%, Propiconazole 0.025% + 0.05% [Cu(OH)<sub>2</sub>], and Propiconazole 0.05%.
- Design: RCBD with two replicates..

#### **7. Project D 22 (D/STEMDC). Stem disease control.**

##### **Wood rot control trials**

##### **PP/WRG1/03. Testing of RRI latex-bitumen protective paint (St Coombs, Field No 8).**

Fresh samples of paint were awaited from RRI to undertake a second trial, possibly in Ratnapura.

#### **8. Project D 23 (D/ROOTDC). Root disease control.**

PP/RDC1/04. Field testing of systemic fungicides and *Trichoderma* sp. in the control of *Poria* root disease (Field No. 3, Rajamalai Division, Moray Estate, Maskeliya).

The treatments (Bitertanol at 2%, *Trichoderma harzianum* at 5g/l of 10<sup>5</sup> spores, Hexaconazole at 1%, and a control) were repeated three times every two months. Two disease assessments were made during the year. There was no appreciable increase in the disease incidence. Arrangements were made to replace missing tags following pruning.

#### **9. Project D 24 (D/HHB). Management of Horse Hair Blight**

**PP/HHB/01/04. Study of the impact of horse hair blight on the yield and management of tea (Field No. 8, St Joachim Estate, Ratnapura).**

This study was carried out in collaboration with the staff of the Advisory Division.

The treatments (control; cleaning + hydrated lime at 10% on the frame only; cleaning + *T. harzianum*; cleaning + Cu(OH)<sub>2</sub>; cleaning + propiconazole;

cleaning + hydrated lime onto frame and litter) were repeated once (3<sup>rd</sup>). Plot yields were recorded weekly.

One round of assessments of the treatments indicated positive results, compared with the untreated control. This was prominent with the systemic fungicide, Propiconazole (Tilt).

#### **10. Project D 25 (D/MISCEL). Miscellaneous Activities.**

##### **Microbial analysis of made tea**

- a. Two hundred and seven made tea samples, forwarded by the Tea Commissioner, SLTB, were analysed for percentage moisture, total aerobes at  $30 \pm 1^\circ\text{C}$ , and total moulds at  $30 \pm 1^\circ\text{C}$ . The reports were sent to the Tea Commissioner. (The cost of analysis of the samples were fixed at 750/= per sample).
- b. A trainee from Aquinas College undertook a four-month project, with the objective of improving made tea quality using microwave radiation. After a series of preliminary assays of the test procedure, a total number of 24 samples was analysed in duplicate, before and after microwave treatment. A dissertation, entitled 'Quality improvement of black tea with microwave treatment', was submitted for the fulfillment of the trainee's Diploma programme.
- c. An undergraduate trainee from the Rajarata University studied the incidence and variation of microbial populations at various stages of tea processing (from field to bin): prior to plucking, prior to withering, after withering, prior to fermentation, after fermentation, and at the drier mouth. This testing was repeated three times over a period of four months, simulating different environmental conditions. A total of 120 samples were tested at a time, in duplicate.

A dissertation entitled, 'Microbial status of tea (*Camellia sinensis*) during different stages in up-country' was submitted for the fulfillment of the trainee's Degree programme.

##### **HACCP standards for tea factories**

Investigations were continued on the request of Balmoral, Glasgow, Nuwara Eliya and Kotiyagalla Estates, and Ambassador Tea (Pvt) Ltd in Colombo, targeting the monitoring and establishment of HACCP standards. This included

the testing of water samples for contamination by the bacteria *Salmonella* and *Escherichia coli*.

Tests were conducted as follows.

Total aerobes at  $30\pm 1^{\circ}\text{C}$ , total moulds at  $30\pm 1^{\circ}\text{C}$ , total coliforms at  $35\pm 1^{\circ}\text{C}$ , *E.coli* at  $44\pm 1^{\circ}\text{C}$  and *Salmonella* at  $35\pm 1^{\circ}\text{C}$ .

The reports included:

Balmoral Estate, 11 swabs, two dhool samples and one water sample;

Glasgow Estate, six swabs;

Nuwara Eliya Estate, four made tea samples and two water samples;

Kotiyagalla, one made tea sample;

General, 15 made tea samples, six factory water samples, and 20 swab tests of factory machinery.

Costs were recovered.

#### **The die-back problem in the ADB mother bush area (cultivar TRI 4053)**

Going by the hypothesis that bushes in production do not show similar symptoms, it was decided to convert the remainder of the mother bush area in Field No. 5 (the 2000 block) to a revenue block. With sufficient rain as support, they showed signs of recovery. However, the bushes recovering after prune in Field No. 8 (the 2001 block) showed some early symptoms of bark damage with accompanying lesions. The area in Field No.4 (the 2003 block), which has a better soil, did not show similar symptoms.

Extended microscopical investigations suggested that this could be the die back caused by *Nectria* sp., probably *N. cinnabarina*. Further work is underway to confirm this.

#### **The die-back syndrome affecting cultivar TRI 2025**

It was planned to undertake a series of short-term studies to confirm the hypothesis that the bacterium *Pantoea agglomerans* plays an active role in symptom expression. The bacterium was isolated afresh from a few affected nursery plants. Fresh inoculation trials were initiated on Nuwara Eliya Estate with the potential inoculum of the *Pantoea agglomerans* bacterium.

Two sets of one-year-old TRI 2025 plants were placed in the Nuwara Eliya and the St Coombs Estates, respectively, and treated with broth cultures of inocu-

lum (*Pantoea agglomerans* bacterium) at fortnightly intervals. They were observed for the development of any symptoms.

#### **Use of microbes in tea brew**

- a. Several yeast species (including an isolate from tea cider) were tested for their fermentability, using sweetened tea decoctions. Laboratory tests were initiated to regulate the growth of the bacterium *Acetobactor xylinum* in the 'chombucha' yeast/bacterium complex, using streptomycin sulphate
- b. A collaborative study was undertaken with the Biochemistry Division to test the ability of yeasts to utilize caffeine as a N source, in the presence of three levels of added N in the tea wine preparation. Tasting of the product is pending.

#### **Use of microbes on tea residue**

An isolate of *Lentinula edodus* was imported from Pennsylvania State University, USA, and is being monitored on malt extract agar (MEA), malt extract broth (MEB) and potato dextrose yeast extract agar (PDYA). The aim is to use this fungus for an economic conversion of refuse tea.

#### **Disease diagnostic service**

Three reports of black root disease (*Rosellinia arcuata*) from St Coombs Estate. One incidence of violet root disease (*Sphaerostilbe repens*) from Nuwara Eliya Estate.

Two wood rot-related non-recovery problems from Imboolpitiya and Abbotsleigh Estates.

One report of large scale rust (algal) disease on oil palm from Nakiyadeniya Estate.

One sample of black blight leaf disease from a small holder in Matugama

### **11. Divisional Activities (D/PLPA)**

#### **Estate visits**

Two estates, Imboolpitiya and Abbotsleigh were visited, in connection with the non-recovery of tea fields after the prune. Nine estate visits were made to Nuwara Eliya, Moray and St Joachim Estates during the year, in connection with on-going experimental work.

## 12. New Capital Items

There were no new capital items purchased during the year.

## 13. Publications

Balasuriya A, 2006. How best can we deal with agricultural pesticides for sustainable productivity? *Crop Life Sri Lanka: Sri Lanka's Plant Protection Industry Journal* 1, 22 – 27.

Balasuriya A, Role of natural vesicular arbuscular mycorrhiza in the sustenance of plantation agriculture with special reference to tea (*Camellia sinensis*). Proceedings, International Conference on Humid Tropical Ecosystems: Changes, Challenges and Opportunities, 4 – 9 December, 2006, Kandy, Sri Lanka.

Pradeepa N H L, Microbial assays in the tea processing environment: major component of a quality assurance programme. *TRI Update* 11 (2).

# PLANT PHYSIOLOGY DIVISION

*Actg. Head – A J Mohotti*

## **Basic Research Projects**

### **1. Project B 11. Studies on photosynthesis and dry matter partitioning.**

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

In this study, variation of yield with age in the pruning cycle was investigated for the two cultivars, TRI 2025 and DT1.

Comparatively, TRI 2025 gave higher yields than DT1, the highest yield being in the second year. The lowest yield obtained during the first year, in both cultivars, was significantly different from that in the other years.

The dry-matter content of a 100 g-sample of fresh tea shoots of different cultivars, and of different years after pruning, and their levels of significance, showed that TRI 2025 had a significantly higher dry-matter content than DT1, in all kinds of shoots. A lower dry-matter content was found in the active shoots than in the crop and banji shoots, in both cultivars. The dry-matter content of crop and banji shoots gradually increased from the 1<sup>st</sup> to the 4<sup>th</sup> year, in both cultivars. The dry-matter content of active shoots increased up to the 3<sup>rd</sup> year, and declined thereafter, in both cultivars.

The dry-matter content of shoots showed a highly-significant variation ( $P < 0.001$ ) in different years, and also between cultivars. Hence, cultivar\*year interactions were not significant.

### **2. Project A 34 Experiments on shade effects and shade trees**

#### **2.1 Effect of shade on yield of mature tea**

The different treatments were imposed in June 2006. The yield of tea under different shade treatments, from June to December, showed no significant difference between the treatments. The unshaded treatment tended to give the highest yield, although this was not significant. The variation could be due to the cloudy weather that prevailed for most part of the year..

## **2.2 Photoinhibition of photosynthesis in tea**

The experiment had to be discontinued for a short time owing to equipment breakdown.

## **2.3 Possible alternate shade tree species**

The experiment is in progress.

## **3. Project B 64 Tea root physiology**

Under this project, the following experiments were carried out.

### **Root studies in field-grown tea**

#### **3.1 Study of the tea root system in cultivars vs seedlings, young tea**

The experiment, which planned to study the root system in young seedlings and cuttings, had to be abandoned during the unrest prevailing during May 2006, as the cuttings and seedlings which had been planted, were affected, and it was not possible to obtain seeds for a repeat experiment.

#### **3.2 Study of the dynamics of the tea root system in organic vs inorganic tea, in relation to shoot growth**

In this experiment, the root windows that were installed in 2003, in the 'TRI OR-CON' trial, were used to make non-destructive measurements of the root system.

The bushes were separately plucked, and the shoots measured and weighed. The shoot yield, and the Active: Banji ratio of the plucked shoots in those bushes, showed no significant difference between treatments.

There were no significant differences between organic and conventional treatments in feeder-root growth, regeneration and mortality.

The study is in progress.

#### **3.3 Variation in the root-distribution pattern of the tea cultivar TRI 2025 (*Camellia sinensis* L.) with age, in the up-country wet zone of Sri Lanka**

This study, which was concerned with changes in the root system with age, was conducted as part of a larger study to determine the economic life span of the cultivar TRI 2025, under up-country conditions in Sri Lanka.

The study was carried out in St Coombs Estate, Talawakele, in fields having 10, 20, 26, 36 and 50 year-old bushes of the cultivar TRI 2025. Soil samples containing roots were collected at different distances away from the base of each bush, using a soil core-sampler, up to a depth of 60 cm. Root fresh weights, dry weights and root lengths were taken separately, at each depth and distance. The flush yields from each field, during previous five-year periods, were obtained from estate records. Soils were analyzed for their physical properties (bulk density, porosity), soil macro-nutrients (nitrogen, phosphorous, potassium), and organic matter.

All measurements on feeder-roots showed a statistically significant difference at different ages. The quantity of feeder roots increased up to about 20 years of age, and thereafter showed a decreasing trend after 26 years.

However, the quantities of the mature roots increased up to nearly 20 years, and remained constant thereafter. Yields (average of the last cycle, expressed as  $\text{kg ha}^{-1} \text{ year}^{-1}$ ) decreased after about 26 years of age. The changes in feeder roots also corresponded with the changes in the yield.

Different fields did not show significant differences in terms of soil nutrients and physical parameters. Hence, in up-country conditions, yields should be carefully monitored after about 26 years of age, as they may be sensitive to changes in the environment. It is also suggested that this study be repeated in more locations having other cultivars and a wider age-profile. Dry-matter partitioning in different parts of the bush should also be studied.

### **3.4 The effect of allelopathy on the decline of tea (*Camellia sinensis* L.) in High Forest, Nuwara Eliya and Tangakelle estates**

This study was initiated to determine whether allelopathic compounds are associated with the tea decline in High Forest, Nuwara Eliya and Tangakelle Estates.

Allelochemicals were extracted from tea roots and soils in the affected areas of these estates. Using these extracts and lettuce (*Lactuca sativa*) seeds, *in vitro* bioassays were carried out to confirm the presence of allelochemicals. The allelopathic effects were evaluated using the germination percentage, hypocotyl length, fresh weight and dry weight of the seedlings. Visual observations were also recorded.

The study provided evidence for the presence of allelopathic compounds in tea soils of the estates studied. The highest inhibitory effects on germination of lettuce seeds was found to be by soil extracts from High Forest Estate, followed by Nuwara Eliya Estate. The lowest phytotoxic effects were observed from Tangakelle Estate soil extracts.

In the presence of soil extracts from High Forest Estate, the lettuce seeds failed to germinate successfully. The germination percentage, hypocotyl length, and fresh weight and dry weight of the seedlings, were significantly smaller in seedlings grown with soil extracts from High Forest and Nuwara Eliya Estates, compared to the controls which were germinated in the presence of distilled water.

It can be concluded therefore that the allelochemicals present in the soils of the High Forest and the Nuwara Eliya Estates are responsible, at least in part, for the yield decline. The source and the constituents of the extracts need to be investigated further.

#### **4. Project - D/PHYS Divisional physiological activities**

##### **Tea leaf anatomy**

The experiment had to be temporarily suspended owing to unfavourable weather.

#### **5. Thrust A 32 Development of an organic family system for tea.**

##### **Project A 32.2 Evaluating the crop response to organic amendments.**

##### **5.1 Yield of organic tea vs conventional tea**

The yield of tea in the 'TRI-ORCON' trial showed no significant differences in yield between treatments.

The experiment is in progress.

##### **5.2 Studies on 'The Conversion Period and Organic Tea'**

##### **5.2.1 Yield of organic tea vs conventional tea**

The yield data in the second and third years after pruning showed no significant difference between treatments.

##### **5.2.2 Growth and distribution of tea (*Camellia sinensis* L.) roots and shoots under organic, integrated and conventional management systems**

This study was carried out in the comparison trial at Giragama Estate, Pilimatalawa. Soil samples were collected separately, at different distances away from the base of the bushes and at different depths. Roots were separated, and fresh and dry weights, and total length, were measured in each sample. Soil was analyzed for major macro-nutrients (nitrogen, phosphorus and potassium), organic carbon, and soil physical properties (bulk density and porosity). In separately-marked buds, shoot growth and pluckable shoot weight were also measured. Yield was monitored separately. Root fresh- and dry weights did not show a statistically significant variation between treatments. However, organic treatments had a tendency to show higher root mass at all soil depths. Significantly higher root length was obtained in the plants managed under conventional treatment. The best soil conditions, in terms of physical and chemical parameters, were present with the integrated treatment; the highest nitrogen, potassium and organic carbon contents, low bulk density and the highest porosity were found here, which was reflected in the shoot measurements. The highest shoot growth and extension rate, pluckable shoot dry weight and yield were recorded in the plants managed under integrated treatment. The favourable soil properties, by improving health and nutrition of bushes under integrated management, would have resulted in the highest shoot growth and yield.

## **6. Project B 65 Studies on drought mitigation**

### **6.1 Developing criteria for screening of tea cultivars for drought tolerance**

Cuttings of the cultivars, TRI 2025, DN (drought-tolerant), TRI 2023, TRI 4006 (drought-susceptible), were planted for the experiment.

The experiment is in progress.

### **6.2 Effect of spraying K on drought tolerance**

This experiment was initiated in 2005, in Field No. 5 of St Coombs Estate, Talawakele, for elucidating the effect of spraying K on drought-tolerance in tea. The treatments are  $\text{KNO}_3$ ,  $\text{KCl}$  and  $\text{K}_2\text{SO}_4$ .

The treatments were imposed in January 2006, prior to the dry period which was anticipated in late January/early February 2006. However, the experiment could not be concluded owing to inconsistent weather and equipment breakdown. There were no significant differences in yield, pruning weight, relative water content of the leaves, and leaf K content, after spraying.

### **6.3 Sap-flow measurements in tea**

The experiment had to be temporarily abandoned owing to breakdown of equipment.

### **7. Studies on carbon sequestration (under Project D/PHYS)**

This experiment was initiated to study carbon sequestration in tea plantations, and to understand its ecological consequences.

The experiment is in progress.

### **8. Other assignments**

1. A J Mohotti continued to serve in the Board of Study, Department of Agricultural Biology, Post Graduate Institute of Agriculture, University of Peradeniya.
2. A J Mohotti served as an examiner of the comprehensive examinations of Ms H M S Herath, Ms A P Siriwardena, Ms M D Samaranayake and Ms G P T Pathirana of the Post Graduate Institute of Agriculture, University of Peradeniya.

### **9. Seminars, workshops and training programmes**

1. A J Mohotti, T L Wijeratne, S Navaratne and N Damayanthi attended the 18<sup>th</sup> PGIA Congress on 16-17 November 2006. A J Mohotti judged a technical session on Crop Physiology at the Congress.
2. T L Wijeratne took part in the following workshops and training programmes.
  - i. Short course on “Environmental Management: Basic Concepts and Legal Framework”, held at the PGIS, Peradeniya, on 28<sup>th</sup> and 29<sup>th</sup> January, 2006.
  - ii. The NSF Library connect seminar, held at the NSF, on 17<sup>th</sup> February 2006.
  - iii. A Workshop on Research Proposal Presentation and Report Writing, held at the In-service Training Institute, Gannoruwa, Peradeniya, on 13<sup>th</sup> March 2006.
  - iv. An NSF Workshop on Effective Proposal Writing, held at the NSF, Colombo, on 27<sup>th</sup> June 2006.
  - v. The “National Training Course on Radiation Safety in Using Radioisotopes for Research and Industrial Applications”, which was organized and held at the AEA, Colombo, during 11-15 December 2006.

## 10. Visitors

Dr Hojka Kraiger of the Forest Physiology and Genetics Department, Slovenian Forestry Institute, and Prof. Robert Zorec of the Institute of Pathophysiology, University of Ljubjana, Slovenia, visited the TRI and the Plant Physiology Division on 28 December 2006.

## 11. Publications

- i. Mohotti, K M and Mohotti, J (2006). Long-term Application of Neem Oil Cake. (I) Effects on Biological, Chemical and Physical Parameters of Tea Soils. In abstracts of papers presented at the “International Workshop on Neem Research and Applications: Current Trends and Future Prospects” held in Colombo on 3-4 August, 2006; in press.
- ii. Mohotti, J and Mohotti, K M (2006). Long-term Application of Neem Oil Cake. (II) Effects on Shoot and Root Growth and Yield of Tea. In abstracts of papers presented at the “International Workshop on Neem Research and Applications: Current Trends and Future Prospects” held in Colombo on 3-4 August, 2006; in press.
- iii. Mohotti, A J, Nilusha, S L R and Wijeratne, T L (2006). A Preliminary Investigation on Growth and Distribution of Tea (*Camellia sinensis* L.) Roots and Shoots under Organic, Integrated and Conventional Management Systems. Proceedings of the 26<sup>th</sup> Annual Sessions of the Institute of Biology, Sri Lanka, September 2006.

## SOILS AND PLANT NUTRITION DIVISION

*Head – L S K Hettiarachchi*

### Research Activities

- 1. Thrust A 15. Development of regional and site-specific fertilizer recommendations for improvement of productivity and made tea quality. Project A 15.1. Characterization of soils to series level in the tea-growing areas of Sri Lanka.**

The information, generated from the project, continued to be used for diagnosing problems associated with tea research and developmental activities in soil fertility and plant nutritional aspects.

**Project A 15.2. Estimating crop response to macro-nutrients (N, K, Mg, S and P) at regional level.**

#### Fertilization experiments

- (a) Effect of application of different rates of N, K and Mg on growth, soil- and plant-nutrient status and yield of tea.**

- 1. Effect of different rates of N (200, 400 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (100, 200 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (50, 100 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar PK 2, Field No 15 B, Court Lodge Estate, Kandapola, AER – WU3 (1999)

As in the yield of the last three months of the 2<sup>nd</sup> year, the 3<sup>rd</sup> year yield also increased significantly with increasing rates of N, but not with that of K and Mg fertilizer. There was no interaction between any of the treatments.

As in most years, soil pH levels at the 0-15 and 15-30 cm depths, decreased significantly with increasing rates of N. So far, no variation has been seen with increasing rates of either K or Mg.

As in previous years, soil ex: K level estimated in this year of the cycle also showed that the levels increased significantly at both depths, with increasing rates of potash fertilizer from 100 to 300 K<sub>2</sub>O kg ha<sup>-1</sup> yr<sup>-1</sup>. In fact, in terms of magnitude, soil K levels at the 15-30 cm depth are similar when compared to that at 0-15 cm, indicating that a considerable amount of K in the soil percolate down the profile when top layer is saturated with K. It appears to occur when the rate of potash fertilizer, exceeds 100 K<sub>2</sub>O kg ha<sup>-1</sup> yr<sup>-1</sup>.

Soil K levels, estimated this year, did not show any significant variations due to application of increasing rates of N or Mg fertilizer, unlike last year when K levels reduced from the application of increasing rates of N. There was no interaction between N, and potash or Mg, fertilizer rates. As in the 2<sup>nd</sup> year, soil Mg levels estimated in the 3<sup>rd</sup> year increased significantly with increasing rate of kieserite, at both depths. Though Mg levels did not vary significantly with increasing rates of potash, Mg levels decreased slightly with increasing N rates, as last year's results also showed.

Leaf nutrient concentrations, estimated in the 3<sup>rd</sup> year, also showed that N concentration increased significantly with increasing rates of N fertilizer, and at the same time Mg concentration decreased, with no change in K and Ca. With increasing rates of potash, leaf K concentration increased significantly and Mg decreased, with no change in N and Ca. Leaf Mg concentration increased significantly with increasing rates of kieserite and K concentration decreased, with no significant changes in N and Ca.

The experiment continues.

2. **Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2026, Field No. 1, Tokatiyamulla Estate, Galle, AER - WL2 (1999)

Following termination of the trial, overall data analyses continue.

3. **Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2027, Field No. 8, Talgaswela Estate, Galle, AER – WL1 (1999)

Following termination of the trial, overall data analyses continue.

4. **Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, Field No. 85, Houpe Estate, Kahawatte, AER – WL2 (1999)

Following termination of the trial, overall data analyses continue.

- 5. Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2026, Field No. 4 B, Lumbini Estate, Deniyaya, AER – WM1 (1999)

Following termination of the trial, overall data analyses continue.

- 6. Effect of different rates of N (160, 320 and 640 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (80, 160 and 320 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (40, 80 and 160 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil and plant nutrient status and yield of tea.**

Cultivar TRI 3019, Field No.2, Ury Estate, Passara, AER – IU2 (1999)

No significant variation was found in yield due to increasing rates of N, K and Mg fertilizers.

Soil pH levels at depths of 0-15 and 15-30 cm, decreased significantly with increasing rates of N, though dolomite was applied at a rate at pruning of 1500 kg ha<sup>-1</sup> cycle<sup>-1</sup>, and no variation was found due to increasing rates of either K or Mg fertilizers.

Soil ex: K level, estimated in the 1<sup>st</sup> year itself, showed that the levels increased significantly at both depths, with increasing rates of potash fertilizer from 80 to 320 K<sub>2</sub>O kg ha<sup>-1</sup> yr<sup>-1</sup>. In fact, in terms of magnitude, soil K levels at the 15-30 cm depth, beyond the rate of 80, are similar to, or higher than, that at 0-15 cm. This indicates that a considerable amount of K in the soil percolates down the profile when the top layer is saturated with K. It is clear that this percolation occur particularly when the rate of potash exceeds 80 K<sub>2</sub>O kg ha<sup>-1</sup> yr<sup>-1</sup>.

Estimations made this year classically showed that soil exchangeable bases, such as K, Mg and Ca, were significantly reduced by the application of increasing rates of N, quite possibly due to decreasing soil pH (and therefore increasing acidity) associated with increasing rates of N fertilizer. Application of increasing rates of kieserite did not show any significant effect on soil K, Mg and Ca.

Leaf nutrient concentrations, estimated this year, did not change significantly due to any of the treatments, though corresponding available nutrients in the soil varied.

The experiment continues.

**7. Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, Field No. NC New Division, Rangala Estate, Karaliyadda, AER – IU1 (2002)

As in previous years, yields increased significantly only with respect to increasing rates of N fertilizer.

Unlike in the 3<sup>rd</sup> year observations, where soil pH levels decreased significantly with increasing rates of N fertilizer, estimations made this year did not show significant variation in soil pH levels at both depths, but the grand mean (4.25) is less than the value estimated in the 3<sup>rd</sup> year. This is likely because of the buffering action in this soil. As expected, no variation was seen with increasing rates of either potash or kieserite.

As in previous years, soil exchangeable K levels this year also increased significantly with increasing rates of K, at both depths. Here again, the indication is that K percolates down to the bottom soil layer from the lowest rate of applied potash, 120 kg ha<sup>-1</sup> yr<sup>-1</sup>, and above, as the available K levels at both depths increase along with increasing rates of potash. Unlike in the 3<sup>rd</sup> year estimations, where the K levels was significantly decreased by the application of increasing rates of N fertilizer, this year's estimation did not show the same effect. As observed, there was no variation with increasing rates of kieserite.

This time again, no variation in soil Mg levels was seen as a result of increasing rates of kieserite, as in the 3<sup>rd</sup> year. There is no significant variation in Mg levels at both the 0-15 and 15-30 cm depths, though it was seen last year that Mg levels at the 0-15 cm depth significantly decreased with increasing rates of potash. Soil Ca levels appeared to be decreasing with increasing rates of N fertilizer, perhaps owing to increasing degrees of acidity associated with increasing rates of N.

As observed in the 3<sup>rd</sup> year estimations, leaf concentrations of N increased significantly with increasing rates of N fertilizers. So far, concentrations of other nutrients did not show great variations at this site, despite last year's tendency for leaf K to increase with increasing rates of potash fertilizer.

This trial continues.

**8. Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 210 and 300 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and Mg (60, 105 and 150 kg ha<sup>-1</sup> yr<sup>-1</sup> MgO) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, Field No NC5, Midlands Estate, Ratthota, AER-IM3 (2000)

At this site, as observed also in previous years, yields increased significantly with respect to increasing rates of N fertilizer, but not with K and Mg fertilizers.

Soil pH, K, Mg and Ca levels were determined in the 4<sup>th</sup> year (September 2005), at depths of 0-15 cm and 15-30 cm. Soil pH levels, at depths of 0-15 and 15-30 cm, decreased significantly with increasing rates of N, as observed also in previous estimations, but increasing rates of K or Mg had no effect on soil pH, as is to be expected.

Though till end of the 2<sup>nd</sup> year, soil ex: K level did not vary significantly, this year's estimation showed significant variation in ex: K, as in the 3<sup>rd</sup> year, but so far Mg and Ca levels did not vary significantly. Soil ex: K level increased significantly, at both depths, with increasing rates of potash fertilizer from 120 to 300 kg ha<sup>-1</sup> yr<sup>-1</sup>. Even this year, in terms of magnitude, K levels at the 15-30 cm depth are either higher than, or similar to, the K levels at the 0-15 cm depth. This shows that a considerable amount of K in the soil moves down the profile, when the top layer is saturated with K, and potash is applied at, or above, 120 K<sub>2</sub>O kg ha<sup>-1</sup> yr<sup>-1</sup> under mid-country conditions. With increasing rates of N fertilizer, both Ca and Mg levels tend to decrease, particularly towards the end of cycle, possibly owing to increasing acidity associated with increasing rates of N fertilizer.

Unlike in 3<sup>rd</sup> year's estimations, this year's results showed that leaf N significantly increased with increasing rates of N fertilizer, as at most other sites. Leaf K, Mg and Ca did not show any great variations, although tendencies for leaf Mg and Ca to decrease with increasing rates of N was seen.

Plants in the experimental plots were pruned in October 2006. Pruning weights increased significantly with increasing rates of N fertilizer, but not with increasing rates of potash or Mg fertilizers, as claimed.

This trial concluded, following completion of a cycle. Overall analysis continues.

**(b) Effect of application of different rates of N and K (and frequencies), on growth, soil- and plant-nutrient status and yield of tea.**

**1. Effect of different rates of N (100, 200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup> N) and K (100, 300 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, St.James Estate, Hali Ela, AER – IU3 (1990)

In general, yields increased significantly with increasing rates of N fertilizer, except in the last eight months of the penultimate year of the cycle. The pattern of increase has been linear. It was also apparent that there was no significant yield response beyond the rate of 100 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O of potash fertilizer. There was no interaction between increasing rates of N and K fertilizers.

Where soil physico-chemical properties are concerned, soil pH levels at both depths decreased significantly and continually with increasing rates of N fertilizer. The application of potash fertilizer had no influence. Soil K levels at both depths increased significantly with increasing rates of potash fertilizer over the cycle, from 100 kg ha<sup>-1</sup> yr<sup>-1</sup> and above. This was the most pronounced effect, indicating percolation of K down the profile, even when the rate exceeded the minimum. Also, K and Mg levels decreased significantly with increasing rates of N fertilizer. This effect was particularly seen towards the latter part of the cycle, but it was not as pronounced as for potassium.

Together with increasing yield, the leaf N concentration also increased significantly, and in a pronounced manner, with increasing rates of N fertilizer, over the cycle. However, no estimations made during the cycle showed that it was affected by the application of potash fertilizer. Leaf K concentration was increased significantly with increasing rates of potash fertilizer, but this effect was as strong as for leaf N and N fertilizer application. It was also evident that, at times, K concentration had decreased significantly with the application of increasing rates of N fertilizer.

**2. Effect of different rates of N (240, 420 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N), K (120, 300 and 480 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O), and frequencies (6-, 8- and 12- weekly intervals), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TC9, Brunswick Estate, Maskeliya, AER – WU1 (1998)

Increasing rates of N fertilizer increased yield significantly as previously, though in the 2<sup>nd</sup> year yield only a tendency for an increase was seen. So far, no interactions were found between increasing rate of either N or K fertilizers and frequency of the applications.

Soil pH, at depths of 0-15 cm and 15-30 cm, decreased significantly with increasing rates of N, as in previous years. Also, as previously, soil ex: K level estimated this year also showed that the levels increased significantly, at both depths, with increasing rates of potash fertilizer from 120 to 480 kg ha<sup>-1</sup> yr<sup>-1</sup>. In fact, in terms of magnitude, K levels at the 15-30 cm depth are either higher than, or similar to, that at the 0-15 cm depth. This indicates that a considerable amount of K in the soil percolates down the profile when the top layer is saturated with K, and the rates of potash exceed 120 kg ha<sup>-1</sup> yr<sup>-1</sup>. However, like last year, K levels did not show great variations, with increasing rates of N, though the 2<sup>nd</sup> year estimation showed a decreasing trend. So far, soil Mg and Ca did not change significantly with increasing rates of the treatments.

With increasing rates of N fertilizer, leaf N concentration increased significantly and as markedly as previously observed, but it remained with no significant change unlike in the previous year, when it decreased with increasing rates of potash. Also, there was no significant change in leaf Mg. With increasing rates of K fertilizer, leaf K concentration increased significantly, and this effect was pronounced. Both Mg and Ca concentrations decreased.

The trial continues.

**3. Effect of different rates of N (180, 240, 360 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup> N) and K (60, 120 and 240 kg ha<sup>-1</sup> yr<sup>-1</sup> K<sub>2</sub>O) on soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2027, Walpita Estate, Galle, AER - WL1 (2004)

This trial was laid out in a mature field planted in 1999 in a complete random block design, and recently pruned (July 2004). This is primarily to establish

optimum yield response under low-country conditions, and its corresponding critical leaf and soil nutrient values, as there is a dearth of such information.

The increasing rate of N fertilizer did not significantly change yields over the wide range of N fertilizer, though there was an increasing tendency.

The trial continues.

**(c) Effect of application of different levels of N, with different levels of compost manure, on growth, soil- and plant-nutrient status and yield.**

**1. Effect of seven different levels of N (0 to 720 kg ha<sup>-1</sup> yr<sup>-1</sup>), with compost manure (at 0 and 5 t ha<sup>-1</sup> yr<sup>-1</sup>), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar DT1, St Coombs Estate, Talawakelle, AER – WU2 (1992)

As observed earlier, yield in the 3<sup>rd</sup> year also showed a significant increase with increasing rates of N. So far, compost appears not to have shown a significant overall effect, except for the fact that the average yield with compost treatment over the N rates, was somewhat higher than that without compost application. This trial continues.

In general, the mean 3<sup>rd</sup> year yield is lower when compared to that of previous cycles. The likely reason is that the crop was not harvested owing to the continued absence of workers for over a month or so.

An attempt was also made to estimate nitrate reductase activity in pluckable shoots, and understand fate of the N fertilizer applied by measuring both ammonium and nitrate N, available in the soil. No soil- and leaf-nutrient data are presented because samples were not obtained as scheduled

**2. Effect of three different levels of N (200, 400 and 600 kg ha<sup>-1</sup> yr<sup>-1</sup>), with different levels of compost manure (0, 10, 20 and 30 t ha<sup>-1</sup> yr<sup>-1</sup>), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2026, Kallebokke Estate, Madulkelle, AER – IU1 (2002)

As observed, yields increased significantly with increasing rates of N fertilizer, and the appearance of the patterns of increase continues to be linear, even this year. So far, compost application had not shown any significant influence on yield.

Available K increased significantly with increasing rates of compost application. So far, there has been no significant influence on yield from the application of increasing rates of N fertilizer.

The trial continues.

**(d) Effect of application of different rates and proportions of urea and sulphate of ammonia, on growth, soil- and plant-nutrient status and yield.**

The seven trials, detailed below, are being carried out as part of a post-graduate study on S nutrition, with specific objectives.

Detailed investigations with each trial continue.

**1) Effect of different rates of N as urea and sulphate of ammonia (240 and 360 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea: SA = 100-0, 75-25, 50-50, 25-75 and 0-100), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, St Coombs Estate, Talawakelle, AER-WU2 (May= 1979)

The mean yield was low in comparison to that of the 2<sup>nd</sup> year of the last cycle, and this is also the case for the 1<sup>st</sup> year. There was no significant difference between the two rates of N fertiliser applications, unlike in most of the 12-monthly periods. This is probably due to the frost damage continually affecting the plants in the experimental plots. In this year too, no variations were seen for the different proportions of SA and urea.

As before, both the rates of N fertilizer and proportions of sulphate of ammonia, in the N combination, significantly altered the soil pH and the sulphate sulphur at both depths. This is despite applying dolomite at a rate of 1500 kg per ha at the time of pruning, in June 2004. Lower pH levels were found at the higher rates of N. At the same time, when the proportion of sulphate of ammonia increases in the combination, sulphate sulphur in soil too increased. As far as sulphate sulphur levels in the 100 percent urea plots are concerned, unlike all the other recent estimations, it was noted that this year's level was remarkably low.

So far, leaf S concentration was not affected by the urea and S/A combinations. However, the leaf S concentration at 360 N was significantly higher than at the lower rate.

The experiment continues.

- 2. Effect of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea: SA = 100-0, 75-25, 50-50, 25-75 and 0-100), on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2027, Field No. 8, Talgaswela Estate, Galle, AER-WL1 (1999)  
This year's data showed that the second-year yields increased significantly with increasing rates of N fertilizer, unlike most other estimations in this trial, but not with different proportions of urea and sulphate of ammonia as with the first-year yield.

Though both the soil pH and sulphate sulphur levels, estimated this year (September 2006), did not show significant variations, expected tendencies such as pH decreasing with increasing rates of N fertilizer and increased proportions of sulphate of ammonia in the combination, and sulphate sulphur increasing with increasing proportions of sulphate of ammonia, were present. Importantly, when previous estimations were also carefully examined, it was often observed that the significant decrease in pH with the increased proportions of sulphate of ammonia, in the combination of urea and sulphate of ammonia, was much more pronounced than the likely decrease with increasing rates of N, unlike at all the other trial sites.

Even at this experimental site, leaf S concentration was not yet affected, either due to the urea and S/A combinations, or the N rates.

The trial continues.

- 3. Effect of application of different rates of N as urea and sulphate of ammonia (200, 300 and 400 growth, soil- and plant-nutrient status and yield of tea. kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100), on growth, soil- and plat-nutrition status and yield of tea.**

Cultivar TRI 3018, Field No. 2, Ury Estate, Passara, AER – IU2 (1999)

The yield, even in the 1<sup>st</sup> year of this cycle, increased significantly with increasing rates of N fertilizer, but there was no variation with the different proportions of urea and SA.

The results, in the first year of the new cycle, showed that only increasing proportions of sulphate of ammonia, in the N combination, significantly reduced soil pH at both depths, while sulphate sulphur increased. However,

decreasing trends in pH, with increasing rates of N fertilizer rates, were seen. This is unlike the significant reductions seen in the latter part of the previous cycle, owing to both the rates of N fertilizer and increasing proportions of sulphate of ammonia in the N combination. It is likely that the total effect of application of increasing rates of N fertilizer on soil pH is overshadowed by the application of dolomite at the time of pruning. However, even at this experimental site too, leaf S concentration was not yet affected by either urea and S/A combinations or N rates.

The trial continues.

- 4. Effect of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea: SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2023, Field No. 3, Upper Division, Mahaousa Estate, Madulkelle, AER – IU1 (2001)

As observed from the 2<sup>nd</sup> year of this cycle, the yield in the third year increased significantly with increasing rates of N, but no effect was seen from the application of N in different proportions of urea and sulphate of ammonia. Especially, it is also worth placing on record, that the yields obtained from the experimental plots in general are above 10,000 MT per ha per year although the cultivar concerned is TRI 2023.

Both the rates of N fertilizer, and the proportions of sulphate of ammonia in the N combination, significantly altered the soil pH and sulphate sulphur, at both depths, as commonly seen from the trials above. The pH levels decreased with increasing rates of N, as well as when the percentages of sulphate of ammonia in the urea: S/A combination increased. The sulphate sulphur at both depths increased with increasing rates of N. This is particularly the case when the percentage of sulphate of ammonia in the urea: S/A combination exceeds 25%. This finding indicates that percentages of sulphate of ammonia above 25% are not advisable, both in terms of increased acidity and sulphur availability.

However, even at this experimental site, leaf S concentration was not yet affected, either by the urea and S/A combinations or by the N rates. As seen previously, this year's estimation also showed that leaf S concentration in the TRI 2023 cultivar is relatively higher than in the others.

The trial continues.

- 5. Effect of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea: SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2026, Field No.7, St. Francis Division Millakande Estate, Horana, AER-WL1 (2001)

The plants in the experimental plots were pruned in May 2006, following completion of two cycles. This trial was concluded owing to prioritization and poor response.

Overall data analyses continue.

- 6. Effect of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2026, Field No.13, B Division, Kiriwanagange Estate, Deniyaya, AER-WM1 (2001)

Second-year data showed that yields varied significantly with the application of N in different proportions of urea and sulphate of ammonia, but not with increasing rates of N, unlike in other trials. It is noteworthy that the yield averaged over N rates for 0: 100 urea to sulphate of ammonia combination, gave rise to a higher value.

Soil pH levels estimated this year showed that pH decreased significantly with increasing proportions of sulphate of ammonia in the urea and sulphate of ammonia combinations, as well as with increasing rates of N fertilizer, except for the urea and sulphate of ammonia combination at the 0-15 cm depth. Last year's data did not show any significant variations, and this was attributed to the effect of the application of dolomite at a rate of 2000 kg per ha, at the time of pruning. Unlike in the 1<sup>st</sup> year, when the sulphate sulphur in the soil increased significantly when the proportion of sulphate of ammonia increases in the combination, this year's estimations showed that the sulphate sulphur tends to increase more with increasing rates of N than with increases in the proportions of sulphate of ammonia.

Leaf S concentration estimated this year also did not show significant variations, unlike in the last year of the previous cycle, where S increased when the proportions of sulphate of ammonia increased in the N combination rates.

The experiment continues.

**7. Effect of application of different rates of N as urea and sulphate of ammonia (200, 300, 400 and 500 kg ha<sup>-1</sup> yr<sup>-1</sup>), and their proportions (urea : SA = 100-0, 75-25, 50-50, 25-75 and 0-100) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TRI 2025, Field No.3 A, Lonor AbbotHood Division Dessford Estate, Nanu-o-ya, AER-WU2 (2001)

Like last year, yield did not vary significantly either with increasing rates of N, or with application of N in different proportions of urea and sulphate of ammonia.

Both the rates of N fertilizer, and the proportions of sulphate of ammonia in the N combination, significantly alter the soil pH and sulphate sulphur at both depths. The pH levels decreased with increasing rates of N, and also when the percentage of sulphate of ammonia in the urea: S/A combination increases, while sulphate sulphur at both depths increased. Similarly so far, leaf S concentrations did not show significant variations.

The field trial continues.

As before, it is worth placing on record that the coefficients of variation (CV%), in the sulphate sulphur measurements from soil, were exceptionally high, and at times values were extraordinarily high at both depths, probably owing to an inadequate time-gap between the treatment application and the sampling. This is despite significant increases shown in the soil sulphate sulphur levels, with increasing proportions of sulphate of ammonia in the urea and sulphate of ammonia combinations, at all the sites. It indicates the inherent variability of the present method of extraction, and also interactions with soil types.

Therefore, an evaluation of widely-accepted test methods was completed, for assessing plant-available soil sulphate sulphur, using the tea cultivar, TRI 4052, grown under glasshouse conditions with major soil series.

The results showed the following:

- a. The best correlation was obtained with NaCl extractant followed by KH PO<sub>2</sub> irrespective of the soil type used
- b. However, when individual soils are concerned, KH PO<sub>2</sub> showed better correlations for each type of soils
- c. Therefore, the KH PO<sub>2</sub> extractant method was selected as the best soil test-method for assessing available sulphur in tea soils in Sri Lanka.

**8. Effect of application of "Humic" substances on soil properties, plant-nutrient status and the growth and yield of tea**

- a. Effect of foliar application of "Humate" on the growth and yield of tea.

Cultivar TRI 2027, Field No. 1999/3Ha, Raigam Estate, Ingiriya, AER -WL1 (2003)

The application of normal Humate to the ground and spraying of Super Humate at increasing rates did not significantly affect the yield. In the absence of urea, increasing rates of Super Humate solution also did not significantly affect the yield.

The trial continues.

- b. **Effect of application of Humate-treated waste tea compost (a rapid method of composting) on the chemical and physical properties of soil, and on the growth and yield of tea.**

Cultivar TRI 2027, Field No. 1999/3Ha, Raigam Estate, Ingiriya, AER -WL1 (2003)

The application of humate-treated compost significantly increased the mean yield, compared to that from plots supplied with refuse tea, that had not been treated with humate for enhanced composting activity. The trial continues.

**9. Development of a protocol for site-specific fertilizer recommendations (SSFR) for improvement of productivity and made-tea quality**

A draft guideline for site-specific fertilizer recommendations for mature tea fields was prepared.

**Project A 15.3 Estimating crop response to micro nutrients (Zn, B, Mn, etc.) at regional level.**

The results of field trials to compare the efficiency of foliar spray solutions of conventional zinc sulphate and/or commercial Epsom salt, with commonly used foliar spray formulations, are presented below.

- **Effect of application of micro nutrient foliar feeds, such as Multiplex and Kiecite, together with two conventional zinc sulphate solution combinations (11 kg Zn ha<sup>-1</sup> yr<sup>-1</sup>) on growth, soil- and plant-nutrient status, and quality and yield of tea.**

1. Cultivar TRI 2025, Field No. 3B, St Coombs Estate, Talawakelle, AER - WU2 (1999)

Following maintenance of yield records over the 1<sup>st</sup> year, and the 1<sup>st</sup> half of the 2<sup>nd</sup> year, for blocking plots based on pre-treatment yield distribution, treatments were imposed in April 2006. During this period, basal fertilizer applications were carried out at N and K<sub>2</sub>O rates of 310 and 120 kg ha<sup>-1</sup>, respectively.

Activities will continue until the end of the 3<sup>rd</sup> year (August 2007).

- **Effect of application of micro nutrient foliar feeds, such as Multiplex and Kiecite, together with two conventional zinc sulphate solution combinations (11 kg Zn ha<sup>-1</sup> yr<sup>-1</sup>) on growth, soil- and plant-nutrient status, and quality and yield of tea.**

2. Cultivar TRI 2025, Field No. 9, Madulkelle Estate, Madulkelle, AER - IU1 (2000)

This trial concluded in November 2006 following completion of a cycle with the treatments. The outcomes so far have been reported in the Annual Report for 2005.

- **Effect of application of micro nutrient foliar feeds, such as Multiplex and Kiecite, together with two conventional zinc sulphate solution combinations (11 kg Zn ha<sup>-1</sup> yr<sup>-1</sup>) on growth, soil- and plant-nutrient status, and quality and yield of tea.**

3. Cultivar TRI 2025, Field No. 3B, Greenwood Estate, Nawalapitiya, AER - WM1 (2000)

The outcomes so far have been reported in the Annual Reports for 2000 to 2005. Over the 1<sup>st</sup> 12 months (May 2005 to April 2006) of the new cycle, yield records were maintained without imposing treatments, and plots were blocked according to pre-treatment yield distribution, with a view to minimizing block variability. Basal fertilizer applications were carried out. The rates of N and K<sub>2</sub>O supplied were 320 and 120 kg ha<sup>-1</sup> yr<sup>-1</sup>, respectively. The treatments were imposed in June 2006. The activities continue.

- **Effect of application of micro nutrient foliar feeds, such as Multiplex and Kiecite, together with two conventional zinc sulphate solution combinations (11 kg Zn ha<sup>-1</sup> yr<sup>-1</sup>) on growth, soil- and plant-nutrient status, and quality and yield of tea.**
4. Cultivar TRI 2027, Field No. 3D, Second Division, Dammeria Estate, Passara, AER – IU2 (2004)

A description of this trial appeared in the Annual Report for 2005.

The plots had been first blocked based on pre-treatment yield distribution, from September 2004 to August 2005, in order to minimize block variability. Foliar treatments were carried out together with each basal fertilizer application. The rates of N and K<sub>2</sub>O supplied were 280 and 140 kg ha<sup>-1</sup> yr<sup>-1</sup>, respectively. There was no significant variation between treatments, except that the yield in the control was lower.

This trial concluded with pruning in November 2006.

**Project A 15.4 Evaluating the effects of macro and micro nutrients on colour and strength of tea liquor.**

Young shoots harvested from plots, treated with nitrogen at 420 kg ha<sup>-1</sup> yr<sup>-1</sup> and potash at 120, 240 and 480 kg ha<sup>-1</sup> yr<sup>-1</sup>, over the period June - July 2006, from the field trial at Brunswick Estate (vide Project A 15.2), were subjected to made-tea assessment for quality, in collaboration with the Biochemistry Division. Analyses continue.

**Project A 15.6 An island-wide survey for identifying factors affecting response to potash, K (and S).**

The outcomes so far have been reported in the Annual Report for 2005. Analysis of the balance part of the data set on potassium has been held up, owing to human resource limitations.

**2. Thrust A 16. Development of regional and site-specific dolomitic limestone recommendations, for ameliorating soil-acidity and enhancing soil-productivity.**

**Project A 16.4. Establishing dolomitic limestone requirements for better growth of mature plants, in different tea-growing regions at soil-series levels.**

**1) Effect of application of increasing levels of dolomitic-limestone, at three frequencies (cycle, mid-cycle and yearly) on growth, soil- and plant-nutrient status and yield of tea.**

Cultivar TC 9, Field No. 4, St Coombs Estate, Talawakelle, AER - WU2 (1989)

An attempt was made to analyze soil samples, collected in October 2006, from this long-term trial to assess plant-availability of soil micro nutrients, since long-term liming in general alters micro nutrient availability, depending on the type of soil, besides the presence of basic cations, such as calcium, magnesium and potassium. Soil zinc, copper, manganese and iron content, estimated as DTPA-extractable, following 3-cycle completion.

Both soil Cu and Fe content varied significantly with increasing rates of dolomite application, and possibly with soil pH variation. Copper content increased significantly with increasing rates of dolomite application, while Fe increased only up to the rate of 2500 kg ha<sup>-1</sup>, beyond which it decreased. No variations were seen due to strategies of application.

Activities continue as a long-term trial.

**3. Thrust A 17. Development of fertilizer and/or dolomite applicators for improving broadcasting efficacy, and overcoming the labour shortage.**

A detailed description of the work carried out, along with the objectives and milestones, appeared in the Annual Reports for 1998 to 2005.

**Delivery testing in the laboratory**

The prototype applicator developed was tested for its delivery when there was variation in material depth, in a static environment, in terms of delivery weight and nutrient content for recommended fertilizer mixtures. At the outset, it was apparent that there was no great variation at delivery.

Nutrient analyses have been completed, and statistical analysis continues.

**Comparing fertilizer distribution by manual and mechanical application**

A trial was laid out in Field No. 4, Mattakelle Estate, with six experimental blocks, each having about 250 mature tea bushes, in order to compare fertilizer distribution, among the bushes, by manual and mechanical application at field level.

Block numbers 2, 4, 6 and numbers 1, 3, 5 in the experiment receive fertilizer, as VP/UM910 mixture, manually and mechanically, respectively. An attempt was made to study the uniformity of the distribution over an application which was carried out on 09<sup>th</sup> November 2006. Ten average-sized bushes were chosen from each block with a view to quantifying distribution. A polythene sheet, having dimensions of 1.5 ft x 1.0 ft, was laid around the base of the chosen bushes. The weight of fertilizer particles falling over the sheets were measured. In order to assess uniformity in distribution, data were analyzed for standard deviation and coefficient of variation; the F test was also performed to determine statistical significance.

The statistical analysis shows that the amounts of fertilizer falling in and around the bushes, during manual application, have higher variance (higher CV and standard deviation) than that during mechanical fertilizer application. In general, average weights at manual application were lower compared to that at mechanical application. This also indicates that distribution at mechanical application is better.

Field-testing at this site, together with necessary refinements to the applicator, and also fabrication of units, continues for performing large-scale field-testing.

**4. Thrust A21 Development/Adaptation and introduction of Mechanical Pruning methods**

**Project A 21.3. Screening lines for cultivar response to native and applied nutrients.**

Field No 13, St Coombs Estate, Talawakelle (2005)

A description of this trial was given in the Annual Report for 2005. Activities continue.

**5. Thrust A22 Development of cost-effective control methods for integrated management of SHB**

**Project A 22.5. Modifying potassium fertilization for reducing SHB damage**

Field No. 9 A, Factory Division, Hantane Estate, Kandy, AER-WM3 (1997)

The plots were pruned in May 2005. The yield was not presented, as the duration of recording harvested crop was considerably short. Activities continue.

The yield following pruning in October 2004 was not presented, as the plants supplied had not recovered fully. Plans are underway for their revival.

Activities continue.

The Entomology Division monitors the incidence of SHB in both trials, and the results will appear in the report of that Division.

**6. Thrust A32 Development of an organic farming system for tea  
Project A 32.1. Evaluating soil fertility in organic tea lands.**

**Effect of the application of different sources of compost in organically grown tea lands.**

Cultivar TRI2023/2025, Gamiseva Seva Sevana, Nilambe AER WM3 (2004)

A description of this activity appeared in the Annual Reports for 2004 to 2005. The treatments are 2 kg compost, 40 g ERP and 400 g poultry manure per plant, at two applications per year; and *Gliricidia* spray over the foliage at two-weekly intervals. Though no significant differences were apparent between the treatments, the yields obtained from the plots that received only *Gliricidia* spray were considerably lower.

Activities continue.

**7. Project B 35. Establishment of critical nutrient levels for better growth of cultivar tea.**

Overall data analyses were held up owing to resource limitations.

**8. Project B 15. Environmental studies.**

**B 15.1. Impact of the variation of weather conditions on crop environment and productivity of tea: assessment of the effects of wet- and dry-depositions from the atmosphere.**

The monitoring of rainwater quality continued in collaboration with the meteorological centers of the Institute's Centres at Talawakelle, Ratnapura, Hantane, Passara, Kottawa and Deniyaya. Parameters such as rainfall, *in situ* pH,  $\text{NO}_3^-$ -N,  $\text{SO}_4^{2-}$ -S,  $\text{Mg}^{2+}$  and  $\text{Ca}^{2+}$  are being monitored on a continuing basis.

Rainwater quality assessment over a three-year period was carried out and the result was published.

**9. Thrust B 'New'. Evaluation of the effect of fertilizer application in up-country tea estates on down-stream pollution of water bodies**

Though plans were made to monitor downstream tributaries of the Maskeliya Oya, activity initiation suffered owing to resource limitations.

**Supportive Projects**

**1. Adaptive fertilizer trials**

**a. Collaboration with the Advisory and Extension Division**

A description of the trials appeared in the Annual Report for 2005. Of six trials, laid out at the Institute's Advisory and Extension Centres (Ratnapura, Kottawa, Hantane, St Coombs, Passara and Deniyaya), in order to compare the present and the former fertilizer recommendations, with a view to raising grower confidence, only five continued.

At all the sites, there was no significant difference between the two recommendations, unlike last year's yields where there was a significant increase in yield for the present fertilizer recommendations, compared to the former, only at the Kottawa site.

Activities continue.

**b. Collaboration with Balangoda and Madulsima Plantations, 2002**

Effect of application of fertilizer mixtures with a N to  $K_2O$  ratio of 1:1 (U 877), and 2:1 (U 709), on soil- and plant-nutrient status, growth and yield in seedling and VP tea (Kew, Kirkoswald, Mahadowa, Wewessa Telbedde, El Teb, Balangoda, and Cecilton Estates).

Details of the trials appeared in the Annual Reports for 2002 to 2005. Of the trials commenced, it was apparent that only the trials at Balangoda and Telbedde continue. The plants in the plots at Telbedde were pruned in October 2005.

The quantities of N and  $K_2O$  supplied are 270 kg ha<sup>-1</sup>, and 135 and 270 kg ha<sup>-1</sup>, respectively, during the above period. The yield, where U 709 was applied, was significantly higher than the plots where U 877 was applied.

Activities continue

**c. Collaboration with Nayabedde Estate: comparison of the present fertilizer recommendation, estate fertilizer practices, and site-specific fertilization.**

A description appeared in the Annual Report for 2005. The quantities of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O, given over the period for 'present, former and site-specific' approaches, are 270, 240 and 270; 35, 33 and nil; and 140, 100 and 120, kg ha<sup>-1</sup> yr<sup>-1</sup>, respectively.

There was no significant variation between treatments. There was also no significant changes in available soil nutrients such as P, K and Mg.

Activities continue.

**d. Collaboration with Uvakellie Estate: an observation trial on recovery from S-deficiency following application of different S sources**

A description of this trial was given in the Annual Report for 2005. At the outset, S deficiency symptoms swiftly disappeared following the application of S-containing fertilizers, regardless of the source of sulphur or the rate of application. Activities concluded with this observation.

**e. Collaboration with Kadiyagala Estate, Deniyaya: screening compost, made out of municipal waste, on young tea.**

A trial was laid out in a new, TRI 2026 clearing of 12 plots, each having 20 plants in a completely randomized block design, to accommodate four treatments replicated thrice. Treatments are application of compost made out of municipal waste, at three rates (5, 10 and 20 mt per ha per year, given in two splits), a control, and fertilization with T 200 as per the Institute's recommendation. Growth until harvesting commenced, was measured in terms of the number of leaves and primary and secondary branches, and plant height to the uppermost centre. At the commencement of harvesting, a representative set of young shoots, mother leaves and maintenance foliage were also taken for nutrient and heavy-metal analyses.

Analyses and activities continue.

## **Basic Research**

**1. Evaluation of phosphorus-availability in an acid tea soil, supplied with different rates and proportions of nitrogen, as urea and sulphate of ammonia**

The objective of the study was to evaluate the influence of N-fertilizers on P-availability in a soil under tea, treated with different amounts and ratios

of urea and ammonium sulphate. Soil samples were collected at two soil depths, 0-15 cm and 15-30 cm, from an on-going field experiment in Mahaousa Estate in the Kandy district.

There were 15 fertilizer treatments, with three replicates, provided with different rates of N (200, 300 and 400 Kg N/ha/year) as urea and sulphate of ammonia (SA), and at different proportions (100:0, 75:25, 50:50, 25:75, 0:100). An incubation study was also conducted, using the same treatments for two months.

The pH, and the extractable-P and NaOH-P<sub>i</sub>, NaOH-P<sub>o</sub>, H<sub>2</sub>SO<sub>4</sub>-P<sub>i</sub> fractions of the samples, were determined. The magnitude of the P concentration in different P fractions were in the order: NaOH-P<sub>i</sub> > NaOH-P<sub>o</sub> > H<sub>2</sub>SO<sub>4</sub>-P<sub>i</sub> > resin P. The results also showed that the extractable-P concentration in the soil increased gradually with increasing rates of N rates, at both depths, in the field trial.

## 2. Evaluation of foliar spraying of Zn, Mn and Mg on tea

Magnesium, Zn and Mn are important for growth and dry-matter production in tea plants. These nutrients are generally present in adequate amounts for plants growing in tea soils. However, there are constraints regarding the availability of the nutrients to the plants. Routine foliar spraying of these elements is a usual practice in many tea plantations.

A study was conducted with the objective of investigating the effect of foliar spraying of ZnSO<sub>4</sub>, MnSO<sub>4</sub> and MgSO<sub>4</sub>.7H<sub>2</sub>O on mature as well as nursery tea plants. The experiment consisted of six treatments, namely 1. ZnSO<sub>4</sub> full dosage, 2. ZnSO<sub>4</sub> half dosage, 3. ZnSO<sub>4</sub> full dosage + urea, 4. ZnSO<sub>4</sub> full dosage + urea + MgSO<sub>4</sub>.7H<sub>2</sub>O, 5. ZnSO<sub>4</sub> full dosage + urea + MgSO<sub>4</sub>, and 6. a control treatment which was also included in the trial. The treatments were replicated at two sites.

Bud break, dry-matter weight and plant heights were not significantly different between the treatments. The two sites showed significantly different values for dry-matter weight and number of plucking points. However, treatments 1 and 5 showed an increase in yield in both sites. Treatments 1, 3 and 4 showed yield increments only in one site. No clear increase in bud break was found at both sites. Comparatively higher shoot growth could be observed in treatments 1 and 5, at both sites. Leaf Zn concentration in treatments 1, 3, 4 and 5 were significantly higher than in the control and in the other treatments, whereas Mg and Mn were not significantly different between treatments.

The trial with nursery plants did not show significant differences due to the treatments, in plant height, number of leaves and number of branches.

**3. An evaluation of nitrogen- and phosphorus-release patterns due to compost and ERP, in organic tea soil**

An incubation study was carried out using soils collected at a depth of 15 cm, from the Gami-Sevasevana organic tea garden at Galaha. The soils were amended with compost at the rate of 25 and 50 mt ha<sup>-1</sup>. Eppawela rock phosphate (ERP) and poultry manure (PM) were applied at constant rates of 100 mg P kg<sup>-1</sup> soil and 5 mt ha<sup>-1</sup>, respectively. The treatments were compost, compost + ERP, and compost + ERP + poultry manure, for both levels of compost. The treated soils were incubated at 50% field capacity for 12 weeks in the laboratory, and the changes in soil-extractable P, NH<sub>4</sub><sup>+</sup>-N, NO<sub>3</sub><sup>-</sup>-N and pH were measured at three-week intervals.

Ammonification (NH<sub>4</sub><sup>+</sup>-N production) reached a maximum in six weeks, but NO<sub>3</sub><sup>-</sup>-N production continued throughout the experiment. The reduction of soil pH was mainly due to acidity produced during nitrification, and this acidity was used for dissolution of ERP. The magnitude of P availability was in the order: compost + ERP + PM > compost + ERP > compost > control, and the same order was observed in the release of nitrogen as well. The treatment comprising 50 mt ha<sup>-1</sup> + ERP + PM resulted in the highest available P, NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, and the lowest pH reduction.

**4. Thrust A 18. Development of regional analytical laboratories for soil, plant and fertilizer analysis.**

**a. Analytical laboratory service**

The mean, mode, minimum and maximum values, along with the number of some routinely-carried out tests in the Talawakelle and Walahanduwa laboratories, are given in Tables 1 to 4, respectively.

TABLE 01 - Soil Analysis (Talawakelle)

AER	pH					C %					P (ppm)					K (ppm)				Mg (ppm)					
	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode
WU1	567	7.00	3.56	5.03	4.80	434	5.32	0.75	2.68	2.55	80	337	1.0	50	10	101	500	41	168	100	109	304	13	132	107
WU2	1831	7.32	3.44	4.73	4.60	1526	7.92	0.37	2.69	2.10	979	331	0.6	28	3	1173	700	20	167	100	1072	395	4	91	39
IU2	249	6.22	3.59	4.71	4.52	213	6.58	0.20	2.48	2.03	149	607	4.0	81	11	162	349	9	133	83	142	272	10	93	95
IU3	29	4.98	4.02	4.51	4.28	29	5.70	1.20	2.29	1.20	2	22	20	21	20	29	258	58	143	133	2	243	146	195	146
WM1	23	5.86	3.94	4.54	3.94	23	2.74	0.99	1.55	1.34	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
WM3	75	6.10	3.73	4.65	4.90	15	4.81	0.38	1.84	1.73	60	142	1	21	1	60	317	17	105	58	24	219	13	71	13
IM2	216	6.45	3.80	5.17	4.80	217	4.84	0.58	2.38	1.66	217	377	1	56	3	217	390	33	122	133	217	304	4	122	13
IM3	47	5.90	3.58	4.54	4.20	47	4.80	0.60	2.31	1.44	8	27	8	12	8	47	392	41	140	75	47	181	13	71	47
WL1	11	5.19	3.87	4.53	3.87	31	3.97	1.95	3.08	3.30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
WL2	13	6.16	4.09	4.93	4.09	13	2.62	0.82	1.64	0.82	4	21	9	17	9	4	108	58	85	58	4	65	43	50	43
WL4	14	5.24	3.24	4.94	5.19	14	3.91	1.61	2.59	1.69	14	12	3	7	3	14	175	62	115	100	14	99	20	64	20

TABLE 02 - Leaf Analysis (Talawakelle)

AER	N%					P%					K%				Mg%					
	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode
WU2	37	4.24	2.32	3.29	2.57	37	0.23	0.11	0.18	0.17	37	1.83	1.10	1.39	1.30	37	0.42	0.19	0.30	0.31
IU1	1	2.60	2.60	2.60	2.60	.	.	.	.	.	1	1.22	1.22	1.22	1.22	1	0.20	0.20	0.20	0.20
IU2	1	2.70	2.70	2.70	2.70	1	0.12	0.12	0.12	0.12	1	1.25	1.25	1.25	1.25	1	0.22	0.22	0.22	0.22
WM2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	0.26	0.18	0.22	0.21

TABLE 03 - Soil Analysis (Walahanduwa)

AER	pH					C %					P (ppm)				K (ppm)				Mg (ppm)					
	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean
WL1	-	-	-	-	-	3	0.54	0.021	0.33	0.2	3	N/D	N/D	N/D	N/D	3	20	15	18	20	-	-	-	-
WL2	2	5.24	5.04	5.14	5.04	5	1.70	0.70	1.09	0.7	2	8	6	7	6	2	117	83	100	83	-	-	-	-
WL4	126	6.52	3.01	4.47	4.10	39	1.45	0.09	1.01	0.8	41	54	N/D	16	3	41	358	15	105	58	33	242	1	80

TABLE 04 - Leaf Analysis (Walahanduwa)

AER	N %					P %					K %				Mg %									
	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean	Mode	Count	Maximum	Minimum	Mean
WM1	22	4.2	3.20	3.67	3.6	22	0.38	0.22	0.32	0.34	22	2.43	1.05	1.68	1.13	22	0.62	0.27	0.41	0.31	-	-	-	-
WL2	10	3.1	1.80	2.68	2.9	10	0.18	0.10	0.15	0.14	10	2.17	0.55	1.58	0.55	-	-	-	-	-	-	-	-	-

WU1 Up country wet zone 1

WU3 Up country wet zone 3

IU3 Up country intermediate zone 1

WM2 Mid country wet zone 2

IM2 Mid country intermediate zone 2

WU2 Up country wet zone 2

IU2 Up country intermediate zone

WM1 Mid country wet zone 1

WM3 Mid country wet zone 3

IM3 Mid country intermediate zone 3

### b. Analytical laboratory accreditation

The Division's Analytical Laboratory at St Coombs participated in the international laboratory evaluation programmes, on chemical analysis of soil (International Soil-Analytical Exchange-ISE) and plants (International Plant-Analytical Exchange-IPE). Four soil and four plant samples were received quarterly over the year. They were subjected to test methods, such as for pH (water, CaCl<sub>2</sub> solution), % C (Walkley and Black), E.C., Na, K, Mg and Ca in soil samples, and Cu, Fe, Mn, Zn, Ca, K, Mg, Na, P and Cd in plant samples, depending on convenience. The results were submitted to the Wageningen University for evaluation.

Evaluation reports, issued by the Wageningen Evaluating Programme for Analytical Laboratories, during 2006, showed that, most of the time, the soil analytical results from the Division's laboratory at St Coombs, such as for pH (H<sub>2</sub>O), pH (CaCl<sub>2</sub>), pH (KCl), soil organic carbon and soil nitrogen, and extractable soil K and Mg, were within the satisfactory range of the Z score, that is  $+2 \geq Z \geq -2$  (Tables 5 and 6). In addition, the total plant analytical results, such as for Ca, Mg, Cu, K, Mn, Zn, and N, were also within the satisfactory range of the Z score. As before, this evaluation exercise was helpful in improving the laboratory's performance.

Table 05. The Z-score values for soil samples

Quarter	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Organic C	-1.93	-1.09	-0.91	-1.27
	-0.93	-3.05	-1.68	-1.19
	-1.16	-2.69	0.32	-0.8
	-1.55	-1.78	0.58	-1.05
pH (H <sub>2</sub> O)	-2.43	-0.62	-0.08	-2.81
	-3.12	-0.22	0	-1.11
	-2.41	-0.4	0.8	-0.89
	-1.27	-0.61	-0.64	-0.04
pH (CaCl <sub>2</sub> )	-2.04	-0.59	-1.73	-2.18
	-6.52	0.04	-1.31	-1.29
	-1.18	-0.42	-1.14	-2.22
	-0.2	-0.55	-1.65	-0.28
pH (KCl)	-3.78	-3.23	-2.78	-1.22
	-3.88	-1.83	-3.4	-0.26
	-2.22	-1.79	-1.8	-0.58
	-1.16	-1.36	-2.68	-0.74
N	1.86	**	1.08	1.13
	4.52	6.71	1.58	0.35
	0.07	**	1.01	0.13
	0.94	-2.02	2.29	5.78

\*\* Extremely out of range

- **General**

- Dr A K N Zoysa assumed duties as the Officer-in-Charge of the Institute's Mid Country Station, Hantane. With effect from 01<sup>st</sup> February.
- Messrs T C N Peries and R G A Wijayawardhana, Technical Assistant and Experimental Officer, resigned from the Institute's services with effect from 01<sup>st</sup> and 02<sup>nd</sup> July, respectively.
- Mrs P L K Tennakoon, Experimental Officer, continued her postgraduate studies on the Development of Bio Fertilisers, and their potential applications, at the University of Agricultural Sciences, Dharwad, Karnataka, India.
- Dr L S K Hettiarachchi, together with Mrs J A M M Jayakody, Head, Agricultural Economics, prepared a draft policy paper on the Likely Impact of the Recent Urea Subsidy Revision on the Tea Sector and the National Economy, for the submission to the Ministry of Plantation Industries
- Dr L S K Hettiarachchi served as:
  - a) a member of the working group on fertilizer of the Sri Lanka Standards Institution;
  - b) a member of the Technical Committee on Organic fertilizer of the Sri Lanka Standards Institute;
  - c) a member to the National Committee appointed by the Honourable Minister of Agricultural Development, Government of Sri Lanka, to advise the Director of the National Fertiliser Secretariat on matters in relation to the administration of National Fertiliser Regulation Act Number 68;
  - d) a visiting lecturer/resource person to the National Institute of Plantation Management, Sri Lanka;
  - e) a member of the National Advisory Committee on organic fertiliser of the Ministry of Agricultural Development, Government of Sri Lanka; and
  - f) the Scientific Advisor to the National Delegation appointed by the Honourable Minister of Plantation Industries, Government of Sri Lanka, to examine an Amino-Phenol Fertiliser manufacturing unit in Yixing, Jiangsu province in China during 9-14<sup>th</sup> November, 2006.
- Dr A K N Zoysa served as:
  - a. a member of the Board of Study in Environmental Science, Post Graduate Institute of Science, University of Peradeniya:

- b. a visiting Lecturer of the Faculty of Agriculture, University of Ruhuna.
- c. a member of the Publications and Presentations Panel of the TRI.

● **Publications**

1. Dissanayake D M B N, Gunaratne O G K A, Gunaratne G P and Heittiarachchi L S K (2006) “Yellow Rain” on tea plantations in Lindula and Agrapatana areas. TRI Update 11 (1), 1.
2. Zoysa A K N, Alagiyawadu U D, Ziyad Mohamed M T and Gunaratne G P (2006) SS Fert Master: Computer Model for Site Specific Fertiliser Estimation. TRI Update 11 (1), 8.
3. Rajasinghe J C K, Zoysa A K N and Kahadawa W B (2006) Yatinuwara Tea in Crisis?. TRI Update 11 (1), 7.
4. Tennakoon P L K, Hettiarachchi L S K, Gunaratne G P, Wijayawardhana R G A W and Gunaratne, O G K A (2006) An assessment of rainwater quality from the tea growing areas of Sri Lanka. S.L.J.Tea Sci 71 (1), 50-62.
5. Heittiarachchi L S K and Jayakody J A M M (2006) Some agronomic measures in tea cultivation for circumventing impact of the revision of urea subsidy. TRI Update 11 (2), 3-6.
6. A Draft Guideline for Site-Specific Fertiliser Recommendations for mature tea fields (2006).

● **Meetings, Seminars and Workshops**

The staff of the Division conducted and actively participated in “Crop Clinic” workshops at the following locations.

- a. Kottawa Galle on 23<sup>rd</sup> January.
- b. Morawangolla Planters Club, Deniyaya on 25<sup>th</sup> January.
- c. Siththamgallena Temple, Hambantota on 9<sup>th</sup> December.

Dr L S K Hettiarachchi attended the following.

- a. A Technical Evaluation Committee meeting at the Tea Small Holdings Development Authority for the procurement of 30 desk-top pH meters for soil pH measurement, Colombo, on 31<sup>st</sup> January.
- b. The closing ceremony of the SRICAN Project Phase IV held at the PGRC Auditorium on 16<sup>th</sup> February.
- c. A meeting for development of a unified salary structure for the Science and Technology, and Agricultural, sectors of Sri Lanka, organized by the National

Science Foundation, with a view to presenting it to the Salaries and Cadre Commission, held in NSF's Auditorium, Colombo, on 05<sup>th</sup> June.

- d. Meetings for development of a unified salary structure for the Plantation Crop Research Institutes, and for the adaptation of a new salary revision, organized by the National Salaries and Cadre Commission, Colombo, on 17<sup>th</sup> June, and 01<sup>st</sup> and 10<sup>th</sup> October, respectively .
- e. A meeting for the development of a consortium for Sri Lankan Agricultural, and Science and Technology, sectors for on-line access to [www.sciencedirect.com](http://www.sciencedirect.com) organized by the National Science Foundation, Colombo, on 09<sup>th</sup> June
- f. A workshop, in April 2006, to assess the short-term Impact of the introduction of the urea fertilizer subsidy to the Agricultural Sector, organized by the Ministry of Agricultural Development, and held at the Hector Kobbekaduwa Agricultural Research and Training Institute on 27<sup>th</sup> July.
- g. A presentation to the members of the Tea Research Board at its 112<sup>th</sup> meeting on "Possible measures for circumventing adverse effects owing to the recent urea subsidy revision", held at the Sri Lanka Tea Board Auditorium on 27<sup>th</sup> June.
- h. A seminar on site-specific nutrient management for improving crop yield, profitability and environmental effects, held at the SRICANSOL Resource Centre, Department of Soil Science, Faculty of Agriculture, University of Peradeniya, on 01<sup>st</sup> December.
- i. First and Second Advisory Committee meetings on matters concerning National Fertilizer Use, organized by the National Fertilizer Secretariat, Ministry of Agricultural Development, held at its Conference Hall, on 25<sup>th</sup> October and 15<sup>th</sup> December, respectively.

A presentation on the out come of Research and Developmemnt activities carried out on Sulphar Nutron in tea for the selection of National Awards for excellence in Agriculture research following short listing held at the board room of the Council of Agricultural Research Policy Office, on 21st December

A cordinator short course on 'Environmental Management Botic Concept and legal framework' held at the Post graduate Institute of Science, University of Peradeniya on January 28-29, 2006.

Dr A K N Zoysa served as a judicator at the Annual Academic Sessions of the University of Ruhuna, Matara, on January 30.

Dr A K N Zoysa delivered a lecture to the members of the Soil Science Society of Sri Lanka, on 'Site-Specific Fertilization of Tea', at the SRICANSOL Centre of the University of Peradeniya, on 01<sup>st</sup> December.

Dr L S K Hettiarachchi, Dr A K N Zoysa, Mr G P Gunaratne and Mrs S Ananthacumaraswamy attended the 212<sup>th</sup> and 213<sup>th</sup> E & E Forum, at the TRI Auditorium, Talawakelle, on 26<sup>th</sup> January and 28<sup>th</sup> July, respectively.

Dr L S K Hettiarachchi attended the 17<sup>th</sup> E & E Forum (Small Holder Sector), at the TRI Auditorium, Ratnapura, on 03<sup>rd</sup> September.

- **Overseas training programme**

Mrs P L K Tennakoon continues her post graduate training programme on Bio Fertilisers at the University of Agricultural Sciences Dharwad, Karnataka, India.

- **Training programmes**

Mr G P Gunaratne attended a training programme on Laboratory Management Systems, organized by the Sri Lanka Accreditation Board, for conformity assessment, held at ITI, Colombo, from 21<sup>st</sup> to 22<sup>nd</sup> August.

Mr G P Gunaratne attended a training program on Monitoring and Evaluation of Research Projects, organized by CARP, and held at the CARP Secretariat on 1<sup>st</sup> September.

Mr D M B N Dissanayake attended a “National training course on radiation safety in using radioisotopes for research and industrial applications”, held at the Atomic Energy Authority from 11<sup>th</sup> to 15<sup>th</sup> December.

- **Visitors and Trainees**

The following groups visited the Division in order to familiarize themselves with soil fertility and nutritional aspects of the tea plant.

1. Staff of the Sri Lanka Tea Board on 21<sup>st</sup> February.
2. Undergraduate students from the Faculty of Plantation Agriculture, Sabaragamuwa University, from 27<sup>th</sup> to 28<sup>th</sup> December.
3. Mr W D R Amarasinghe, Trainee Assistant Manager, Frotoft Estate, Ramboda, underwent training in the Division on soil fertility and plant nutritional aspects, on 22<sup>nd</sup> August.
4. Mr G G N S Kumara, a NDT student from the Hardy Advanced Technical Institute, Ampara, commenced four months in-plant training on 17<sup>th</sup> July, while Mr JN Ratnayake commenced two months in-plant training on 11<sup>th</sup> September. Both completed their training on 17<sup>th</sup> November.
5. Mr S S Perera, a final-year student from the Faculty of Agriculture, University of Peradeniya, underwent one month's in-plant training in the Division as from 28<sup>th</sup> September, in order to become familiar with activities carried out in a research and development laboratory where soil fertility and plant nutritional aspects are dealt with

## TECHNOLOGY DIVISION

*Officer-in-Charge – K Raveendran*

### 1. New Experiments

#### 1.1 Testing the characteristic performance curve of newly-introduced withering - trough fans.

The withering is the prime and most important process in tea manufacture. Nearly 50% of the total electricity consumption, and about 40% of the total thermal energy, are used in this process. The higher electricity consumption is due to operation of a fan motor system coupled to withering units called troughs.

In order to reduce electricity consumption, several newly-designed, low-weight withering fans are introduced in tea factories. These fans are supplied to the factories without a proper performance curve being available. Owing to this, the fan fails to supply the required amount of air for the withering process. As such, withering is delayed and more electrical energy and thermal energy are consumed for the process.

It was decided to fabricate a testing facility called the “Test Rig” to test such fans. The standard, ISO5801:1997, for the Test Rig was purchased, and after careful study a suitable type of installation was selected. It was decided to carry out the experiment in collaboration with the Energy Conservation Fund, (ECF) and a project proposal was submitted to the ECP for a positive response.

#### 1.2 Testing *Gliricidia* and *Calliandra* firewood for tea drying.

In black tea manufacture, thermal energy is used to generate hot air for drying and the withering processes. Firewood is widely used as a fuel source for thermal energy generation in tea factories. However, firewood is also not adequately available, and getting good firewood in right quantities is not possible at factory locations most of the time. Further, the price of the firewood increases with demand and with scarcity.

A project was designed to test energy plantation crops such as *Gliricidia* and *Calliandra* for tea drying. Trials were conducted with *Gliricidia* firewood at St Coombs Estate, Mattakelle Estate and St Joachim Estate. The specific consumption varied between 0.53 and 0.65 kg firewood/kg MT. The *Gliricidia* firewood used for the experiments was purchased at Rs.2.50/kg. The transport cost for the firewood was Rs.0.75/kg. The cost of drying was found to be low,

at Rs.1.72 – Rs.2.11/kg MT.

*Calliandra* firewood was collected from St Coombs Estate, in order to conduct experiments with different types of driers and air heaters at St Coombs Estate and Mattakelle Estate. The *Calliandra* firewood was cut to different sizes, and the drying rate of the firewood was monitored by keeping the firewood in a firewood shed for a period of 40 days.

It was found that the drying of *Calliandra* to a moisture content of about 25% takes nearly 24 days.

### 1.3 Optimising grading-room operations in low-country manufacture

The objective of this study is to optimise the use of machinery, increase worker productivity, and develop a Grading Programme. Trials were conducted to find the actual time taken for the grading of teas in the Grading Room, during the period under review. Initially, trials were conducted with large leaf fraction obtained from 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> dhools and Big bulk in Myddlton after passing it through Fibromat. The large fraction was graded using Michie sifters, Winnower and Colour separator. The rolling programme followed was,

**Batch size – 580 kg**

**Charging interval – 45 minutes**

**Dhool production,**

<b>Dhool/ BB</b>	<b>%</b>
1 <sup>st</sup>	7
2 <sup>nd</sup>	15
3 <sup>rd</sup>	25.5
4 <sup>th</sup>	18.4
BB	32.5

The throughput of dhool/ BB in Fibromat and Myddlton and throughput of graded teas obtained from the large leaf fraction in Winnower and Colour Separator was studied. A Grading Programme was drawn for grading of large fraction of teas obtained from Dhool/ BB in Myddlton based on the data obtained through the experiment. Grading programme for Medium fraction and small fraction teas will be drawn similarly and a final drawing programme will be drawn from the data obtained from more experiments in the year 2007.

#### **1.4 Optimisation of low-country grade mix using a combination of No. 3 and 4 meshes in the roll breaker.**

The objective of this study is to determine the merits and demerits of using a combination of No. 3 and No. 4 meshes, instead of a No. 4 mesh alone, in the roll breaker, in low-country tea manufacture. One trial was conducted during the year at the St Joachim tea factory.

The green leaf received was withered using two identical troughs: trough No. 3 and trough No. 4. The withered leaf from trough No. 4 was manufactured using No. 4 mesh only, in the roll breakers. The withered leaf from trough No. 3 was manufactured using the combination of No. 3 and No. 4 meshes, in the roll breakers.

As expected, the initial dhool percentages increased when the Nos. 3 and 4 mesh combination was used in the roll breakers. This resulted in an increased percentage of OPA and Pekoe grades, and a reduced percentage of smaller size grades, such as FF and FF1, as given in the Table below. However, conclusions will be arrived at, based on the analysis of data from more experiments, conducted during the year 2007.

## **2. On-going Experiments**

### **2.1 Project A 27.1. Evaluating new types of paper sacks**

Asia Siyaka Commodities (Pvt) Ltd and the TRI collaborated in testing teas, packed under vacuum, for improvements in keeping quality. A vacuum-packing machine was used in this experiment. The teas tested were broken-grade teas from the orthodox-Rotorvane type of manufacture, and leafy grade teas from the pure Orthodox type of manufacture. The broken grades and the leafy grades were obtained from the Institute's Tea Factories at St Coombs and St Joachim Estates, respectively. The method of testing and the results obtained are described below.

#### **Tests on broken-grade teas**

The broken grades tested were BOP, BOPF and Dust 1. The teas were separately packed in standard paper sacks, as well as in MVP barrier bags under vacuum (700 mm Hg). Tea samples were drawn from the standard paper sacks and the MVP barrier bags after a period of three months, and the following were conducted.

- 1. Moisture test**
- 2. Chemical analysis for theaflavin and thearubigins**
- 3. Organoleptic analysis**

The reduction of moisture content in teas packed under vacuum was found to be high. The moisture from the teas might have escaped to the void which was under vacuum. This reduction supports ensuring keeping quality of teas during storage and transportation. In the absence of trapped air (that is, absence of oxygen) post fermentation, and changes in levels of quality-giving compounds, such as theaflavin and thearubigins, are not expected to take place.

The variation in the amount of theaflavin was small. However, a small increase in the thearubigins could be expected in the case of teas packed in standard paper sacks. This is because of possible post fermentation reactions in the presence of trapped air. Post fermentation sometimes enhances the quality, provided that the teas do not attain the correct fermentation point at the time of drying.

The teas are evaluated by professional tea tasters in the tea trade, and tea samples were sent to them for independent organoleptic analysis. Their comments on infused leaf, liquor colour, liquor strength and liquor briskness/quality for individual teas were obtained. The tea tasters' evaluations were analysed by giving marks to every comment they made on the tea samples. As the present market prefers teas with more liquor strength and liquor briskness/quality, each of these were given an importance score of 30%. The importance score given to liquor colour was 25%, and that for infused leaf was 15%.

The tea tasters found some quality improvements in BOPF- and Dust 1-grade teas. The lower marks obtained for BOP-grade teas may be due to possible post fermentation and after effects, as explained above.

#### **Tests on leafy-grade teas**

The leafy grades tested were OP, OP1, BOP1, FBOP1 and FBOPF. The teas were separately packed in standard paper sacks, as well as in MVP barrier bags under vacuum (300 – 450 mm Hg). The vacuum level was reduced for leafy-grade teas as high vacuum was not needed. The level was further reduced for larger size leafy-grade teas.

Tea samples were drawn from the standard paper sacks and MVP barrier bags after a period of three months, and the following were conducted.

1. Moisture test
2. Sieve analysis for particle-size degradation

The leafy-grade teas are evaluated based on their blackness and twisted appearance. Properly manufactured teas have these characteristics, and this method of evaluation is found to be effective. As such, the chemical analysis and organoleptic analysis were not conducted for leafy-grade teas. Instead, particle deterioration in teas, owing to packing the teas under vacuum, was tested.

The initial moisture content, and the final moisture content (after three months), in the teas were measured using the standard oven method.

The variation in moisture content of teas packed in standard paper sacks, and MVP barrier bags, was small. This may be due to a high initial moisture content in the teas.

The teas samples were tested for particle-size degradation using a sieve shaker. The amplitude was set to 10 mm, and the duration for shaking was set to 10 minutes. The sieve size selected varied from 0.71 mm – 6.70 mm. 100 g samples of each of the grades were used in the analysis, and the weight of teas retained in each of the sieves was measured.

The particle-size degradation was small in most of the leafy-grade teas, except for BOP1. However, the moisture content in these teas was above 6.5% at the time of the analysis. The degradation could be more when

- 1.the moisture content in the teas are low, and
- 2.more flaky teas are mixed with the teas.

The teas were exposed to ambient air, and the change in the moisture content in the teas was monitored for three hours. The variation in moisture content of teas packed in standard paper sacks, and in MVP barrier bags, was small.

The teas, when packed under vacuum at low initial moisture levels, loses its moisture to the tea void. This reduction supports ensuring keeping quality of teas during storage and transportation. Further, post fermentation in teas could be avoided in the absence of trapped air (that is, absence of oxygen), and changes in the levels of quality-giving compounds, such as theaflavin and thearubigins, could be avoided. Therefore the tea character in properly manufactured teas could be preserved to a great extent.

Professional tea tasters detected the small changes in tea character which occurred in teas packed in the standard paper sacks. This shows the sensitivity of the tea tasters to such small changes, and confirms the effectiveness of packing teas under vacuum.

A small amount of tea particles in leafy-grade teas tend to break when packed under vacuum. This amount could be increased when the moisture content in the teas is low, or when the teas contain a higher percentage of flaky teas. This effect could be minimized by flushing inert gases such as N<sub>2</sub> into the teas packed under vacuum.

## **2.2 Design and development of a Rotary Sifting Machine for leafy grade teas.**

In Low-Country tea manufacture difficulties are experienced in grading teas in Michie Sifters such as low output and deterioration of tea particles. Further, automation to tea grading is not possible with this type of tea sifters. An improved machine is under development taking all these factors into consideration. A prototype machine was fabricated with mesh of size No.10 and tested for grading teas. As it was not giving high output, it was decided to improve the machine further.

## **2.3 CTTA standard for packing leafy teas in paper sacks**

An experiment was designed to obtain maximum tolerance limit for degradation of tea particles of leafy grade teas in packing and during transportation in various types of paper sacks. During the year one experiment was conducted with OPA grade teas.

Initially the packing density of OPA grade teas was tested and was found to be 23 kg/ paper sack. However, the actual practice is packing 25 kg/ paper sack. Therefore it was decided to pack the paper sacks with both 23 kg teas and 25 kg teas. The test paper sacks were stacked with different grades of teas in 5 rows in a transporting lorry and transported to Broker's warehouse.

The tea samples were obtained before packing, after packing & before transporting and after transporting and tested for particle size degradation using sieve analysis. The percentage breakage of the tea particles in the transported teas was found to be significantly high. The maximum tolerance limit for degradation of tea particles will be obtained by analysing data from more experiments.

## **3. Other Divisional Activities**

### **3.1 TASL-SGS Product Certification Standard, St Coombs Estate**

The staff supported implementation of the ISO 9001:2000 Quality Management System at the St Coombs Tea Factory. As decided by the TRI Management, the staff prepared the manuals for St Coombs Estate, for

implementation of the TASL–SGS Product Certification Standard, in consultation with TASL. These manuals were submitted to the Superintendent of St Coombs Estate for submission to the SGS for certification.

### **3.2 Development of a Temperature Indicator Alarm Unit for FBD-4.**

A patent was obtained for the Temperature Indicator Alarm Unit, which was developed to monitor the weir-end temperature in the Fluidized Bed Drier and control the feeding rate of dhool.

The number of units fabricated and installed at tea factories during the year was one.

The number of factories visited to repair the unit was four.

### **3.3 During the period under review:**

- The staff made 79 visits to tea factories on various aspects of tea manufacture.
- The number of tea samples received from estates for moisture determinations was 134.
- The number of tea samples received from estates for particle-size analysis was 07.
- The number of moisture meters calibrated was 22.
- The number of thermometers calibrated was 59.
- The number of hygrometers calibrated was 37.
- Mr W M U A B Marapana and Ms K B M Sripalika participated in a training programme on “TASL–SGS Product Certification Standard applicable to the Tea Manufacturing Facility”.
- Mr G L C Galahitiyawa was appointed as an observer of the Board of Management of the Tea Shakthi Fund.
- The staff participated in seminars/workshops on tea manufacture, and conducted training programmes on HACCP which were organised by tea factories.
- The staff supported the Advisory and Extension Division in producing video programmes on low-country tea manufacture.
- The staff supported the NIPM in conducting training programmes and related activities.

# ADVISORY AND EXTENSION SERVICES DIVISION

*Head - B A D Samansiri*

## 1. Routine Advisory and Extension Activities

Table 1. Summary of the Routine Advisory and Extension Activities.

Activity-2006	T'kelle	R'pura	Passara	Kottawa	Hantana	Deniyaya	Total
<b>1 Estates visits</b>							
1.1 On call Adv. Visit-Estates	112	39			25	17	193
1.2 On-call Advisory Visit-Small Holdings	47	48			23	15	133
1.3 Routine Advisory Visit	7					6	13
1.4 Extension Visit		98			30	72	200
1.5 Collaborative research Visit	11				1	47	59
1.6 Familiarization visits					22	21	43
<b>Total visits made</b>	<b>177</b>	<b>185</b>	<b>66</b>	<b>34</b>	<b>101</b>	<b>178</b>	<b>741</b>
<b>2 Individual contacts</b>							<b>0</b>
2.1 Office calls	480	148			181	0	809
2.2 Inquiries through telephone	1290	386			159	347	2182
<b>Total</b>	<b>1770</b>	<b>534</b>			<b>340</b>	<b>347</b>	<b>2991</b>
<b>3 Adv. &amp; Extension correspondence</b>							<b>0</b>
3.1 Advisory Documents	1160	752			168	57	2137
3.2 Extension services report		166			101	322	589
3.3 Publications		44			16	8	68
3.4 Administrative matters	1309	29			35	283	1656
<b>Total</b>	<b>2469</b>	<b>991</b>	<b>263</b>	<b>364</b>	<b>320</b>	<b>670</b>	<b>5077</b>
<b>4 Training Programme</b>							<b>0</b>
4.1 familiarization Programmes Estates	19	2			8	0	29
4.2 Familiarization Programmes -Small holders	14				9	0	23
4.3 Skill training programmes	14	1			8	0	23
4.4 Educational Programmes	18	11			2	6	36
4.5 Tailo-made training programs on request	6	1			15	0	22
<b>Total</b>	<b>71</b>	<b>15</b>	<b>9</b>	<b>62</b>	<b>42</b>	<b>6</b>	<b>204</b>
<b>5 Commercial Nursery Inspections</b>	0	41	15	0	5	0	61
<b>6 Exhibition</b>	2	2				4	8
<b>7 Visitors</b>							<b>0</b>
7.1 Tea Growers	253	472			619	664	2008
7.2 Higher Educational Students	521	39			139	3	702
7.3 School Students	1299	17			39	98	1454
7.4 Foreign Personnel	55	4			22	2	83
7.5 General Visitors	541	22			85	77	725
<b>Total</b>	<b>2669</b>	<b>554</b>	<b>344</b>	<b>1180</b>	<b>904</b>	<b>845</b>	<b>6496</b>
<b>8 Group Extension Techniques</b>							<b>0</b>
8.1 Demonstrations	3	44				12	59
8.2 Field Days	3	89			19	0	111
8.3 Informal Discussion with Small Group		73			23	22	118
8.4 Lecture/Panel/Symposium/Seminar	14	6			3	12	35
8.5 Workshop-1/RSC -2	6				4	3	15
8.6 Crop Clinics conducted	0	0	0	1	0	2	3
<b>Total</b>	<b>28</b>	<b>219</b>			<b>51</b>	<b>51</b>	<b>349</b>
<b>9 Mass Media Extension Techniques</b>							<b>0</b>
9.1 Newspapers articles	3	4				0	7
9.2 Newsletters	8	2				1	11
9.3 Folders/Leaflets/Pamphlets/CDs	3	2				0	5
9.4 Radio Programmes	2					0	2
9.5 Posters/Wall Charts/banners	19					0	19
<b>Total</b>	<b>35</b>	<b>8</b>			<b>1</b>	<b>1</b>	<b>45</b>
<b>10 Soil Testing</b>	0	786	426	430	528	348	2518
<b>11 Publications</b>							<b>0</b>
11.1 Free Issues	1233	651			1606	1215	4705
11.2 Priced Publications	0	1084			297	1038	2417
<b>Total</b>	<b>1233</b>	<b>1735</b>			<b>1903</b>	<b>2253</b>	<b>7122</b>

## **2. Special Advisory and Extension Activities**

The following special activities were undertaken during the year.

### **Regional Technical and Extension Forum Workshops**

Seven workshops for the Regional Technical and Extension Forum, which has a wide representation from the small-holdings sector, and the regional-level extension workers of the Tea Small Holding Development Authority (TSHDA), were conducted to educate representatives of the small-holding sector on the Use of Pesticides in Tea and the New International Quality Standards and Pesticide Residues in Made Tea. The seven programs were conducted for Nuwara Eliya, Kandy, Galle, Matara, Passara, Ratnapura/Kalutara and Kegalle Regional Managers' regions.

### **'Crop Clinics'**

Three 'Crop Clinic' programs were organised with the participation of the Institute's scientists, technical and advisory staff. The intention was to achieve several objectives within a relatively short period, to provide remedies to problems in tea cultivation and processing, and to assist estate staff in enhancing their knowledge on various aspects of cultivation and processing, so that they may become familiar with the problems on the ground, and be able to focus on areas which need more attention.

23 January – TRI Regional Station, Kottawa

25 January - Morawakkorale Planter's Club, Deniyaya.

9 December- Siththamgallena Temple in the Hambantota District

### **E & E Forum (in Sinhala) for the Small-Holdings Sector**

One Extension and Experiment Forum seminar for the small-holdings sector was conducted for the purpose of having direct dialogues between scientists and the representatives of the sector. Mr J C K Rajasinghe served as the Convener Secretary.

### **Regional Scientific Activities**

Six RSC seminars were conducted in the Dickoya, Kandy, Badulla, Ratnapura, Kegalle and Galle/M atara RSC regions to educate Superintendents and Assistant Superintendents on the "Safe Use of Pesticides in Tea".

The following subjects were covered in these seminars.

- “New International Quality Standards and Pesticide Residues in Made Tea” by Dr Tissa Amarakoon
- “Safety in Pesticide Use in Tea: GAP and GMP” by Dr Keerthi Mohotti
- “Safe Use of Herbicides with more emphasis on 2-4 D and Glyphosate” by Dr Kapila Premathilake
- “Fungicide Residues in Made Tea – Way Forward!” by Dr A. Balasuriya
- “Pest Control vs Pesticide Residues: What Matters” Mr. Sampath Walgama

### **The ADB Mother Bush Project**

The Mother Bush Project, which was designed to multiply new tea cultivars at various locations, comes under the purview of the TRI and the TSHDA in the tea-growing areas. Issuing of cuttings from the mother bushes was monitored by the Coordinator.

The extent of the mother bushes under the different organisations are: TRI 55.56 ha; TSHDA 18.98 ha; private tea estates 4.00 ha; and smallholder lands 4.50 ha (Total: 83.04 ha). Mr JCK Rajasinghe, Senior Advisory Officer, continued to serve as the Coordinator of Mother Bush Project activities.

The total number of cuttings issued during 2006, from the TRI Mother Bush sites, are given below.

<b>TRI Site</b>	<b>Total No. of Cuttings</b>
St. Coombs Estate	997,607
St Joachim Estate	3,266,885
Hantana	158,500
Kottawa	194,750
Deniyaya	94,000
Passara	115,245
<b>Total</b>	<b>4,826,987</b>

### **Commercial Nursery Inspection visits**

Only 26 nurseries in the Kalutara region, 25 in the Bandarawela region, and 15 in the Kandy region, were inspected during the year. Several internal discussions were held to address the formalising of commercial nursery-inspection activity, since everybody was convinced that the provisions under the present system are not adequate to achieve the objectives of this activity. Avenues were investigated for using the provisions given in the National Seed Act to improve this activity. A committee was appointed by the Director to review the activity and submit a report.

### **Training/Workshop (Talawakelle)**

- 21-23 September – A three-days training program for Agriculture Instructors of the Hadabima Authority, Kandy.
- One-day Nursery Training Program for field staff of Agalawatta Plantations Ltd.
- A three-days training program for field staff of Agalwatta Plantations Ltd.
- A workshop on nursery management for the Managers and Assistant Managers of Kelani Valley Plantations Ltd.
- 21-22 March – A two-day training program for a group of small holders in Akurassa, organized by “Ladalu Mahima”.
- 22-23 March – A two-day familiarisation program for the students of Aquinas College, Colombo.
- 14 September – A one-day familiarisation program for undergraduate students of Eastern University.
- 1 March – A one-day familiarisation program for agriculture undergraduate students of Peradeniya University.
- 28 April – A one-day familiarisation program for agriculture undergraduate students of Peradeniya University.
- Pre-testing a TOT program for Tea Inspectors in the Nuwara Eliya region
- A one-day familiarisation program for undergraduate students of Rajarata University
- A one-day familiarisation program for students of the Technical College, Dambulla.
- A one-day familiarisation program for students of the Technical College, Kuliypitiya.
- Three one-day workshops for Talawakelle Plantations, Watawala Plantations, Namunukula Plantations and Agrapatana Plantations, in collaboration with SPN, Agronomy and Entomology Divisions.

### **Survey on Pesticide Usage in Small Holdings**

Three pilot surveys were conducted by the Advisory and Extension Staff to collect preliminary information on the usage of pesticides in tea small holdings.

- Survey on agro-chemical usage in small holdings in the Akuressa region - Mr K G J P Mahindapala and B H R Hemantha, (NDT trainee)
- Current status of agro-chemical usage patterns in the tea smallholding sector in the Kegalle District - Mr SLD Amarathunga, TRI and R M T D Ranasinghe.
- Pesticide usage patterns in tea smallholdings in the Ratnapura District - All Advisory and Extension Staff.

### **Familiarization Programme**

A familiarisation training program for an Extension Officer, attached to the JAICA project in Nepal, was conducted from 20<sup>th</sup> June to 20<sup>th</sup> July 2006, in Talawakelle, Ratnapura, Kandy, Passara and Deniyaya regional stations, at the request of NIPM.

One diploma students from the Technical College, Dambulla underwent her four-month in-plant training program on tea cultivation.

### **Adaptive Trials**

The following adaptive trails are in progress.

The new TRI fertiliser mixtures (VP/UM 910, VP/Uva 945 and VP/Low 880) were compared with the U 709 mixtures, at St Coombs and at the Ratnapura, Passara, Hantana and Kottawa Centres. The Soil and Plant Nutrition, and Advisory Divisions are involved in the trial. The trial established in Field No. 1 of St Joachim Estate, Ratnapura, completed one pruning cycle.

### **Exhibitions**

The Advisory and Extension staff participated in the following exhibitions during the year.

- Agriculture and Trade Exhibition at St Anne's Church in Puttalam, organised by the Advisory staff of Talawakelle and Kandy.
- Mahapola Exhibition at St Thomas College, Matale, organised by the Advisory staff of Talawakelle and Kandy.
- Small- and Medium-Scale Entrepreneurs' Exhibitions at the National Conventions Centre, Colombo, organised by the Advisory staff of Talawakelle.
- Science and Technology Exhibition at BMICH, Colombo by the Advisory staff of Talawakelle

- Educational Exhibition at the Tea Museum, Hantana, by the Advisory staff of Kandy.
- Educational Exhibition at the International College, Nuwara Eliya, by the Advisory staff of Talawakelle.

### **Special Problems**

#### **Death of Some Tea Cultivars in the Up-Country Region.**

Complaints have been received from estates in the up-country region that several tea cultivars, such as TRI 2026, TRI 2024, K145 and DN, which are more than 30 years old, were dying despite the absence of any known pest or pathology. This matter was referred to the relevant scientists for further investigation.

### **Advisory and Extension Services, Mid-Country Station, Kandy Senior Advisory Officer in Charge: Mr J C K Rajasinghe**

1. Routine Advisory and Extension Activities (see Table 1)
2. The following special activities were undertaken by the staff of the Advisory and Extension Service of the Mid-Country Station.
  - A field day on collar canker for a group of small holders at Sunny Field, Menikdivela.
  - A demonstration on pruning of tea at Kellebokka Estate for the Superintendents and Asst. Superintendents of SLSPC. The Hon. Plantation Minister also participated in the program.
  - A training programs on the TSTH and the TRI Basket at Rothschild Estate, Pussellawa, Sunny Field, Manikdivela, Hatale Estate, Madolkelle, Hangurugama Estate, Madamahanuwara, Erine Estate, Galaha, Brookland Estate, Nawalapitiya, Winsley Estate, Panvilatenna, Wirawa Estate, Nawalapitiya, Doragala Proprietary Estate, Patithalawa, TSHD Society, and Tea Smallholders Co-operative Society, Ukuwela.
  - Workshop on conventional and non-conventional breeding methods for two groups of students of the Open University of Sri Lanka.
  - Special visits to Pitakanda and Alkaduwa Estate to study the out-grower system.
  - A pruning demonstration at Galagedera for smallholders.
  - A workshop at Stellenberg Estate on tea tortrix, in collaboration with the Entomology staff of Hanthana.
  - Four lecture sessions for groups of NIPM students.

- Eight training workshops on cultural practices for tea, for small holder groups who visited the Centre.
- One field day for the small holders of the Small Organic Farmers Association at the TRIMCS.
- A one-day field training program for the field staff of Sanquar Estate.
- A practical training program for a group of students of the Advanced Technical Institute, Nawala.
- Continued development work at the Model Tea-Cultivation Block at the Centre.
- Development of an Estate Information Data Base on mid-country tea estates.
- The Senior Advisory Officer participated in a training program conducted for the Estate Managers of Kelani Valley Plantations Ltd at TRI, Talawakelle.
- Developed a set of display materials for exhibition work.

The RSC-IV was convened at the Centre. New office bearers were appointed for the committee, and a fresh work program was finalised.

### **Advisory and Extension Service, Low-Country Station, Ratnapura Advisory Officer Mr. M K S L D Amaratunga**

1. Routine Advisory and Extension Activities (see Table 1)
2. The following special activities were undertaken by the staff of the Low-Country Advisory and Extension Service.

#### **Seminars/Field Days/Training and Familiarization Programs.**

- Two RSC field-day programs on appropriate strategies to handle the rush crop in the field, for Assistant Managers and Field Officers of the Kegalle/Kalutara and Ratnapura regions, were held on 28<sup>th</sup> and 29<sup>th</sup> March 2006, entitled 'Pruning and Rush-Crop Management'.
- Two RSC workshops on appropriate strategies to handle the rush crop in factories, for RSC-V1 Factory officers, Senior Assistant Factory Officers of the Kalutara/Kegalle regions, and RSC-V for the Ratnapura region, were held on 03<sup>rd</sup> and 4<sup>th</sup> April 2006, respectively.
- The TRI Advisory Division conducted a series of tea factory-based group interactive awareness programs, for more than 250 bought-leaf suppliers

attached to leading tea factories, such as St Joachim, Galpaditenne, Nandana, Alupola, etc., in order to introduce

- Tea-related technologies, together with input packages for small holders, for enhancing the adoption rate of TRI-recommended practices.
- Tea Inspectors organised groups of tea small holders from their ranges in order to empower them by conducting methods- and results demonstrations on technically-sound agronomic practices. This activity is a collaboration between the TRI and TSHDA. Seventeen such programs were conducted for more than 600 tea small holders through tea inspectors in the Ratnapura, Kegalle and Kalutara districts. These programs will also facilitate opportunities for two-way communication between resource persons and tea growers.
- A special workshop was organised for the TRI Advisory and Research staff on the Safe Use of Agro-Chemicals, in collaboration with the Crop Life Association.
- A training programme was organised for STIs and TIs of TSHDA, Ratnapura on pH testing .
- A training programme was conducted for management trainees of AgStar Limited, on practical problems related to cultural practices, such as plucking, pruning, fertiliser applications, and pests and diseases control.
- Fifteen group discussions and field demonstrations were held for Managers Assistant Managers and field staff, for popularising the Plucking Basket in corporate-sector estates. Ten programmes were also conducted for popularising the Plucking Basket among the smallholders.

### **Educational Programmes**

Five programmes were conducted for school students on cultivation aspects and processing technologies.

Two programmes were conducted, in collaboration with the scientific and technical staff, for the students of the Sabaragamuwa University and the Sri Jayawardenpura University.

Four programmes were conducted, in collaboration with the scientific and technical staff, for the students of the Agriculture School of Karapincha, Agunakolapalessa.

### **In-Plant Training Programmes**

Two undergraduates from the Universities of Peradeniya and Ruhuna carried out their final year projects with the Advisory staff.

Six diploma students from the School of Agriculture, Hardy, Niwala, underwent a four-month in-plant training program on tea cultivation.

Two students from the NAITA, Ratnapura underwent their training program on stenography, typing and data-entry, for a period of six months.

### **Mass Media Extension Activities**

Two paper articles were published in the 'Govibima' supplement of the 'Sri Lankadeepa' paper. These were: "How to prevent nursery casualties using poly-tunnels" by SLD Amarathunga, and "Soil improvement by rehabilitation" by TGN Mahinda.

Land suitability, and updated tea-growing and agro-ecological maps were produced, and are available for sale at the TRI Advisory Division, Ratnapura.

Two interactive CD programs were produced with the technical assistance of the Audio-Visual Centre, Gonnoruwa. These were: "Mechanization of Field Practices in Tea Cultivation" by SLD Amarathunga, and "Guide to the TRI" by TGN Mahinda.

### **Collaborative Research Studies**

- **Comparative study on the effectiveness of different control measures for Horse-Hair Blight**

The collection of field information and yield records, in the collaborative field study on the effectiveness of different control measures for Horse Hair Blight, was continued in No. 8 Field of St Joachim Estate, in collaboration with the Pathology Division and St Joachim Estate (AB/NHLP/SLD/TGN/CS/MP).

- **Land-suitability mapping for tea-growing lands in tea-growing Districts**  
Mr SLD Amarathunga, Advisory Officer, attended to the identification of suitable AGA Divisions in tea-growing Districts, in the collaborative study with the Agronomy Division and the Natural Resource Centre, Gannoruwa. This study aims at selecting suitable areas for tea cultivation, at the AGA-Division level, based on yield, rainfall, soil and other general information from tea estates.
- **Extension Studies/Observational Trials**  
A study on factors affecting the quality of nursery plants in commercial nurseries in the Kalutara and Kegalle Districts.

This study attempts to identify factors that contribute to standards of commercial nurseries, and to ascertain an effective scheme for upgrading quality in the commercial nurseries in the Kegalle and Kalutara Districts. Thirty-six randomly-selected, registered nurseries, and 24 unregistered nurseries, in seven Tea Inspector (TI) ranges in the Kegalle District, and 24 registered nurseries and 10 unregistered nurseries in five TI ranges in the Kalutara District, was studied using questionnaires and nursery observation.

Current status of agro-chemical usage patterns in the tea smallholding sector of the Kegalle District.

This study was undertaken at five purposely-selected Divisional Secretaries (DS), Yatiyanthota, Deraniyagala, Dehiowita, Bulathkohupitiya and Ruwanwella, which represent the densely-populated tea smallholdings. Tea-Inspector (TI) regions in the Kegalle District, 100 small holders and five agro-chemical sub-dealers were randomly selected for the study.

The results reveal that 67% of tea smallholdings in the Kegalle District have used pesticides. Of these, the majority use herbicides (89%), while an equal proportion of the balance apply either herbicide and fungicide, or herbicide and insecticide. Meanwhile, a small proportion apply either fungicide or insecticide alone. The majority of the small holders practice either hand-weeding and chemical weeding, or only hand-weeding. Of those practising chemical weeding, 89% of the small holdings have used glyphosate as a herbicide. The majority of the small holders apply herbicide at below the recommended dosage and frequencies.

### **Publications**

M K S L D Amarathunge, U G H P Dharmadasa, M Wijeratne 2006. Potential Knowledge Transfer through Tea Leaf Supervisors. Proceedings, 62nd Annual Sessions of the SLAAS, Section F, 15, 12.

### **Workshop attended by Advisory Staff**

Mr S L D Amarathunga, Advisory Officer, attended a workshop on 'Statistical thinking to satisfy social needs', conducted by the SLAAS, Section E1, held at the Sri Lanka Foundation Institute, Colombo, on 29<sup>th</sup> May 2006.

### **Regional Advisory and Extension Station, Kottawa**

**Officer in Charge/Senior Advisory Officer: Mr K D Dahanayake**

1. Routine Advisory and Extension Activities (see Table 1)
2. The following special activities were attended to by the Officer in Charge and Extension Officer of the Advisory and Extension Centre.
  - One RSC Seminar was organised for RSC-VII at Galle.
  - A Crop Clinic program was organised for stakeholders in the area on 23<sup>rd</sup> January.
  - Six awareness programs were organised for small holders in the region.
  - Twenty-two informal discussions were held in order to find solutions for various problems, such as labour shortage and pest and diseases control.
  - The OIC and Extension Officer attended a total number of 17 meetings, including HODs', Advisory Officers' Forum, E & E, DDC, and Advisory and Research Linkage meetings.
  - It was found that the new cultivars, TRI 3025, 3055, 4006, 4042, 4049, and 4053, are popular among tea growers in the region. The Centre was able to distribute 194,750 numbers of cuttings from these cultivars during the year.

### **On-going Research Trials and Observation Trials in the Station**

The following trials are being conducted in observation blocks maintained at the Kottawa Centre. Mr K D Dahanayake and Mr Saman Ratnayake are involved in this activity.

1. Plant Breeding TRI 5000 series – LVP 37 at F/No.03
2. SPND - U 709 Vs VP/LC/880 trial at F/No.04
3. Nematode population monitoring trial at F/No.04
4. Intercropping observation – Tea and Coconut at F/No.02
5. Intercropping trial – Tea and Coconut at Citrus Estate
6. Shear-plucking observation block

**Regional Advisory and Extension Centre, Passara**  
**Actg. Officer in Charge: Mr Suranjan Fernando**

1. Routine Advisory and Extension Activities (see Table 1)
2. The following special activities were attended to by the Officer in Charge of the Advisory and Extension Centre.
  - Evaluating, with the staff of the Plant Breeding Division, the performance under Uva conditions, of polyclonal and bicultural seedlings from Salawa, Kiriporuwa, Halpe, Reucastle and Rambukkanda Estates, planted at the Passara Centre.
  - Monitoring Clonal Observation Trials, UVP 9 and 10 (2/VP37/Uva), and Seed-Stock Evaluations. The trials are in progress. The Plant Breeding, and Advisory, Divisions are involved in the trials.
  - Monitoring activities in seed variety-evaluation trial plots, established in the Centre, are in progress. Seed varieties were evaluated for SHB infestation by the Entomology Division.
  - Demonstration plots, on shear/hand plucking, and different fertiliser mixtures (U 709, Uva 945 and T 1130 ) in Field No. 1 in the Centre, are in progress.
  - Monitoring the evaluation trial of the TRI 5000 series, Phase III trial blocks, in Field No. 1 in the Station, is in progress.
  - A nematode trial was initiated by the Nematology Division to evaluate injury levels with different inoculations.
  - Grafted plants, with various combinations of new cultivars on a trial basis, have been planted in test plots, and evaluations are being done.
  - In-filling of vacancies in the germplasm area was completed. The Plant Breeding and the Advisory Divisions are involved in this activity.

**Regional Advisory and Extension Centre, Kotapola, Deniyaya**  
**Actg. Officer in Charge: Mr K G J P Mahindapala**

1. Routine Advisory and Extension Activities (see Table 1)
2. The following special activities were attended to by the Officer in Charge of the Advisory and Extension Centre.

**Survey on agro-chemical usage in smallholdings in the Akuressa region**

A preliminary survey was conducted to study the agro-chemical usage patterns,

and other related issues, in the smallholding sector in the Akuressa planting region. In this survey, 278 smallholders from five Divisional Secretariat areas, Akuressa, Athuraliya, Kamburupitiya, Welipitiya and Malimbada, were interviewed by visiting their holdings, and information required by the questioner was gathered. Some of the basic findings of this survey are:

- ❑ 51% of the small holders are using agro-chemicals, at least once per year, of which more than 95% are weedicides.
- ❑ Out of the tea growers who used the agrochemicals
  - 80% have used glyphosate;
  - 20% exceed the frequency per annum recommended for glyphosate by the TRI;
  - 19% of them exceed the dosage per application recommended for glyphosate by the TRI;
  - the majority of the smallholders get information on anything related to the agro-chemicals from dealers; and
  - about 80% of the smallholders do not have adequate knowledge on label information.

#### **Extension survey on shot-hole borer-infestation levels in the main stem of “affected bushes”**

An extension survey was conducted to assess the shot-hole borer-infestation levels in the main stem of tea bushes showing characteristic symptoms (flowering, defoliation, etc.), in the Deniyaya region. Forty-eight small holdings in the Deniyaya TI region were visited, and relevant information was collected by uprooting and dissecting a few randomly-selected affected bushes from each holding.

According to observations, SHB damage were noticed in all the bushes. In 97.9% of the bushes, the damage was noticed in the main or basal stem. Of the affected main stems, 60% were severely galleried, while 30% were moderately galleried. It was also observed that rotting commenced from the point of the galleries.

#### **On-going experiments, conducted by Plant Breeding and Advisory staff, on cultivar evaluation, under the Corporate Plan, 1999-2003**

- LVP 74 phase II.
- Phase III trials in Deniyaya Estate and Indola Estate.
- Observational trial commenced in Kiruwanaganga Estate using the same cultivar.

**On-going experiments, conducted by different research disciplines with the assistance of TRI, Deniyaya, under the Corporate Plan, 1999-2003**

- Soil and Plant Nutrition Division: Evaluation of crop response for different proportions of SA and urea (Kiruwanaganga Estate).
- Agronomy Division: Development of an economically-viable system to eliminate or reduce the soil rehabilitation period in replanting in the low country (Handford Estate).

**Observational trials**

- A observational trial was started at the Deniyaya Station to evaluate the success of low-level pruning.
- The observations were recorded in a smallholding tea field where refuse tea was applied (rapid decomposition method developed by the TRI).

**Trials on the Deniyaya problem**

Two collaborative experiments commenced in Richiland Estate, Deniyaya (Agronomy TRILCS and TRI, Deniyaya).

**Problem-specific trials**

Experiment on the use of city solid-waste compost for young tea plants (SPND and TRI, Deniyaya).

**Other involvements of the Divisional staff**

In addition to his duties as Head of the Division, Mr B A D Samansiri, served as the Convenor/Secretary of the Consultative Committee on Advisory Services and Estates of the Tea Research Board;

served on the examination panel for the Induction Course for Planter Trainees of the NIPM; and

served in the Curriculum Development Panel of the National Diploma for the Plantation Management course of the NIPM.

Mr J C K Rajasinghe, Senior Advisory Officer, served as the Coordinator of the ADB Mother Bush Project, and as the Convenor/Secretary of the E & E Forum for the smallholder sector.

Mr K D Dahanayake overlooked the tea fields of the Walahanduwa Laboratory, and served as the Convenor/Secretary of the Advisory Officers' Forum.

Mr Lalitha Amaratunge and Mr Janaka Mahindapala were entrusted with the task of reviewing the commercial-nursery inspection activity, and the certification procedure for formalising the activity.

### Photography Unit

Photographer: Rajika Niroshan

Dark Room Attendent: T. Thevathasan

The photographs and prints produced during the year were:

Category of Photographs	Number
Colour prints (official)	1997
Digital photographs	3649
Colour and B/W photographs (for staff)	
Colour prints (for staff)	388
Other	

### Audio-Visual Unit

Audio-Visual Assistant: Mr N S Ekanayake

The following video programmes and CDs were issued to tea growers:

Item	VHS	VCDs	Films
Tea Smallholders	-	37	137
Trainees	-	11	41
Tea Plantations	-	18	58
Universities/Institutes	-	-	-
Exhibition	-	-	-
Crop Clinics	-	-	-
TRI Divisions	-	43	141
TRI Centres	-	288	1235

**LOW-COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE,  
RATNAPURA**

*Officer-in-Charge – M A Wijeratne*

**1. General**

There were 38 permanent staff members attached to the TRI Low country station. Out of them 24 were in the scientific divisions.

**2. Awards**

Dr M A Wijeratne, the Senior Research Officer & Officer-in-Charge, TRI Low Country Station received two awards namely National Science & Technology Awards-2006 for the development of suitable devices for improving worker productivity and quality of made tea & the General Research Committee Award -2006 of the Sri Lanka Association of the Advancement of Science for outstanding contribution to scientific research in Sri Lanka.

**3. Appointments, Transfers, Retirements and Resignations**

Mr.H K M S Kumarasinghe, Extension Officer rendered his registration w.e.f.9<sup>th</sup> March 2006. Mr A G Samantha Jayasiri, GuestHouse Keeper was transferred to TRI-Low Country Station w.e.f.10<sup>th</sup> April 2006 from head office.

**4. Buildings & Layout maintenance**

Painting & roof repairs of staff quarters & office & laboratory buildings, polishing and general cleaning of hostel, office, sports club & guest house etc were continued. Visitor's toilets of the office & laboratory were repaired and tiled. Other day-to-day repairs and maintenance of buildings & layout were satisfactorily continued.

**5. Electrical maintenance**

Re-wiring of bungalow Nos.C-11, C-14, C-15 and C-12, were completed. Other electrical maintenance of the buildings, quarters and scientific divisions was satisfactorily continued.

**6. Transport**

Repairs, general maintenance and servicing of the vehicles at the TRI Low country station were carried out satisfactorily.

## **7. Research, Advisory and Extension Programme**

A number of field and laboratory experiments were conducted in Agronomy, Plant Breeding, Entomology and Technology divisions. The TRI Low Country Station received more than 575 visitors during the year 2006. The Advisory and extension division has conducted about 185 estate visits, 15 training programmes, 41 commercial nursery inspections and more than 200 group extension techniques during the year. They also have tested more than 700 soil samples for pH and issued more than 1700 TRI publications. The number of exhibitions participated was 3.

# MIDCOUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE, KANDY

*Officer in Charge - A K N Zoysa*

## **1. General**

There are nine technical and four administration staff assigned at the Mid Country Research, Advisory and Extension Centre, Hantane, Kandy. The technical staff conducted research in the fields of Agronomy, Entomology, Plant Breeding, and Soils and Plant Nutrition. Additionally, the technical staff assists the Advisory and Extension Division of the centre in transferring new technologies and innovations to the plantation and smallholder sector of the region. Other research activities in the Mid country are carried out by the staff deployed from the main station at Talawakelle.

Mr P B Ekanayake, Officer in Charge of the Mid Country station retired from TRI services with effect from January 3, 2006. Mr Janaka Rajasinghe, Senior Advisory Officer transferred to the Mid Country station in January 1, 2006 and acted for the position of Officer in Charge with effect from January 3, 2006 until January 31, 2006. Dr A K N Zoysa, Senior Research Officer of the Soils and Plant Nutrition Division promoted to the position of the Officer in Charge of the Mid country station with effect from February 1, 2006.

Mrs B K S Herath (Accounts clerk), Mrs. R M D K Ratnayake (Clerk/Typist), Mrs. R Wijeratne (Clerk/Typist) were transferred from Hantane station to Talawakelle main station with effect from February 1, 2006. Mrs D Ratnayake (Stenographer) and Mrs. G A S Gunasekara (Accounts clerk) were transferred from Talawakelle main station to Hantane station with effect from February 1, 2006. Mrs R M D T Pallemulla (Research Officer) was transferred from Hantane station to the Entomology Division Talawakelle with effect from August 1, 2006.

## **2. Research Advisory and Extension Programmes**

The research programmes of the Agronomy, Entomology, Plant Breeding, and Soils and Plant Nutrition are in progress and there are 35 long term experiments that are managed by the Mid country station. Field days were conducted for smallholder groups from various parts of the region. A field day was conducted for the Managers and Assistant Managers at Kelebokka estate on prun-

ing of tea. Eleven training programmes on the use of TSTH and TRI basket were conducted for estates as well as smallholder groups. Educational training programmes were conducted for university students and NIPM trainees. Eight training workshops were held on cultural operations for smallholder groups who visited the station. A field day was conducted for organic farmers of SOFA at the station on organic agricultural practices on tea. A Regional Scientific Seminar was conducted for the Managers and Assistant Managers to make an awareness about the pesticide use in tea and their maximum permissible residue limits (MRL) in made tea and its importance in the securing of Sri Lankan tea marketing abroad.

The Mid country station joined the Governor of Central Province and other stakeholders in organizing the first tea exhibition ever held in Sri Lanka at the Tea Museum under the theme "Ceylon tea; pride of the nation" for making an awareness among the younger generation and school children about tea cultivation, processing and marketing. The advisory division participated in organizing the exhibitions held at Matale and at BMICH, Colombo. The advisory division started developing an information base system by collecting estate information of Mid country estates and the work is in progress. The station was instrumental in reawakening the RSC IV (Kandy) and a new set of office bearers were appointed. The officers of the station collectively developed a set of display materials for use in the exhibitions in future. Additionally a field plot was demarcated for live demonstration on good agricultural practices in tea and the work is in progress.

Three undergraduate students (University of Peradeniya and University of Ruhuna) completed their research projects on tea under the guidance of the Officer in Charge. Two students from the Agriculture School of Hardy, Ampara underwent training for their agriculture diploma at the station. Two trainees from NAITA has completed their on the job training at the advisory division of the station.

### **3. Extent**

The extent as at 31<sup>st</sup> December 2006 is given below:

<b>Type of land Use</b>	<b>ha</b>
Seedling tea	2.00
VP Tea (mature)	5.50
VP tea (young)	3.50
Mother bushes	2.75
Nursery Tea	0.20
Under Mana grass	0.50
Fruit Trees	0.40
Coconut	0.81
Forestry	1.20
Marshy Land	0.62
Building, gardens, paths and roads	5.77
<b>Total</b>	<b>23.25</b>

### 3. Crop

The green leaf harvested (kg) during the year 2006 is given below:

<b>Month</b>	<b>Crop Harvested</b>	<b>Crop Sold</b>	<b>Rate paid/ kg</b>	<b>Total</b>
		<b>kg</b>	<b>Rs.cts</b>	<b>Rs.cts</b>
January		2414	25.00	60,350.00
February		2326	25.00	58,150.00
March		2761	25.00	69,025.00
April		2976	25.00	74,400.00
May		2607	25.00	65,175.00
June		2271	25.00	56,775.00
July		1843	22.00	40,546.00
August		2186	22.00	48,092.00
September		2297	22.00	50,534.00
October		1997	22.00	43,934.00
November		2418	22.00	53,196.00
December		1140	22.00	25,080.00
<b>Total</b>		<b>27,236</b>		<b>645,257.00</b>

#### 4. Income

No of cuttings sold	380,250
Income from sale of cuttings	Rs. 114,075.00
No of VP plants sold	26,952
Income from sale of plants	Rs. 323,424.00
Total crop harvested (kg)	27,236
Income from sale of green leaf	Rs. 645,257.00
Guesthouse occupation charges	Rs. 47,525.00
Soil testing (for pH) charges	Rs. 7,510.00
Sale of TRI Publications	Rs. 38,350.00
Miscellaneous	Rs. 18,421.00

#### 5. Special Scientific Visitors

- Mr Colin Dale Susandale, Andrew Williams, Peter Martin, UK in March
- Mr R K Nathaniel, Shiran Nathaniel, Brian Adridge, Blain Oeder, Neal Selin,
- Mr Dick Sparks, USA in March
- Mr Greg Redmond, S R Gnanam, Australia in March
- Mr R C Ingram, UK in April
- Mr Melene Makaya, UK in May
- Dr B L Perera, UK in September

#### 4. Experiments conducted by the Research Divisions

The results and details of the experiments are reported under the relevant Divisions and only the experiment objectives and the site of the field trial are given below.

##### Agronomy Division

1. Effect of intercropping tea and coconut on productivity and land utilization (Citrus and Mawarala estates).
2. Effect of intercropping tea and minor export crops (pepper, coffee and vanilla) in the Mid country (Sunhill, New Peacock and Surya Agro Estate).
3. Effect of alternate methods of soil reconditioning in comparison to traditional methods on the tea establishment and yields (Ratwatte estate).
4. Effect of surface application and incorporation of mulching materials on soil properties and growth of tea (Ratwatte estate).
5. Comparison of manual and shear harvesting of tea.
6. Use of low dosages of herbicides on management of weeds in young tea (New Peacock).
7. Effect of earthworm cast on growth and yield of tea (Stelenberg estate).

8. Demonstration of SALT hedgerows.

**Entomology Division**

1. Screening of insecticides to manage scavenging termites.
2. Screening of insecticides for the control of Shot hole borer.
3. Screening of biological control agents for reducing Shot hole borer damage in tea.
4. Modifying potassium fertilization with a view to reducing Shot hole borer damage.
5. Studying the Shot hole borer distribution pattern in Nayapana and Madulkelle estates.
6. Management of nematode pests in tea.
7. Analytical services for estates on nematodes.

**Plant Breeding Division**

1. Evaluation of cultivars for the Mid country.
2. Development of seed stocks/varieties for Mid country.
3. Controlled hybridization programme.
4. Use of nuclear related techniques to improve tea cultivars.
5. Progeny trial on TRI 4004 and 4006

**Soils and Plant Nutrition Division**

1. Estimating crop response to micro nutrients (Zn, B, Mn etc.) at regional level (Greenwood and Madulkelle estates).
2. Estimating crop response to macro nutrients (N, K, Mg etc.) at regional level (Rangala and Midland estates).
3. Farm centered research on organic tea: soil fertility studies (collaborative research project with Gami Seva Sevana).
4. Development of regional analytical laboratories for soil, plant and fertilizer analysis.
5. Providing laboratory analytical services to the stakeholders in the region.

**8. New Construction**

1. Colour washing of quarters C2, ARP B1, ARP B2, ARP C type and D 4 were completed.
2. Construction of retaining wall near the guardroom of the entrance was completed.
3. Fencing part of the periphery of the TRI campus was completed.

**UVA ADVISORY AND EXTENSION CENTRE,  
PASSARA**

*Actg. Officer-in-Charge - Suranjan Fernando*

**1. General**

Mr W M R B Wijesekara, Extension Officer resigned from TRI in March 2006 after serving One year in the TRI.

**Staff**

Mr M A J Suranjan Fernando	Actg. Officer in Charge
Mr A M Karunasudara	Driver
Extension officer	Vacant (from March 2006)
Station Assistant	Vacant
Guest house keeper	Vacant

**2. Advisory and Extension Activities**

Advisory letters issued	112
Advisory visits made to Estates and Smallholdings in Uva	66
Seminars/field days/training programmes	
Held for estates/small holders/school children	13
Regional seminars held in collaboration with Uva RSC	01
Visitors, including planters/ small holders to the Centre	139
Soil samples tested for pH	426
Soil samples tested for Organic Carbon content	81
VP cuttings issued	208710
Commercial Nursery Inspection	25

**3. Hectarage of the Centre as at 31<sup>st</sup> December 2006 (ha)**

Mature tea in plucking	3.44
Mother bushes	1.15
Young tea (Experimental block)	0.30
ADB Clearing	2.06
Buildings/Roads	0.50
Forest / Scrub / Grass land	6.85
<b>Total extent</b>	<b>14.30</b>

**4. Crop****Green leaf sold in 2006**

<b>Month</b>	<b>Sold(kg)</b>	<b>Price Rs. / kg</b>	<b>Income Rs.</b>
January	2128	24.48	52093.44
February	1701	25.69	43698.69
March	4065	25.92	105364.80
April	3874	22.53	87281.22
May	3951	20.52	81074.52
June	4546	19.56	88919.76
July	3937	26.34	103700.58
August	2208	24.51	54118.08
September	3496	25.75	90022.00
October	4468	29.26	130733.68
November	3063	22.88	70081.44
December	2829	24.61	69621.69
<b>Total Revenue</b>			<b>977591.00</b>

The total amount paid as transport charges was Rs. 44507.10 and the net income realized from the sale of green leaf for the year was Rs. 929689.10

**5. Income (Rs.)**

Income from sale of VP cuttings	60504.50
Income from green leaf	929689.10
Soil Analytical charges	1045.00
Sale of Publications	9250.00
Guesthouse accommodation charges	11125.00
Sale of vp plants	52200.00
Other income(Sale of firewood)	9318.50
<b>Total Income</b>	<b>Rs 1073132.10</b>

**6. Check-roll workers (as at 31<sup>st</sup> December 2006)**

No. of check-roll workers	23
Out turn (Women)	39.13%
Out turn (Men)	60.87%

## **7. Field Trials**

Polyclonal & Biclinal seedlings from Salawa, Kiriporuwa, Halpe, Reucastle and Rambukkanda estates were planted in the station to evaluate their performance under Uva conditions by Plant breeding division. Second cut was given to the plants.

Monitoring activities of clonal observation trials UVP 7, UVP 8 and 2/VP37/Uva area in progress.

Plucking weights are being recorded of the seed variety evaluation trial plots established in the station. Seed varieties were evaluated for SHB infestation by Entomology division

Infilling the vacancies of Germplasm area was completed.

Demonstration plots on shear/ Hand plucking & different fertilizer mixtures (U709, Uva 945 and T1130) in field No 01 in the station are in progress.

To carrying evaluation trial of 5000 series, Phase 111 trial blocks were established in field No 01 in the station.

Nematode trial initiated by the Nematology Division to evaluate injury levels with varying inoculations was started

Grafted plants with various combinations of new cultivars, on trial basis have been planted in test plot and evaluations are being done.

# SOUTHERN PROVINCE ADVISORY AND EXTENSION CENTRE, KOTTAWA, GALLE

*Officer in Charge – K D Dahanayake.*

## 1. General

Rehabilitation commenced in field No: 06 (entrance field: approximately 2.5Ha) leading to produce a model estate with new cultivars and establishment of commercial nursery to accommodate 80000 plants completed successfully. Renovation of Field office Roof was completed.

### 1.1 Mother Bushes Project

Approximately 1.5 Ha Mother bush area used to issue new cultivars among the stakeholders.

### 1.2 Special Assignments

Mr K D Dahanayake shared the responsibilities of inspection of tea fields of Walahanduwa TRI in addition to his normal duties.

Mr S P Rathnayake completed his Postgraduate studies in China and assumed duties at station.

Extension Officer Mr C J Liyanarachchi was transferred to TRI Deniyaya station.

## 2. Labour force

Number on check-roll	42
Out turn	35 Average

## 3. Land Use Information

VP tea mature (ha)	7.0
VP tea young - ADB (ha)	5.0
Nursery (tea)	1.0
Seed garden (tea)	1.0
Under Rehabilitation (Guatemala)	2.0
Experimental Trials	1.0
Coconut, Fruit trees and Germplasm (ha)	1.5
Forestry (ha)	7.3
Buildings, gardens, roads	9.8
<b>Total extent (ha)</b>	<b>35.6</b>

**4. Green leaf harvested - 2006**

Month	Sold kg	Rate paid/kg	Total income
		Rs. Cts	Rs. Cts.
January	4164	30.218	125827.75
February	3585	30.250	108446.25
March	4950	31.39	155380.50
April	3756	30.861	115913.92
May	5206	30.905	160891.43
June	6033	30.898	186407.63
July	4799	31.00	148769.00
August	5093	30.90	157373.70
September	5129	33.181	170185.35
October	4863	33.395	162399.89
November	4238	33.261	140960.12
December	1873	33.00 appr	61479.00 appr
	53124		1694034.54 appr

Total Rainfall 2431.6 mm.

No. of Sunshine Hours 1962.2

**5. Income**

Income from sale of Green leaf	Rs. 1694034.54 appr
Income from sale of 194750 VP Cuttings	Rs. 58425.00
Income from sale of Publications	Rs. 44785.00
Income from Testing 430 Soil Samples for pH	Rs. 14875.00
Miscellaneous income	Rs. 11135.00
	Rs. 1823254.54 appr

**6. Advisory & Extension Services - 2006****6.1. Advisory correspondences**

The Advisory and Extension staff made 364 Advisory correspondences for the year 2006.

**6.2. Advisory and Extension Services****6.2.1 Routine Services****a) Advisory Visits**

The total number of advisory visits made by the Advisory and Extension staff was 34, which included routing visits to the estates, and the smallholdings visited.

**b) Commercial nursery inspections**

The advisory staff had not involved in commercial nursery inspections.

**6.2.2 Training programs / Seminars**

Conducted 52 Seminars and Training Programs / Field Days at Kottawa station and outside. The target groups were tea Smallholders, Green leaf suppliers & Factory owners.

**6.2.3 Video programs**

Thirty two (42) video shows were presented on plucking, land preparation, soil conservation of tea and pest and diseases of tea in and outside Kottawa station.

**6.3. Visitors to the station**

The number who visited the station personally seeking advice and collecting VP shoots.

Estate management and Smallholders - 792

University/Diploma students and others - 346

05 Advanced level students gained information and completed the project report.

**6.4. Advisory and Extension programmes conducted**

**RSC activities**

01 RSC Seminar was held at Hall de Galle.

**Crop Clinic**

01 Crop Clinic was held for stakeholders in the area in January

**Awareness programs for staff/workers and smallholders**

The Advisory and Extension staff organized Six (06) awareness programs.

**Informal discussions**

Twenty two (22) informal discussions were held in finding solutions for various problems such as labour shortage, pest/diseases control which encountering in tea industry.

### **Meetings attended**

Attended 17 meetings including HOD, Advisory Officers' forum , E & E , DDC and Advisory and Research linkage meeting etc.

### **6.5 Soil samples tested for pH**

430 Soil Samples were tested for pH Values

### **6.6 Advisory publications distributed**

Around 2000 nos. of Priced and Free Issuing Advisory and extension publications has been distributed.

### **6.7 Sale of VP Cuttings**

194750 VP Cuttings were distributed

Cultivars TRI 3025, 3055, 4006,4042, 4049,4053

### **6.8 Ongoing Trials , Experiments & Observations**

01. Plant Breeding 5000 series – LVP 37 at F/No.03
02. SPND - U 709 Vs VP/LC/880 trial at F/No.04
03. Nematode population monitoring trial at F/No.04
04. Intercropping observation – Tea and Coconut at F/No.02
05. Intercropping trial – Tea and Coconut at Citrus Estate
06. Shear plucking observation block

### **7. Staff list as at 31.12.2006**

Mr K D Dahanayake	Officer-in-Charge	Grade I
Mr S P Ratnayake	Extension Officer	Grade IV
Mr P K Jayawickrama	Experimental Officer (Nematology)	Grade IV
Mr M Sarath	Field Supervisor	Grade V
Ms P V D Chandrakanthi	Accounts Clerk	Grade V
Mr K M Jagath Prasanna	Guest House Keeper	Grade VI
Mr.H I Meththananda	Driver	Grade VI

**DENIYAYA REGIONAL ADVISORY AND EXTENSION CENTRE,  
KOTAPOLA, DENIYAYA**

*Actg. Officer-in-Charge- K G J P Mahindapala*

**1. General**

- Mr. K.G.J.P. Mahindapala Extension Officer continued to work as the Actg. Officer-In- Charge TRI Advisory and Extension Centre, Deniyaya.
- Mr. P. S. Kulasiri Field Supervisor was transferred to the station on temporary basis from TRI Kottawa station with effect from 9<sup>th</sup> January 2006.
- Mr .C.J. Liyanaarachchi, Extension Officer was transferred to the station from TRI Kottawa station with effect from 2<sup>nd</sup> May 2006.
- Sambodhi Welfare Society Ltd. has informed that their land can not be released to establish the TRI Deniyaya regional station. Therefore it was decided to obtain a land belongs to LRC and managed by a Regional Plantation Company for this purpose.

**2. Permanent Staff Position as at 31<sup>st</sup> December 2006**

Mr. K G J. P Mahindapala	Extension Officer / Actg. Officer-in-Charge
Mr. O W Jayawardana	Station Assistant
Mr. C J Liyaanarachchi	Extension Officer
Mr. P S Kulasiri	Field Supervisor
Driver	Vacant
Guest House Keeper	Vacant

**3. Land use information (in ha)**

VP tea –mature	6.79
VP tea- Young (under ADB)	0.50
ADB Mother bushes	0.50
Other Mother bushes	0.50
Rehabilitated abounded Area (under ADB)	1.00
Nursery (tea)	0.10
Coconut area	0.10
Forestry	0.42
Marshy land	0.50
Building, gardens, Roads	1.44
Pepper	0.05
Encroachment	0.36
Uncultivated area	0.96
<b>Total extent</b>	<b>13.22</b>

**4. Green leaf statement of the TRI-Deniyaya - 2006**

Month	Factory	Kgs	Rate / Kg	Total Full Amount
January	Deniyaya Estate	1960	28.204	55279.84
	M.K.T.P.Co-op, Kotapola	1314	29.170	38329.38
February	Deniyaya Estate	1879	27.000	50733.00
	M.K.T.P.Co-op, Kotapola	1557	28.194	43898.06
March	Deniyaya Estate	1777	27.279	48474.78
	M.K.T.P.Co-op, Kotapola	1891	30.139	56992.85
April	Deniyaya Estate	2041	26.153	53378.27
	M.K.T.P.Co-op, Kotapola	1265	30.288	38314.32
May	Deniyaya Estate	1888	27.016	51006.21
	M.K.T.P.Co-op, Kotapola	598	30.000	17940.00
June	Deniyaya Estate	1860	26.478	49249.08
	M.K.T.P.Co-op, Kotapola	669	30.247	20235.24
July	Deniyaya Estate	1529	27.198	41586.23
	M.K.T.P.Co-op, Kotapola	923	30.656	28295.49
August	Deniyaya Estate	1921	27.166	52185.89
	M.K.T.P.Co-op, Kotapola	937	30.770	28831.49
September	Deniyaya Estate	1949	28.820	56170.18
	M.K.T.P.Co-op, Kotapola	1433	32.461	46516.61
October	Deniyaya Estate	1745	30.566	53337.67
	M.K.T.P.Co-op, Kotapola	916	32.828	30070.45
November	Deniyaya Estate	2071	30.855	63900.71
	M.K.T.P.Co-op, Kotapola	1384	32.787	45377.21
December	Deniyaya Estate	1247	33.000	41151.00
	M.K.T.P.Co-op, Kotapola	1183	33.866	40063.48
<b>Total</b>		<b>35,937</b>	<b>29.254</b>	<b>1,051,317.44</b>

**5. Income**

No of cuttings sold		102,250
Sale of cuttings	Rs.	30,675.00
No of plants sold		Nil
Sale of plants		Nil
Crop harvested (Kgs)		35,937
Sale of crop	Rs	1,051,317.44
Average price (Kg/Green leaf)		Rs. 29.25
Miscellaneous income	Rs.	17,340.56
<b>Total Income</b>	<b>Rs.</b>	<b>1,099,362.25</b>

## 6. Experiments / Surveys

### • **Survey on Agro chemical usage in small Holdings in Akuressa region**

A comprehensive survey was conducted to study the agrochemical usage pattern and other related issues in small holding sector in Akuressa planting region. In this survey, 278 small holders from 5 Divisional secretariat areas – Akuressa, Athuraliya, Kamburupitiya, Welipitiya, Malimbada were interviewed by visiting their holdings and required information according to the questioner was gathered.

Some of the basic findings of this survey are:

- 51% of the small holders are used agrochemicals at least one time per year of which more than 95% was weedicide.
  - Out of the tea growers who used the agrochemicals
  - 80% of the tea growers have used Glyphosate
  - 20% of them exceed the frequency per annum recommended by the TRI for Glyphosate.
  - 19% of them exceed the dosage per application recommended by the TRI for Glyphosate.
  - Majority of the small holders get the information from dealers on any thing related to the agrochemicals.
  - About 80% of the small holders do not have adequate knowledge on label information.
- **Extension Survey on Shot-hole-borer infestation level in the main stem of “affected bushes”**

Extension Survey was conducted to asses the Shot-hole-borer infestation level in the main stem of the affected and characteristic symptoms showing tea bushes (Flowering, Defoliation etc.) in Deniyaya region. 48 small holdings in Deniyaya TI region were visited and relevant information was collected by uprooting and dissecting the randomly selected few affected bushes from each holding.

According to our observation SHB damage were notice all the bushes and of which 97.9% bushes, the damage noticed in the main/basal stem. Out of these affected main stems 60% were severely galleried while 30% were moderately galleried. It was also observed that rotting was commenced from the point of galleries.

- **On- going Experiments conducted under Corporate Plan 1999-2003 by Plant Breeding and Advisory staff on cultivar evaluation.**

LVP 74 phase II: Although this trial was terminated, various assessments were being continued. In addition to that this has been used as a multiplication plot to full fill the requirement of phase III trials.

Phase III trials in Deniyaya Estate and Indola Estate

At the end of the year Deniyaya plants were 2 years old while Indola plants were 18 months. Re-supplying has to be done in frequently in certain cultivars in the both trial. In Deniyaya estate trial out of 12 cultivars No.235>613>57 were observed to be relatively performed well in the young stage while Indola estate out of 8 cultivars No.59>84>93 were being performed well. These trails are in progress.

The observational trial commenced in Kiruwanaganga estate, using the same cultivar in Indola estate, has been completed 15 months at the end of the year 2006. The cultivar no. 124>168>1>195>174>93 were observed to be perform well. The trail is in progress.

- **On going Experiments conducted under Corporate Plan 1999-2003 by different research disciplines with the assistance of TRI-Deniyaya.**

Soil and plant Nutrition Division: Evaluation of crop response for different proportion of SA and urea. (In Kiruwanaganga Estate). Trial is in progress.

Agronomy Division: Development of an economically viable system to eliminate/reduce the soil rehabilitation period in replanting in the low country. The experiment conducts in Handford Estate Deniyaya and one cycle is completed. Trial is in progress.

- **Observational trail**

A observational trial was started in Deniyaya station (Old Diyadawa field) (at 250m msl) to evaluate the success of a low level pruning including collar pruning as to see any possibility of restore the debilitated primarily branches which could be seen in the most places of this region.(WL1a)

**Observation:**

Further observation are being carried out

Treatment	% of bud break after 3 Months
Collar Pruning	50%
Height of the pruning – 6”	67%
Height of the pruning – 12”	75 %
Height of the pruning – 18”	100%
Height of the pruning – 21”	100%

The observations were recorded in a small holding tea field in Tenipita, Deniyaya where the refuse tea (Rapid decomposition method develop by TRI) were applied. Monitoring the field had been doing only for 2 months period after the application of the refuse tea. During this period no any detrimental effects were noticed.

• **Trials on Deniyaya Problem**

The following two collaborative experiments commenced in Richiland Estate, Deniyaya is in progress

1. On source of planting material – Deniyaya plants vs Ratnapura plants.
2. On soil physical improvements.

Agronomy TRILCS & TRI Deniyaya staff continued to monitor and take the growth assessments.

• **Problem Specific Trials**

Experiment on use of city solid waste compost for young tea plants

This trial was established in August 2005 in Willie and Kadigala Estate. 3 treatment and control were assigned in 3 replicates. By the end of year 2006, 3 applications of CSW compost were done at the rate of 0, 5, 10 and 20 Metric tons/ha. TRI Deniyaya and SPND staff continued to take the growth assessment. The leaf and soil samples were also taken for residue analysis and the trial is in progress (SPND & TRI Den)

**7. Advisory and Extension Activities**

**7.1 Advisory correspondence**

390 Advisory correspondences were sent out on regular Advisory and Extension matters.

**7.2 Advisory & Extension visits**

- 63 Advisory and Extension visits were made by the Advisory staff to company estates, proprietary plantations for the various Advisory and

Extension matters such as monitoring of routine agriculture practises, Problem diagnosis, Advisory activities, data collection, monitoring of experiments & adaptive trials.

- 47 Advisory and Extension Visits were made to smallholdings for the various Advisory and Extension matters.
- 47 Extension research visits were made to the Nurseries and tea fields to undertake the surveys, collect the data and monitoring activities.
- 21 Collaborative research visits with research staff were made for monitoring, evaluation and inspection activities of experiments established in the estate sector and small holdings.

### **7.3 Visitors to the station**

Estate sector	124
Small holders	540
Students/ School Children	102
General Visitors	77
Foreign Personnel	02
Total	845

### **7.4 Advisory and Extension Programmes**

#### **Regional Scientific Activities:**

1 RSC seminar was conducted in Galle for the Plantation Sector.

1 Regional Technical and Extension forum was conducted at Akuressa for Matara District Small Holding Sector. 4 seminar presentations, 1 poster presentations and open discussion were conducted successfully.

**Field days, Seminars, Demonstration and Awareness programmes:** 30 programs for Plantation sector, Small Holding sector & Students were conducted.

#### **Crop Clinic:**

##### **Plantation Sector**

A very successful crop clinic was held for the planters in Morawakkorale on 25<sup>th</sup> January 2006 at the planter's club, Deniyaya. The main theme of this crop clinic was the bush debilitation in Deniyaya region. About over 200 Planters from the RPCs Estate and proprietary estates were participated.

##### **Small Holding Sector:**

Another successful crop clinic was held for the small holders of Hambantota District on 9<sup>th</sup> December 2006, with the participation of Senior Scientists

from various disciplines and Advisory staff of TRI. Over 450 small holders were gathered and Knowledge, new techniques, findings were disseminated to the tea growers. Agriculture Minister Hon. Chamal Rajapaksha was also present.

**Model Nursery:**

With the assistance of "Save the Children" TRI initiated a programme to establish the 15 Model nurseries in this region to motivate the nursery owners to raise a good quality plant in their nursery,

**Popularization of New improved cultivar in Estate Sector:**

A collaborative work initiated with Plant Breeding Division to establish TRI 3000/4000 series cultivars in large scale in the selected RPC estate in the region. In this programme TRI has given the planting material and other technical support to Kiruwanaganga, Deniyaya and Indola estates and aimed to plant 4ha in Kiruwanaganga 2 ha in Deniyaya and 1 ha in Indola with those new cultivars in year 2007.

**Newspaper Article:** 1 article was written to the news paper published in the regional level.

**Informal Discussion:**

46 with planters  
160 with small holders  
14 with students

**Inquires through Telephone seeking the advices on tea:** 347

**Informal Contacts:** 107

**7.5 Meeting attended by the Advisory staff:**

**Internal -22**

1 Advisory officers' meetings  
3 E & E meetings  
19 other meeting (Divisional, HOD, Review, Preview meeting, Mother Bush meeting etc.)

**External -16**

District Agriculture Committee, Regional coordinating committee, Nursery Review committee meeting etc,

**7.7 Soil analysis for pH: 349**

**7.8 Advisory publication distributed:**

Free issuing	1215
Priced Publications	1036

**7.9 Distribution of Planting Materials (Cuttings): 102,250**

**7.10 Student Trained**

1 B.H.R. Hemantha, Hardy Technical College, Ampara

**8. Special Task**

Officer-in-charge has served as a committee member of the committee appointed by the Director/TRI to review the commercial nursery inspection and certification procedure and to make the suitable suggestion.

The Committee review the existing process and Interim report has been prepared.

# BIOMETRY UNIT

*Research Assistant - T U S Peiris*

## 1. Project D. Biometry

### **Evaluation of autocorrelation of weekly harvestings in long-term fertilizer experiments in tea.**

The objective of this study was to assess the interdependency of adjacent weekly tea harvestings, with a view to predicting crop when sudden failures occur in long-term fertilizer experiments. However, owing to difficulties in obtaining weekly yield data, this study could not be carried out with fertilizer experiment data. Therefore this study was carried out in a shade experiment conducted by the Physiology Division, as a preliminary study.

Preliminary analysis of weekly tea harvestings showed significant interdependency of two adjacent harvestings.

The project is continuing.

Year	Lag	Covariance	Correlation	STD Error
2002	1	45298.153	0.48320	0.150756
2003	1	21635.468	0.54771	0.138675

### **The impact of spatial analysis on the selection of superior lines in tea cultivar evaluation trials.**

From the analysis of results obtained so far from project (c) (below), it is seen that several improvements could be made in the accuracy and precision of tea cultivar evaluation trials by using spatial techniques.

The present project is to assess whether existing failures contribute significantly in terms of selection of top lines and, if so, to identify those lines and improve on-going trials.

The results of the experiments, as evaluated, are given below.

Experiment	No. of other lines selected by the different spatial model / No. of other lines selected by the RCB model			
	Pap 1	Pap 2	MA1	MA2
LVP76-79	3,5,8/0,2,2	2,4,3/0,1,4	1,3,3/1,4,3	1,3,4/2,5,4
VP81	4,4,0,5,1,0,2 /0,0,1,0,0,0,0	0,3,0,1,0,0,0 /2,0,1,0,0,0,0	0,0,2,1,0,0,2 /2,0,0,0,0,0,0	1,5,3,1,1,3,3 /0,0,0,0,0,0,0
VP82	4,2/1,1	1,0/0,1	2,1/1,1	5,3/0,1
UVP9	-	-	-	-

Results of the comparisons with different standard clones are given separately.

### Efficiency of spatial analysis in improving Phase I and Phase II varietal trials.

Models were compared using the Akaike Information Criterion (AIC). The model with the lowest AIC value is considered to be better than the other models. In all trials, the highest value was found in RCB model.

No model was found to be in full agreement with the conventional RCB model. The percentage agreements, measured by the Dice coefficient for similarity, are given in the following table.

Experiment	Percentage agreement with the conventional RCB design			
	Pap 1	Pap 2	MA1	MA2
LVP76-79	0.8795	0.9182	0.9032	0.8774
VP81	0.8722	0.9412	0.9421	0.8741
VP82	0.6087	0.8889	0.7059	0.6400
UVP9	-	-	-	-

## 2. Project B 31. Development of a Drought Index for obviating the problems involved in prediction of crop using rainfall.

In predicting crop using rainfall, the correlation between yield and the amount of rainfall is taken directly. Normally not much attention is given to the develop an index including both aspects to get a more representative rainfall factor.

The index developed is based on the following aspects: scores for the length of dry spells (months) vs. level at which a wet spell is broken, scores for the residual effect of the previous heavy rains, and adjustment for increased drought during periods of longer day length.

The results from two stations are given below.

Agro-meteorological Station	Drought Index		Rainfall	
	Lag 0	Lag 1	Lag 0	Lag 1
Talawakelle	0.3481	-0.0686	-0.2662	-0.1638
Passara	-0.5789	-0.2024	-0.0793	0.5259

### 3. Project B 12.

Investigation of the factors responsible for the vast gap between the figures for experimental yields and normal yields.

Though usually higher values would be expected for yields from experimental plots than for normal yields owing to close supervision of experimental plots, most of the experimental yield figures in tea experiments are unexpectedly higher than normal yield figures. Sometimes these figures are 2-3 times higher than the average yields of the surrounding fields.

The present project is designed to investigate whether this is the true potential from optimal level of inputs, true potential of the applying treatments, or unreliable limits of extrapolation.

#### **Use of geostatistics as a tool to improve soil sampling**

This project is for developing a sampling strategy to enable end-users to obtain more representative soil samples, in order to generate larger volumes of information from a minor sampling effort. This would result in better performance, and an economical use of time and money.

#### **Designing Field Experiments, and Analysis and Interpretation of Data.**

Based on requests from other Divisions, advice was given on efficient protocols for experimentation and surveys, and on sound statistical methods for data analysis and for the drawing of statistical inferences.

## **LIBRARY**

*Library Assistant – S K Amunugama*

Main function of the library is collecting and dissemination of information on the requirements of TRI scientists for work connected to their research & publications.

Library render its service to TRI staff, undergraduate and diploma students who doing their projects in TRI and on official request of to out side libraries and people.

The Library was engaged in the following activities during the year.

- Acquisition, collecting and maintaining the library materials
- Lending library materials
- Circulation of Contents pages of Current Journals
- Maintaining the News Clippings collection
- Photocopy Service
- Inter Library Loan Service
- Making Literature surveys from CARP
- Services under AGRINET SDI Service

### **Acquisition**

The library procured 132 journals/serials through subscription, gift and exchange. It subscribed to 31 foreign journals. Exchange relation was maintained with 48 institutes of foreign and local by sending TRI publications of Annual Report, Sri Lanka Journal of Tea Science & TRI Update. During the year, 4599 book collection was expanded by 20 new books, as 5 purchase, 8 by exchange and 7 free of charge.

### **Current Awareness Service**

During the year, library has circulated 332 photocopied content pages and 353 articles respectively to the staff from current awareness journals .

### **News Paper Article**

669 news paper articles were sent to the Director and 775 to the Heads of the Divisions.

### **Literature Surveys**

6 literature surveys were made from CARP

### **Inter Library Loan**

35 requests were received to library from outside libraries and 29 articles were supplied.

From 43 articles requested from outside libraries on behalf of the staff, only 35 were received.

### **Photocopy**

274 articles were photocopied from bound periodical collection for TRI users. Total number of pages were 5,891 by the library during the year for requests of TRI staff.

### **Other**

17 publications were sent to Low Country Station library at Ratnapura and 15 publications were sent to Mid Country Station library, Hantana.

Proceed to collect the borrowed library books at the end of the year for physical verification.

34 students from Universities and Technical Colleges used the library for their reference during the year.

Mrs. Wasantha Illangantilake, resigned from the post of Librarian with effect from 28<sup>th</sup> February, 2006.

**ST. COOMBS / LAMILIERE ESTATE,  
THALAWAKELLE**

*Superintendent - Jayantha U Hulangamuwa*

**1 Staff as at 31<sup>st</sup> December 2006**

Mr. Jayantha Hulangamuwa

Superintendent

**Office Staff**

- |                              |                        |
|------------------------------|------------------------|
| 1. Mr D H Jayatillake        | Chief Clerk            |
| 2. Mr R W Kitnasamy          | Junior Assistant Clerk |
| 3. Mr N G L Dayatillake      | Junior Assistant Clerk |
| 4. Mrs T G S Chandrakanthi   | Junior Assistant Clerk |
| 5. Miss H M Badra Jayatilake | Junior Assistant Clerk |

**Field Staff**

- |                         |                                |
|-------------------------|--------------------------------|
| 6. Mr Nimal De.Silva    | Field Officer                  |
| 7. Mr N Illangeswaran   | Field Officer                  |
| 8. Mr I W M D Alahakoon | Junior Assistant Field Officer |
| 9. Mr U V Dayananda     | Junior Assistant Field Officer |
| 10. Mr S Suresh         | Junior Assistant Field Officer |
| 11. Mr S D Perera       | Junior Assistant field Officer |

**Factory Staff**

- |                          |                                  |
|--------------------------|----------------------------------|
| 12. Mr E M Dayaratne     | Factory Officer                  |
| 13. Mr H M R Kuladasa    | Junior Assistant Factory Officer |
| 14. Mr S M Sunil Shantha | Junior Assistant Factory Officer |
| 15. Mr J R Yapa          | Junior Assistant Factory Officer |
| 16. Mr A D C Premalal    | Junior Assistant Factory Officer |

**Medical Staff**

- |                        |                             |
|------------------------|-----------------------------|
| 17. Mr K Ramesnath     | Estate Medical Practitioner |
| 18. Mr S Fernando      | Estate Medical Practitioner |
| 19. Mr D Puniyamoorthy | Welfare Officer             |

**Drivers**

- |                      |        |
|----------------------|--------|
| 20. Mr K Selvaraj    | Driver |
| 21. Mr S Christopher | Driver |
| 22. Mr T Ramanathan  | Driver |
| 23. Mr R Udayakumar  | Driver |

## 2. Weather and Rainfall

A rainfall of 2495.3mm was recorded on 184 days against 2081.2mm on 205 days in 2005.

## 3. Field work & cultivation

### 3.1 Hectare statement as at 31<sup>st</sup> December 2006

	St.Coombs	Lamilliere	Total
Old Seedling Tea in Bearing	8.60	2.00	10.60
V.P.Tea in Bearing	80.72	45.50	126.22
V.P.Tea Immature	-	-	-
ADB Project	11.39	2.62	14.01
Nurseries	1.20	0.10	1.30
T R I Experimental Area	2.50	-	2.50
<b>Total in Tea</b>	<b>104.41</b>	<b>50.22</b>	<b>154.63</b>
Labour Housing	2.09	-	2.09
Ravines & Grass Land	31.00	1.00	32.00
Building ,Roads,Gardens ect.	34.28	14.70	48.98
<b>TOTAL</b>	<b>171.78</b>	<b>65.92</b>	<b>237.70</b>

### 3.2 Crop and Yield

	2006		2005	
	Crop (kg)	Yield (kg/ha)	Crop (kg)	Yield (kg/ha)
St.Coombs	240,111	2688	226,177	2513
Lamilliere	129,582	2728	122,099	2590
Total	369,693	2,702	348,276,	2,529
Bought Leaf	8,784		8,373	
<b>Grand Total</b>	<b>378,477</b>	<b>2,702</b>	<b>356,649</b>	<b>2527</b>

The yield of 2702 Kgs/Hect was the highest recorded on St. Coombs Lamilliere Estate surpassing the previous highest of 2527 Kgs /Hect recorded in 2005.

### 3.3 Cultural Operations

The following fields were pruned during the season

Upper Division      Field Nos. 2,5, and 6B

Lamiliere Division      Field Nos 4A and 8 B

Nitrogen /Yield Replacement Ratio was at 11.28

### 3.4 ADB mother Bush Project

463232 shoots of TRI 3000 and 4000 series were issued to Tea Small Holders and Corporate Sector.

## 4. Factory and Manufacture

### 4.1 Top Prices

Silver Tips teas were sold at Rs.7,200.00 / Kg.

## 5. General

M/s. Forbes & Walker Tea Brokers (Pvt) ltd re commenced auctioning 100% of St.Coombs teas with effect from 01<sup>st</sup> September ,2006.

## 6. Working Results

The Estate should made a profit of Rs. 9,584,498.27 for the season.

## 7. Labour wages

The labour wages were increased with effect from 01<sup>st</sup> November, 2006.

	Previous	Current
Basic wage	Rs.135.00	Rs.170.00
EPF/ETF	20.25	25.50
Fixed Price Share Supplementary	Rs. 20.00	Rs. 20.00
Attendance Incentive for attendance .Not less than 75% of the days work Offered per month	Rs. 25.00	Rs. 70.00
VPSS as per National Sale average	-	-

## ST. JOACHIM ESTATE

*Superintendent – M S E Perera*

### 1. General

Mr M S E Perera functioned as the Superintendent since, 15/12/2001 to 15<sup>th</sup> October 2006 and Mr A U Weerasingha was appointed as Superintendent on 01<sup>st</sup> November '06.

The Visiting Agent Mr Devan S Warusavitane, made his visit to this estate on 27/28<sup>th</sup> May 2006.

### 2. Hectarage as at 31<sup>st</sup> December 2006.

	Ha	
Mature tea	47.14	
Major infilled areas	1.18	
Nursery	1.58	
<b>Land under coconut (TRI)</b>	<b>3.89</b>	
ADB Project	30.00	
Land under paddy	8.74	
Crop - Tea /Rubber	3.68	
<b>Rubber</b>	<b>7.12</b>	
Mana Grass	13.02	<b>116.35</b>
<b>Other Lands</b>		
Acquisition by Government		
Buildings/roads/ravines	<b>25.63</b>	
<b>Total extent</b>		<b>141.98</b>

### 2. Crop (made tea kg)

The production on St.Joachim Estate in 2006, compared to the previous year was as follows

Year	Estate Crop (Kg)	Bought Crop ((Kg)
2005	58,336	574,284
2006	59,987	502,678

The production on the estate registered an increase of 1651 kg or 2.83%, in comparison to the previous year.



The following work has been carried out in the factory during the year:-

1. The Tempest Drier converted to solid fuel firing .
2. The bird mesh for factory, Floor Tiling work completed under HACCP Vote .

### 9. Staff Vacancies:

Junior Assistant Clerk's vacancy is remains since 15/11/2005 and the Chief Clerk Mr W M L M Perera retired on 18<sup>th</sup> November 2006 and worked for a one month period on Contratual basis up to end and now the Senior Assistant Clerk Mrs. N D A Gunawardena is covering up the duties.

**Table 1.**

Working Accounts of St. Joachim Estate for 2006  
In Comparison with Previous Years

Year	Total Crop Sold /Made Tea Yeild	Made TEA kg/ha	Net Sale Average Rs/Kg	Estimated C.O.P. (Rs/kg)	C,O,P. Rs.kg	Actual +Profit -Loss (Combined)Rs.
2000	711,325 # 75,336	13931	138/70	82.98	75/62	9,360,576.00
2001	609,732 66,459	1140	137/23	89/48	89/13	(424,423.00)
2002	658,619 65,071	1358	147/84	96/26	100/56	(1,306,425.00)
2003	648,692 62,071	1293	143/37	130/09	93/46	155,325.00
2004	585,486 56,059	1160	177/12	164/74	168/69	2,637,356.00
2005	574,284 58,336	1251	180/12	165/97	180/02	(68,043.42)
2006	471,923 551,172	1273	175,90	176/44	180/03	(120,690.18)

**Table 2. Monthly Yield (Kg/ha) rainfall and average "N" applied from 2001 to 2006 St. Joachim Estate.**

Month	2001	2002	2003	2004	2005	2006
January	123	102	106	79	113	108
February	115	81	88	71	65	98
March	122	109	105	89	107	122
April	113	109	131	117	126	124
May	118	127	116	90	107	106
June	87	130	112	111	106	104
July	86	116	124	103	107	120
August	88	130	95	103	115	101
September	56	104	100	92	108	101
October	88	113	112	106	96	100
November	78	105	107	104	104	86
December	90	85	97	94	95	102
<b>Total</b>	<b>1164</b>	<b>1311</b>	<b>1293</b>	<b>1159</b>	<b>1249</b>	<b>1272</b>
<b>Rainfall</b>	<b>3593.5</b>	<b>3194.8</b>	<b>3984.6</b>	<b>3914.3</b>	<b>3511.5</b>	<b>3927.4</b>
<b>No. of</b>						
<b>Wet Days</b>	<b>189</b>	<b>206</b>	<b>227</b>	<b>216</b>	<b>189</b>	<b>192</b>
<b>Average "N"</b>						
<b>(Kg/Ha/Yr)</b>	<b>163</b>	<b>162</b>	<b>124</b>	<b>127</b>	<b>121</b>	<b>129</b>

Field No	Extent	Total N	Fert Mixt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	2.68	240	VPLC/880	112	171	150	163	179	154	275	206	222	184	216	192	2224
1B	0.80	420	VPLC/880	354	299	426	606	347	377	276	400	259	307	284	424	4359
2A	0.93	380	VPLC/880	212	226	226	285	336	243	305	263	222	300	215	344	3177
2F	6.50	80	VPLC/880	33	25	40	67	69	75	54	56	83	64	45	75	686
3	8.40	100	VPLC/880	76	74	69	72	64	69	82	67	-	-	-	-	573
4	5.85	160	VPLC/880	77	75	110	134	86	90	141	96	120	104	112	115	1260
6	1.00	310	VPLC/880	103	148	160	168	167	116	230	162	307	262	206	229	2258
6B	1.10	170	VPLC/880	-	-	186	149	171	154	234	121	139	150	107	196	1607
6C	2.00	170	VPLC/880	07	43	167	172	159	152	165	142	170	197	115	133	1622
8A	6.00	100	VPLC/880	143	112	121	68	-	-	-	13	17	60	35	53	622
8B	2.02	420	VPLC/880	287	250	252	305	356	411	306	324	312	260	229	262	3554
8C	1.90	90	VPLC/880	135	54	92	85	74	-	-	07	14	18	35	42	556
2 (TRI)	4.12			68	47	97	53	55	50	76	46	57	38	33	37	657
3A(TRI)	3.34			63	50	73	61	54	71	57	46	63	45	47	40	670
6A(TRI)	0.50			178	150	20	12	56	-	-	12	36	50	106	112	732
Total	47.14			108	98	122	124	107	104	120	101	101	100	86	102	1273

**METEOROLOGICAL OBSERVATIONS - 2006**  
**TEA RESEARCH INSTITUTE, TALAWAKELLE**

Month	Mean Temperature (°C)				Relative Humidity		Wind travelled (miles)	Sunshine hours hrs/day	Evaporation (mm)	Rainfall (mm)	Wet days
	Ambient Air		Soil Temp. at 20cm								
	min.	max.	9.00 am	16.00 pm	9.00 am	16.00 pm					
January	13.9	24.4	20.1	21.8	79.1	70.2	1771.56	5.8	72.3	48.0	5
February	14.0	26.0	21.1	23.1	79.0	65.7	1757.00	6.5	77.6	62.9	7
March	12.4	25.4	21.7	23.5	80.2	66.4	1460.59	6.6	91.1	87.9	13
April	13.7	26.0	22.6	24.3	84.5	72.3	1204.43	6.8	78.3	122.8	12
May	15.4	24.4	22.3	23.3	89.6	84.8	1359.36	4.5	51.8	364.3	23
June	15.9	24.1	21.9	23.2	86.6	75.7	1881.43	5.2	67.5	185.7	9
July	15.7	21.5	20.5	21.3	93.9	84.5	2740.83	2.6	45.3	239.3	22
August	14.5	23.5	21.2	22.3	90.5	80.7	1858.25	4.3	64.6	142.8	18
September	15.5	23.9	22.0	23.0	83.9	78.4	1818.22	7.0	64.6	118.8	13
October	14.8	24.2	21.8	22.6	86.4	82.8	1388.49	4.0	56.2	269.6	21
November	14.7	24.8	21.7	22.6	80.4	89.4	1439.45	3.8	60.4	391.5	22
December	14.1	23.4	20.3	21.9	79.5	80.5	2289.74	3.7	65.1	106.6	11
<b>Total</b>									<b>794.84</b>	<b>2140.09</b>	<b>176</b>
Average	14.6	24.3	21.4	22.7	84.5	77.6	1747.4	5.1	66.2	178.3	

**METEOROLOGICAL OBSERVATIONS - 2006**  
**LOW-COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE, RATNAPURA**

Month	Mean Temperature (°C)		Relative Humidity		Sunshine hours hrs/day	Rainfall (mm)	Wet days	Mean Evaporation (mm)
	min.	max.	9.00 am	16.00 pm				
January	21.49	34.20	88	65	4.20	228.5	13	2.31
February	22.98	34.48	91	62	5.61	179.6	11	2.94
March	22.88	34.57	87	62	5.42	240.3	15	2.69
April	23.74	34.28	88	63	4.83	220.8	15	3.36
May	23.78	33.49	87	67	4.43	436.4	21	3.28
June	23.51	32.84	87	65	4.01	445.1	14	3.01
July	23.60	32.02	89	66	4.25	187.2	14	2.89
August	22.96	32.26	88	69	3.69	427.1	18	3.18
September	23.06	32.85	86	63	4.15	232.5	11	2.76
October	22.86	32.62	84	65	4.31	660	23	3.89
November	23.23	33.27	87	67	3.76	456.1	20	2.92
December	22.85	31.83	90	65	2.9	156.1	13	1.91
<b>Total</b>						<b>3869.7</b>	<b>188</b>	
<b>Average</b>	<b>23.07</b>	<b>33.22</b>	<b>88</b>	<b>65</b>	<b>4.29</b>			<b>2.92</b>

**METEOROLOGICAL OBSERVATIONS - 2006**  
**MID-COUNTRY RESEARCH, ADVISORY AND EXTENSION CENTRE, KANDY**

Month	Mean Temperature (°C)		Relative Humidity		Sunshine hours hrs/day	Rainfall (mm)	Wet days	Mean Evaporation (mm)
	min.	max.	9.00 am	16.00 pm				
January	19.0	24.1	98.1	97.7	5.0	155.00	12	81.32
February	20.1	25.5	97.9	95.5	6.6	078.50	5	82.48
March	20.9	26.5	98.5	95.3	5.5	165.25	13	96.69
April	22.3	26.6	98.7	96.5	6.2	143.60	9	88.47
May	23.1	25.5	98.9	97.6	5.8	143.49	14	81.92
June	23.3	26.3	98.1	96.4	6.2	154.70	5	97.69
July	21.0	23.2	98.8	95.5	6.2	130.70	11	75.32
August	22.4	25.0	95.2	97.0	3.3	138.70	12	81.60
September	22.6	25.4	97.5	97.0	5.9	091.00	8	88.16
October	22.6	25	98.0	97.1	4.4	380.50	14	63.60
November	22.1	24.4	98.4	97.2	4.7	468.90	19	50.70
December	20.8	23.5	98.3	97.3	3.8	125.90	10	76.70

## METEOROLOGICAL OBSERVATIONS - 2006

### UVA ADVISORY AND EXTENSION CENTRE, PASSARA

(Latitude 6°56'N, Longitude 81°07'E, Elevation 1120m amsl)

Month	Mean Temperature (°C)		Relative Humidity		Sunshine hours hrs/day	Rainfall (mm)	Wet days	Mean Evaporation (mm)
	min.	max.	9.00 am	16.00 pm				
January	21.9	15.9	95	89	5.3	4.31	232.1	61.48
February	24.1	17.0	91	88	5.1	2.9	137.3	62.44
March	25.9	18.2	88	85	5.5	1.36	180.5	87.7
April	26.7	18.8	88	86	4.6	3.01	156.5	72.20
May	26.8	19.3	85	87	3.9	1.47	184.1	74.18
June	26.9	18.9	85	86	5.0	1.29	192.6	70.9
July	27.0	18.5	82	83	4.6	1.57	13.5	91.1
August	27.7	18.8	83	87	4.58	0.96	106.05	86.4
September	26.0	17.5	80	80.3	4.1	1.26	210.1	75.1
October	26.0	18.4	80	79	3.59	0.87	488.0	62.4
November	23.8	17.5	74.5	74	2.1	1.3	570.5	46.5
December	22.7	17.5	90	78	1.87	2.58	338.4	39.94
<b>Total</b>	<b>305.5</b>	<b>216.3</b>	<b>1021.5</b>	<b>1002.3</b>	<b>50.24</b>	<b>22.88</b>	<b>2809.6</b>	<b>830.34</b>
<b>Average</b>	<b>25.5</b>	<b>18.3</b>	<b>85.3</b>	<b>83.5</b>	<b>4.2</b>	<b>1.91</b>	<b>234.1</b>	<b>69.2</b>

**METEOROLOGICAL OBSERVATIONS - 2006**  
**SOUTHERN PROVINCE ADVISORY AND EXTENSION**  
**CENTRE, KOTTAWA, GALLE**

Month	Mean Temperature (°C)		Mean Sunshine Hours hrs/day	Rainfall (mm)	Wet days
	min.	max.			
January	30.9	21.3	6.4	73.5	7
February	31.7	22.2	7.5	34.1	5
March	32.8	22.4	5	134.6	9
April	32.6	23.1	7.4	137.3	13
May	29.7	23.5	5.6	306.2	20
June	32.8		5.9	221.9	18
July	31.5		4.9	210.4	18
August	31.4		5.3	135.2	11
September	31.7		3.1	462.8	22
October	30.9	22.1	5.3	292.6	24
November	30.9	22.8	5.2	203.3	15
December	30.1	22.2	3	219.7	13
<b>Total</b>					
<b>Average</b>			1962.2	2431.6	175
			5.4		

**METEOROLOGICAL OBSERVATIONS**  
**ADVISORY AND EXTENSION CENTRE - DENIYAYA**  
(Lat 6° 43' N; Long 80° E 33.3' Elevation 250 m amsl)

Month	Mean Temperature (°C)				Rainfall (mm)	Wet days	Evaporation (mm)	Mean Sunshine Hours hrs/day
	Ambient Air		Soil Temp. at 20cm					
	min.	max.	9.00 am	16.00 pm				
January	NA	NA	NA	NA	147.6	13	NA	5.31
February	NA	NA	NA	NA	201.0	10	NA	6.00
March	NA	NA	NA	NA	409.3	20	2.43	5.16
April	NA	NA	NA	NA	261.2	13	2.66	4.62
May	NA	30.17	NA	NA	199.25	14	3.17	5.18
June	NA	30.54	NA	NA	212.63	16	4.06	3.34
July	NA	30.22	27.2	27.3	129.8	15	2.94	4.69
August	NA	30.11	27.7	27.3	260.8	21	2.89	5.40
September	NA	29.72	27.9	27.8	187.3	19	2.30	4.19
October	22.04	30.87	28.1	28.2	728.6	21	2.69	3.10
November	21.72	31.00	28.1	27.8	501.6	25	2.40	4.77
December	21.95	29.65	27.5	27.5	120.6	09	2.15	3.67
<b>Total</b>	<b>3359.98</b>	<b>205</b>		<b>55.43</b>				
<b>Average</b>	<b>21.90</b>	<b>30.29</b>			<b>290.05</b>	<b>17.1</b>	<b>2.77</b>	<b>4.62</b>