ANNUAL REPORT 2013

বাংলাদেশ চা বোর্ড
বিটিআরআই

BANGLADESH TEA RESEARCH INSTITUTE
SRIMANGAL-3210, MOULVIBAZAR
An organ of
BANGLADESH TEA BOARD
171-172, Baizid Bostami Road
Nasirabad, Chittagong

ANNUAL REPORT 2013

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DIRECTOR'S REPORT

STAFF

The report of the technical staff shows the position as on 31 December 2013.

Director : **Dr. Mainuddin Ahmed**
M.Sc. (DU), B.Ed. (DU), M.Sc. (London)
DIC (London), Ph.D.

TECHNICAL DIVISIONS

1. DEPARTMENT OF CHEMISTRY

Chief Scientific Officer : **M.A. Motalib**
M.Sc. (DU)

A. SOIL SCIENCE DIVISION

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B.Sc. (Hons). M.Sc. (DU)
M.Sc (Reading, UK)

Senior Scientific Officer : **Ashim Kumar Saha**
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Scientific Officer : **Apu Biswas**
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Scientific Officer : **Kanij Fatema Tuz Zohora**
B.Sc. (Hons), M.S. (CU)

B. BIOCHEMISTRY DIVISION

Scientific Officer : **Md. Imrul Hasan Chowdhury**
B.Sc. (Hons), M.S. (JU)

2. DEPARTMENT OF CROP PRODUCTION

Chief Scientific Officer : **S.M. Altaf Hossain**
B.Sc. (Hons), M.Sc. (RU)
M.Sc. (Reading, UK)

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B.Sc.Ag.(Hons), M.S. (BAU)

Senior Scientific Officer : **Md. Abdul Aziz**
B.Sc. (Hons), M.Sc. (RU), Dipl. (China)

Scientific Officer : **Shefali Boonerjee**
B.Sc. (Hons), M.Sc. (RU)

Scientific Officer : **Md. Abul Kasem**
B.Sc. (Hons), M.Sc. (CU)

Senior Farm Assistant : **Md. Majibur Rahman**
B.Sc. (CU)

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Senior Scientific Officer (Deputation) : **Mohammad Masud Rana**
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Farm Supervisor : **Vacant**

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B.Sc. (Hons), M.Sc. (CU), M.Sc. (Newcastle, UK)
PGD (India), Ph.D

A. ENTOMOLOGY DIVISION

Senior Scientific Officer : **Mohammad Shameem Al Mamun**
B.Sc.Ag. (Hons.), M.S. (BAU), PGD (India)

Scientific Officer : **Shovon Kumar Paul**
B.Sc.Ag. (Hons.) (KU), M.S. (BSMRAU)

B. PLANT PATHOLOGY DIVISION

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B.Sc.Ag., M.S. (BAU)

TECHNOLOGY DIVISION

Scientific Officer : **Dulal Chandra Dey**
B.Sc. Engg. Mech. (BUET)

Senior Tea Maker : **Md. Amir Ali**
B.Sc. (RU)

Assistant Engineer (Civil) : **Sadeque Ahmed**
Dip-in-Engg. Civil, (Dhaka)

Foreman : **Nazrul Islam Chaudhury**
Dip-in-Engg. Elect. (Sylhet)

STATISTICS & ECONOMICS DIVISION

Principal Scientific Officer : **Vacant**

BTRI SUB-STATION, FATIKCHARI, CHITTAGONG

Scientific Officer & Officer in-charge : **Md. Moshiur Rahman Akonda**
B.Sc.Ag. (Hons), M.S. (BAU)

Senior Farm Assistant : **Ajit Chandra Choudhury**
B.A. (NU)

BTRI SUB-STATION, KALITI, KULAURA

Field Assistant : **Aminul Islam Mandal**
Dip.-in-Agric. (Sherpur)

BTRI REGIONAL STATION, PANCHAGARH

Senior Farm Assistant : **Md. Zayed Imam Siddique**
Dip.- in- Agric. (Rangpur)

BILASHCHERRA EXPERIMENTAL FARM

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M.Sc (NU)

Farm Supervisor : **Md. Hossain Mahamud**
Dip.- in- Agric. (Dhaka)

Field Assistant : **Ajit Kumar Sarker**
Dip.- in- Agric. (Mymensingh)

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Librarian-cum-Publication Officer : **Mohammad Kamal Uddin**
M. Sc. (RUD), M.S.S. (NU), LL.B (NU)
PGD in Lib. Sc. (Dhaka)

RESEARCH

A total of 46 experiments on different areas of tea culture were carried out in six research divisions during 2013. The main features are briefly enumerated below:

Soil Science Division carried out researches on two major fields in respect of fertilizer efficiency and improvement of soil properties. Effect of dolomitic lime on the yield of tea and soil properties has been undertaken. Fertilizer requirement of mature tea in northern tea growing areas is being continued. The importance of organic fertilizers and its sources were also duly emphasized. Besides, the most useful advisory services on planting, replanting, manuring, soil rehabilitation, extension and other aspects of tea husbandry were rendered to the tea industry through soil analysis. A total of 3346 soil, 121 fertilizer including lime samples were analyzed during 2013.

Improved planting materials received top priority amongst the research activities of Botany Division. Several new test clones were under different stages of long term yield and quality trial. Hybridization between clones and agrotypes, collection and preservation of germplasm of tea from home and abroad were continued. Two tea tasting sessions were organized for the tea planters to improve the quality of tea.

Agronomy Division carried out researches on various cultural practices i.e. planting, pruning, tipping, plucking and related agro-techniques as well as determining ideal plant population, shade spacing, etc. Besides, this year, new experiments on the effect of some exotic plants on tea soil, water and yield of tea and management of shade plant canopy for sustainable tea production in Bangladesh have been initiated.

Research programmmes of Entomology Division include screening of host preference of pests, susceptibility of tea clones for nematodes, studies on indigenous plant extracts, searching and identification of bio-control agents, standardization of pesticides against *Helopeltis,* red spider mites, termites, nematodes, aphids & flush worms and determination of residue level of pesticides in made tea of different tea agro-types. The Division also rendered all sorts of advisory services to Tea Estates on problems arising out of pests of tea and analyzed soil, water and cowdung for nematode count. The division also engaged in analyzing made tea sample for the detection of pesticide residue received from different Tea Estates, companies and organizations.

Plant Pathology Division are concerned with the isolation and culture of major disease causing organisms of tea and ancillary crops, screening of different fungicides and herbicides, bio-ecology of disease causing organisms and integrated management of diseases and weeds, assessment arbuscular mycorrhizal (AM) fungi in tea and tea associated plants. Determination of critical period of weed competition in young tea and evaluation of biofungicidal activities of some plant extracts against different foliar diseases of tea are the new areas of research of the division.

Besides normal manufacture of tea in the factory from the green leaves harvested from its Main station farm and Bilashcherra experimental farm, different experiments on the improvement of tea manufacturing technique were being conducted by Technology Division.

The supply of improved planting materials, fresh and rooted cuttings and biclonal seeds was continued from the BTRI and sub-stations in 2013. A total of 47,76,400 fresh cuttings, 1,68,607 rooted cuttings and 630 kg bi-clonal seeds were distributed to different Tea Estates in the year of 2013. Technology disseminations through seminars, workshops and advisory visits were continued in the Main station and Sub-stations during the year.

VISITS

Scientific personnel of the institute and sub-stations paid a total of 161 experimental and advisory visits to different tea estates in order to solve various problems connected with tea culture and experimental purposes during the period under report.

PUBLICATIONS

Circular no. 136 on 'Compatibility Between and Among-Pesticides, Inorganic Fertilizers and Pesticides and Inorganic Fertilizers for Foliar Application in Tea' was published in August 2013. Annual Report 2012 was published in June, 2013 and Tea Journal of Bangladesh, Volume 41, 2012 was published in December 2013

ANNUAL COURSE / SEMINAR / WORKSHOP

The 48th Annual course (6 days) was held on 'Tea Culture' at the Institute for the covenanted staff of Tea Estates of greater Sylhet. Same courses were held at Chittagong and Panchagarh Sub-stations having two days duration each. In these courses, Managers, Assistant Managers, Proprietors of different Tea Estates, small tea growers and officers of PDU were participated.

MANAGEMENT TRAINING COURSE

Scientists of BTRI conducted a series of Management Training Modules on nursery, young and mature tea management, pruning, pest management, soil management, etc. organized by MTC of Bangladesh Tea Board for the management executives and staff of different Tea Estates during the periods under report.

OFFICIAL CORRESPONDENCE 2013

Total receipts - 1875
Total issues - 1597

LIBRARY

BTRI Library contained 4,566 books and 8,995 Periodicals, Journals, Pamphlets and Circulars, Newsletter, Research highlights, etc.

(Dr. Mainuddin Ahmed)
Director

SOIL SCIENCE DIVISION

Abdul Qayyum Khan
Principal Scientific Officer (In- charge)

STAFF

Mr. M. A. Motalib, Chief Scientific Officer of the Division proceeded on PRL from 31/12/2013. Mr. Abdul Qayyum Khan took over the charge of the Division on 01/01/2013. Ms. Kanij Fatema Tuz Zohora joined as Scientific Officer on 29/12/2013. There was no other change in the personnel position in this Division during the reporting year.

RESEARCH

A total of four experiments were conducted during the year 2013 by Soil Science Division. Progress of the experiments is given below.

SS 1. Studies on performance of organic matter status on different levels in reducing chemical fertilizer use in tea (2012-2015)

The long term (2012-2015) experiment has been undertaken to observe the performance of organic matter on different levels in reducing the use of chemical fertilizer at Bilashcherra Experimental Farm. Dolomitic lime and NPK were applied on the soil after a good shower, simultaneously organic matter (cow-dung) was also applied and mixed with the soil by light forking in two split doses. Usual cultural practices and pest control measures were taken as and when needed. Regular weekly plucking data were recorded during the plucking season. The experiment was laid out in the year 2012 and be continued upto 2015. There are eight treatments in a Randomized Block Design (RBD) with three replications. The unit plot size is 14.4 m^2 .The treatment combinations are presented below.

T_1= Control
T_2= BTRI Recommended dose of chemical fertilizer
T_3= Organic matter (2t/ha)
T_4= Organic matter (6t/ha)
T_5= 85% of T_2 + Organic matter (2t/ha)
T_6= 85% of T_2 + Organic matter (6t/ha)
T_7= 70% of T_2 + Organic matter (2t/ha)
T_8= 70% of T_2 + Organic matter (6t/ha)
(Recommended Fertilizer dose: Urea $_{220}$, TSP $_{66}$, MOP $_{120}$ kg/ha)

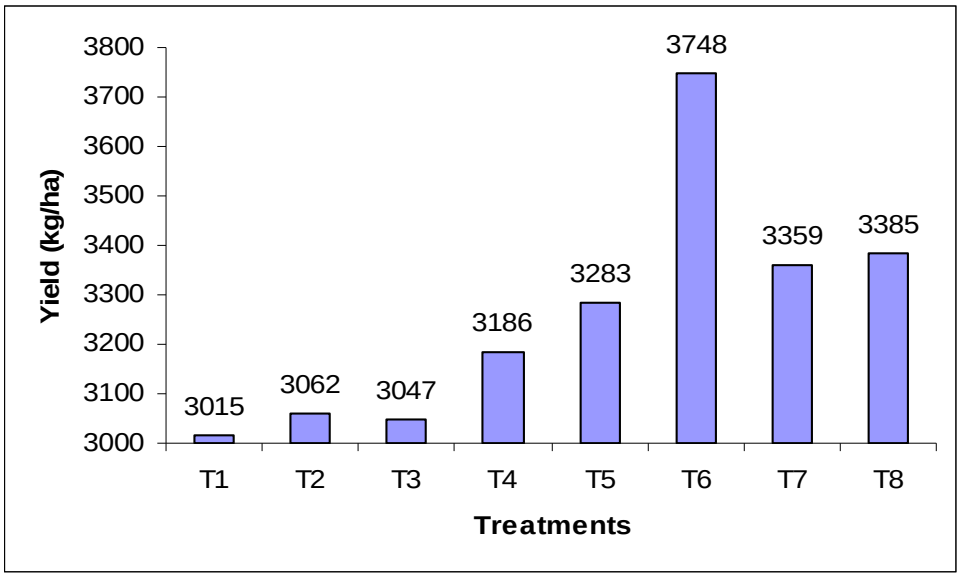

Fig-1: Effect of different treatments on the yield of tea

Result shows, in every treatment increased yield was found over the Control. The highest yield i.e 3748 kg/ha made tea was recorded in treatment T_6 where 85% of the recommended dose of chemical fertilizer and 6 t/ha organic matter were applied. The rate of increase over the Control was 24.31%. But the differences among the rates of increases in yield due to other treatments was statistically insignificant (F=1.32). This experiment will be repeated in the year 2014.

SS 2. Studies on upgrading the present fertilizer recommendation (2012-2015)

A long term (2012-2015) experiment was initiated in 2012 to find out appropriate dose of chemical fertilizers for tea plantation with the change of soil environment on the basis of production. The experiment was conducted at two locations- one at BTRI Farm and another at Srigobindpur Tea Estate. Usual cultural operations and pest control measures were taken as and when needed. Fertilizer was applied in two split doses. The 1st dose was applied after a good shower of monsoon and the 2nd was applied in the 1st week of August, 2013. Regular weekly harvesting data were recorded during the harvesting season. There are seven treatments in a Randomized Block Design (RBD) with three replications. Each plot size is 35.60 m^2. Treatment combinations are as follows:

T_1= Control
T_2= 40 (kg/ha) N +5 (kg/ha) P_2O_5 + 30 (kg/ha) K_2O + 10 (kg/ha) Zn
T_3= 50 (kg/ha) N + 10 (kg/ha) P_2O_5 + 35 (kg/ha) K_2O + 10 (kg/ha) Zn
T_4= 60 (kg/ha) N + 15 (kg/ha) P_2O_5 + 40 (kg/ha) K_2O + 10 (kg/ha) Zn
T_5= 70 (kg/ha) N + 20 (kg/ha) P_2O_5 + 45 (kg/ha) K_2O + 10 (kg/ha) Zn
T_6= 80 (kg/ha) N + 25 (kg/ha) P_2O_5 + 50 (kg/ha) K_2O + 10 (kg/ha) Zn
T_7= 90 (kg/ha) N + 30 (kg/ha) P_2O_5 + 55 (kg/ha) K_2O + 10 (kg/ha) Zn

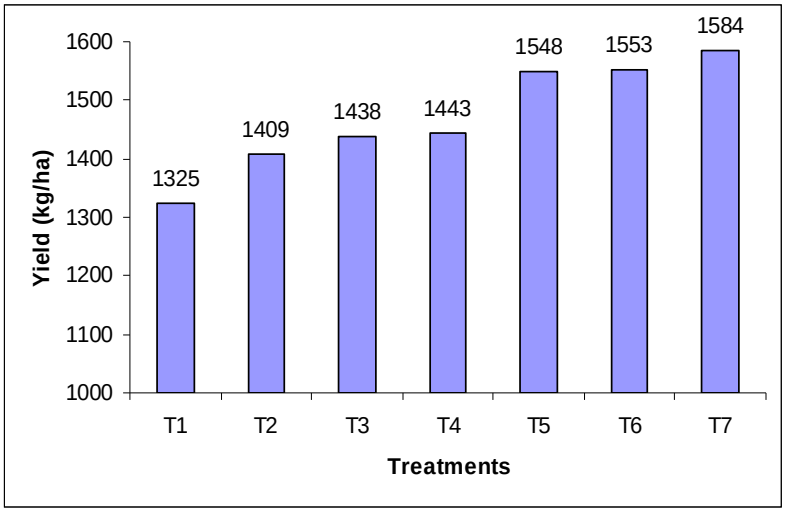

Fig-2: Effect of different fertilizer doses on the yield of tea (BTRI Farm)

Result shows, at BTRI Farm, in every treatment increased yield were found over the Control. The highest yield i.e 1584 kg/ha made tea was recorded in the treatment T_7 where N_{90}, P_{30}, K_{55}, and Zn_{10} were applied. The rate of increase over the Control was 19.55% in T_7. But the differences among the increases of yield due to different treatments was statistically insignificant (F=1.070). This experiment will be repeated in the year 2014.

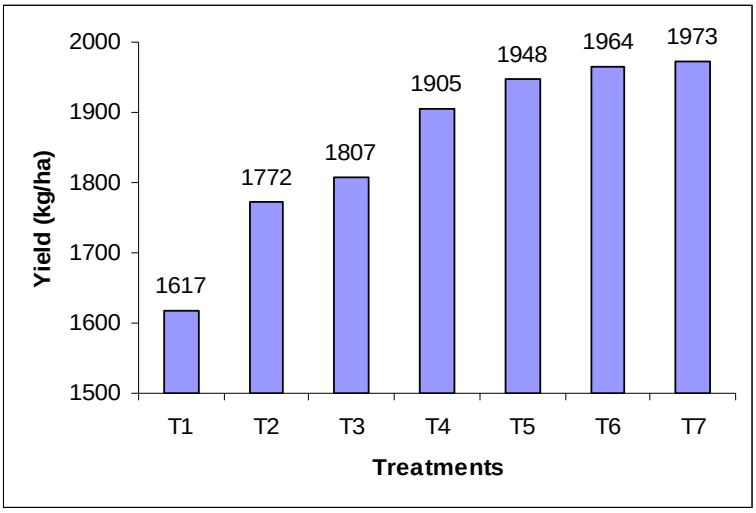

Fig-3: Effect of different fertilizer doses on the yield of tea (Srigobindpur T. E.)

Result shows, in Srigobindpur Tea Estate, increase of yield was recorded in every treatment over the Control. The highest yield i.e 1973 kg/ha made tea was recorded in treatment T_7 where N_{90}, P_{30}, K_{55}, and Zn_{10} were applied. The rate of increase over the Control was 22.02%. The statistical analysis shows that increase of yield due to different treatments was significant at 5% level

(F=3.24). Among the treatments T_7 is the best while T_6 and T_5 are the second and third ranking treatments. This experiment will be repeated in the year 2014 at SGPTE similar at BTRI Farm.

SS 3. Studies on performance of Zinc in different doses as foliar application (2012-2013)

To identify the efficiency of foliar application of zinc, a short term (2012-2013) field experiment was conducted at BTRI Farm. The experiment was laid out in a RBD having four treatments and three replications. Three times (June, August, October) foliar application were done during harvesting period. Each plot size was 37 m^2. Usual cultural operations and pest control measures were taken as and when needed. Regular weekly harvesting data were recorded during the harvesting season. Treatment combinations are as follows:

T_1 = Control, T_2 = 2 kg/ha, T_3 = 4 kg/ha, T_4 = 6 kg/ha

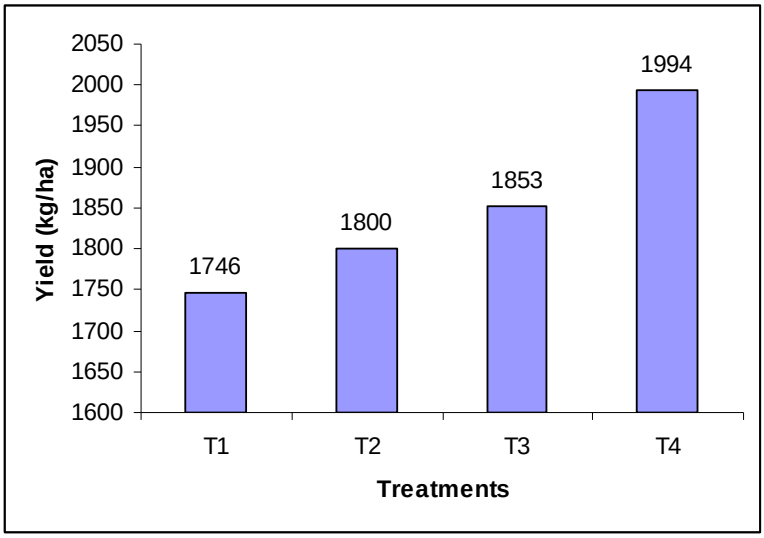

Fig-4: Effect of foliar application of zinc on the yield of tea

The result reveals that yield increased with the increase of Zn application. Treatment differences were highly significant. Highest yield (1994 kg/ha) was recorded in T_4 where zinc was applied at the rate of 6 kg/ha. The rate of increase was 14.20% over the Control. The experiment will not be repeated in the year 2014.

SS 4. Necessity of rehabilitation of old tea soil before replanting and its effect on growth and yield of tea (collaborative with Agronomy Division) (2013-2018)

The details of this experiment were presented by the Agronomy Division as it is a collaborative research program of Agronomy and Soil Science Division.

Advisory

The advisory work is comprised of analysis of soil, water, fertilizer, lime, compost, etc. collected or received from different Tea Estates. Soil samples were analyzed to find out their suitability for proposed new extension, replanting, rehabilitation and also to diagnose the cause of poor growth and/or failure of existing tea, to recommend appropriate fertilizer requirement and to study the

suitability of establishing seed or V.P nursery. During the year under report a total of 3346 soil samples and 121 other samples from 83 tea estates were analyzed.

Table 1. Number of samples analyzed

Year	Soil	Fertilizer	Lime / Dolomite	Water	Compost	Total (others)	(Soil & others)
2013	3346	95	26	-	-	121	3467

Table 2. List of Tea Estates from where soil and other samples were received or collected and analyzed during the year 2013

Amo	Chatlapore	Horincherra	Marina	Premnagar
Amtali	Dinarpur	Jhemai	Mertinga	Rema
Alladad	Deanston	Junglebari	Modonmohanpur	Rajkie
Ameenabad	Deundi	Kodala	New Samanbagh	Rashidpur
Amrail	Daragao	Kurma	Nahar	Rajghat
Asgarabad	Dauracherra	Kapnapahar	Nurjahan	Ramgarh
Asia	Doloi	Khan	New Dantmara	Ruthna
Allynugger	Etah	Kaiyacherra	Noyapara	Sabazpur
Burjan	Green field	Lallakhal	Nalua	Shumshernugger
Bidyabheel	Gazipore	Lalchand	Ootterbagh & Indanugger	Srigobindpur
Brindaban	Hossainabad	Lubacherra	Oodalia	Sathgao
Chandpore	Hatimara	Malnicherra	Phulbari	Sreepore
Clevedon	Hooglicherra	Madhupur	Phulcherra	Sreebari
Chandbagh	Hazinagar	Mazdehee	Pooteacherra	Saif
Chandicherra	Habibnagar	Mirzapore	Phooltullah	Surma
Clonal	Hamidia	Monipur	Patharia	
Teliapara	Udnacherra	Zareen	Parkul	

Advisory Correspondence

A total of 228 advisory letters to different Tea Estates on soil, fertilizers, dolomite, compost and other soil related aspects were sent during the year 2013.

Tours

During the year under report officers of the Division paid a total of 37 visits to different tea estates and other related places for experimental, advisory and official purposes.

Courses on Tea Culture

Comprehensive lectures on different aspects of soil management were presented by the scientific personnel of the Division at the annual course organized by BTRI for the covenanted staff of Tea Estate during the year 2013. Scientists of this Division also delivered lectures as resource speakers at the Management Training Centre (MTC) for Post Graduate Diploma Course organized by Project Development Unit (PDU) of Bangladesh Tea Board.

BIOCHEMISTRY DIVISION

Md. Imrul Hasan Chowdhury
Scientific Officer

STAFF

There was no change in the personnel position of the Division during the period under report.

RESEARCH

The procurement process of laboratory equipment was accomplished in the year 2013 and all the newly purchased equipment were successfully installed. The scheduled experiments of the Division could not be started as the installation of lab-equipment was going on. But the experiment in collaboration with the Technology Division is in progress. The progress of the experiment is summarized below.

Bio 1: Study on the effect of different physical leaf composition on the tea quality and its grade percentage.

Progress:

a. Highest quality of made tea from one bud and one leaf.
b. Lowest quality of made tea from one bud and three leaves.

Table 1. Scoring of tea quality parameter with leaf composition.

Sl. No	Leaf	Infused Leaf	Color	Strength	Briskness	Total	Average
1	One leaf & a bud	6.50	7.50	6.50	7.50	28.00	27.83
		7.00	7.00	6.50	7.50	28.00	
		6.50	6.50	7.50	7.00	27.50	
2	Two leaves & a bud	6.50	6.00	6.50	6.50	25.50	25.83
		7.00	6.50	6.00	6.00	25.50	
		6.00	7.50	6.00	7.50	26.50	
3	Three leaves & a bud	5.50	6.00	6.50	5.50	23.50	23.67
		6.00	5.50	5.50	6.00	23.00	
		5.50	6.00	6.00	6.50	24.00	

BOTANY DIVISION

Md. Ismail Hossain
Principal Scientific Officer

STAFF

Mr Md. Abdul Aziz, Senior Scientific Officer joined the Division on 1 April 2013 after completion of his deputation for Ph.D. course. Mr. Md. Abul Kashem joined the Division as Scientific Officer on 15 December, 2013. The posts of one Scientific Officer, one Field Assistant and one Laboratory Helper were vacant. There was no other change in the personnel position of the division during the period under report.

RESEARCH

Twenty three experiments in four programme areas namely - preliminary selection of vegetative clones, long term yield and quality trial of provisionally selected clones, tea breeding and field performances of BTRI released clones were carried out by the Division. Results of these experiments are briefly described below:

B1: PRELIMINARY SELECTION OF VEGETATIVE CLONES

B1-27: **Selection of Vegetative Clones at Shumshernugger T. E., Section Doublecherra-13 & Main Div. Sec. No. 9 (1993-2013).**

From the Estate, 19 new bushes were selected during the period under report besides previous selections. Newly selected bushes were pruned in order to collect cuttings. A total of 5234 cuttings from 28 selected bushes of section no. 9 Shumshernuggar Tea Estate were collected and put into the rooting trial.

B1-28: Selection of Vegetative Clones at Amo T. E., Section No. 8 (1993-2013).
Twenty four new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 4889 cuttings from 27 bushes of section no. 8 of Amo Tea Estate were collected and planted in the nursery.

B1-31: Selection of Vegetative Clones at Baraoorah T. E., Section No. 8 (2007-2013)

Twenty two bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 1722 cuttings from 13 bushes of section no. 8 of Baraoorah Tea Estate were collected and planted in the nursery.

B2: LONG TERM YIELD & QUALITY TRIAL OF PROVISIONALLY SELECTED CLONES

B2-35: Yield and Quality Trial of Test Clones Selected from Shumshernugger and Amo T. Es., Test Clones Sh/D/11/313, A/8/8, A/17/7 and A/22/39 against Control BT1 (BTRI, 1996-2013).

The plants of this trial were light skiffed at 83 cm in 2013. There were 30 plucking rounds in 2013. The yield data were analyzed and presented in Table-1 and made tea production in kg/ha in Fig.1.

Table 1. Yield of green leaves (g/plant)

Clone	Year	SH/D/11/313	A/8/8	A/17/7	A/22/39	TV1
Treatment mean	2013	1175	1178	1248	1158	1090

Treatment difference: Insignificant

The statistical analyses reveal that all the Test clones are comparable in the case of yield with the Control TV1. The estimated Made tea production in Kg/ha is presented in Fig.1. The cup qualities of all the Test clones were assessed through organoleptically and the average values of the scores are presented in Table 2.

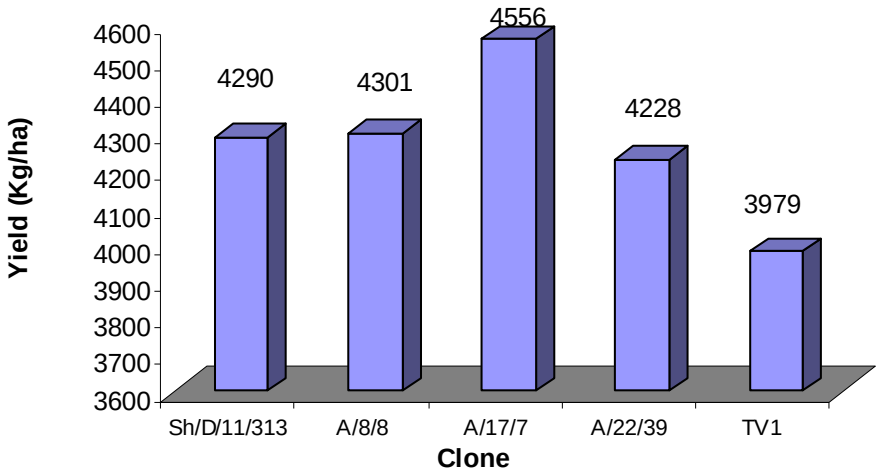

Fig. 1. Comparative yield of the clones (made tea kg/ha)

Table 2. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
SH/D/11/313	7.36	7.71	7.35	7.39	2.77	32.58	AA
A/8/8	7.51	7.59	7.28	7.36	2.81	32.55	AA
A/17/7	7.55	7.71	7.45	7.35	2.83	32.89	AA
A/22/39	7.47	7.56	7.38	7.42	2.77	32.60	AA
TV1	7.71	7.80	7.71	7.86	3.08	34.16	E

The Test clones are above average while the Control is excellent in terms of quality.

B2-36: Yield and Quality Trial of Test Clones Selected from Amo T. E. Test Clones A/8/01, A/17/22, A/22/27 and A/22/40 against Control BT1 (BTRI, 1996-2013).

The plants of this trial were light skiffed at 83 cm in 2013. There were 30 plucking rounds in 2013. The yield data were analyzed and presented in Table-3 and the estimated made tea production in kg/ha in Fig. 2.

Table 3. Yield of green leaves (g/plant)

Clone	Year	A/8/01	A/17/22	A/22/27	A/22/40	BT1
Treatment mean	2013	1005.2	942.5	986.9	1001.5	888.2

Treatment difference: LSD at 5% =98.87

The analytical results reveal that yield difference was significant in 2013; Test clones A/8/01 and A/22/40 gave significantly higher yield over the control BT1 while Test clone A/17/22 and A/22/27 yielded similar with the Control. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 4.

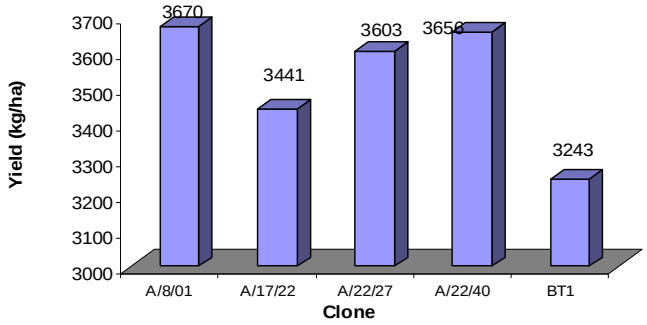

Fig. 2. Comparative yield of the clones (made tea kg/ha)

Table 4. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/01	7.31	7.19	7.13	7.39	2.82	31.84	A
A/17/22	7.41	7.52	7.31	7.53	2.71	32.48	AA
A/22/27	7.59	7.51	7.41	7.29	2.81	32.61	AA
A/22/40	7.38	7.58	7.43	7.29	2.89	32.57	AA
BT1	7.62	7.68	7.51	7.42	2.91	33.14	AA

All the test clones excepting A/8/01 were comparable with the control BT1 in case of quality while test clone A/8/01 was inferior in cup than the control.

B2-38: Yield and Quality Trial of Test Clones Selected from Chandpore, Shumshernugger and Amo T. Es.; Test Clones C/J1/10, Sh/B/6/59, Sh/B/6/62 and A/8/24 against Control BT2 (BTRI, 1997-2013).

The plants of this trial were medium skiffed at 78 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table-5 and Made tea production in kg/ha is presented in Fig. 3.

Table 5. Yield of green leaves (g/plant)

Clone	Year	CHA/J1/10	Sh/B/6/59	Sh/B/6/62	A/8/24	BT2
Treatment mean	2013	880.9	915.3	863.5	1271.0	812.5

Treatment difference: LSD at 5% = 168.7

The analytical results reveal that yield difference was significant in 2013; test clones A/8/24 gave significantly higher yield over the Control BT2 but the test clone Sh/B/6/59, Sh/B/6/62 and CHA/J1/10 gave similar yield with the Control BT2. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 6.

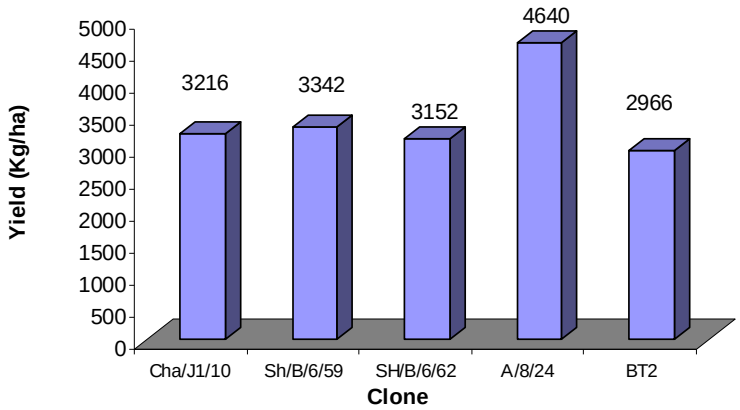

Fig. 3. Comparative yield of the clones (made tea kg/ha)

Table 6. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
CHA/J1/10	7.48	7.45	7.39	7.41	2.82	32.55	AA
Sh/B/6/59	7.37	7.65	7.28	7.55	2.77	32.62	AA
Sh/B/6/62	7.43	7.54	7.86	7.74	2.89	33.46	AA
A/8/24	7.41	7.24	7.51	7.22	2.71	32.09	AA
BT2	7.46	7.71	7.38	7.23	2.92	32.70	AA

All the Test clones have got comparable cup quality with Test clone BT2 excepting the Test clones unique flavoury character.

B2-39: Yield and Quality Trial of Four Test Clones Selected from Shumshernugger T.E.; Test Clones Sh/B/6/36, Sh/B/6/38, Sh/B/6/55 and Sh/B/6/67 against Standard BT1 (BTRI, 1998-2014).

The plants of this trial were deep skiffed at 74 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table 7 and the estimated made tea production in kg/ha in Fig. 4.

Table 7. Yield of green leaves (g/plant)

Clone	Year	Sh/B/6/36	Sh/B/6/38	Sh/B/6/55	Sh/B/6/67	BT1
Treatment mean	2013	901.0	937.7	1071.0	1001.0	930

Treatment difference: Insignificant

The analytical results reveal that all the Test clones are comparable in terms of yield. The cup quality of Made tea for all the Test clones was assessed organoleptically and average scores are presented in Table 8.

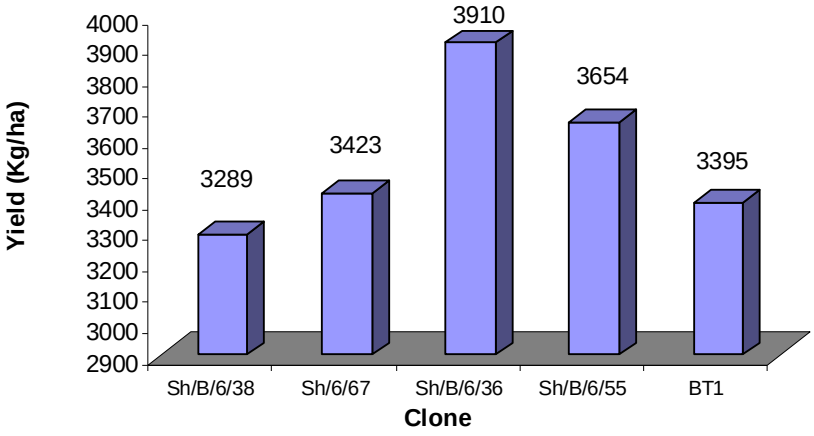

Fig. 4 Comparative yield of the clones (made tea kg/ha)

Table 8. Quality scores (average of one year)

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/B/6/36	7.44	7.27	7.51	7.11	2.79	32.12	AA
Sh/B/6/38	7.46	7.28	7.59	7.68	2.91	32.92	AA
Sh/B/6/55	7.34	7.11	7.25	7.22	2.68	31.60	A
Sh/B/6/67	7.57	7.56	7.32	7.33	2.87	32.65	AA
BT1	7.42	7.41	7.39	7.58	2.91	32.71	AA

All the Test clones excepting Sh/B/6/55 were comparable in cup with the Control BT1. Test clone Sh/B/6/55 was inferior to the control BT1 in case of cup quality.

B2-40: Yield and Quality Trial of Six Test Clones – MZ/39, E/4, D/13, B2T1, BR2/97 and SDL/1 against Standard BT2 (BTRI, 2000-2013).

The plants of this trial were light skiffed at 79 cm in 2013. There were 30 plucking rounds in 2013. The yield data were analyzed and presented in Table 9 and the estimated Made tea production in kg/ha in Fig. 5.

Table 9. Yield of green leaves (g/plant)

Clone	Year	MZ/39	E/4	D/13	B2T1	BR2/97	SDL/1	BT2
Treatment mean	2013	1259.44	874.46	892.86	1068.89	975.63	1100.07	1149.33

Treatment difference: LSD at 5% =188.2

The analytical results reveal that yield difference was significant in 2013. The yield potential of the Test clones MZ/39, SDL/1, B2T1 and BR2/97 are comparable with the Control BT2 while the rest of the Test clones performed lower yield than the control. The cup quality of Made tea for all the Test clones were assessed through organoleptic test and the average scores are presented in Table 10.

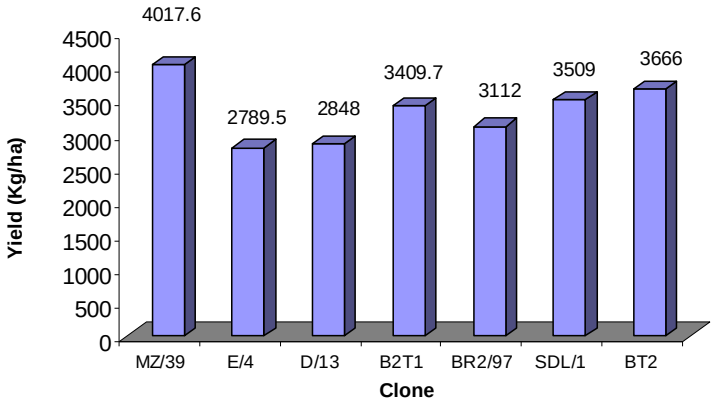

Fig. 5 Comparative yield of the clones (made tea kg/ha)

Table 10. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
MZ/39	7.55	7.47	7.49	7.65	2.71	32.87	AA
E/4	7.64	7.87	7.36	7.42	2.58	32.87	AA
D/13	7.75	7.69	7.34	7.63	2.78	33.19	AA
B2T1	7.33	7.55	7.24	7.49	2.72	32.33	AA
BR2/97	7.57	7.52	7.51	7.32	2.78	32.70	AA
SDL/1	7.51	7.59	7.36	7.31	2.79	32.56	AA
BT2	7.43	7.62	7.43	7.21	2.68	32.12	AA

All the Test clones were comparable in cup with the Control BT2. However, the unique flavoury character of BT2 was not considered in case of assessing cup quality.

B2-41: Yield and Quality Trial of Four Test Clones Selected from Amo T. E.; Test Clones – A/8/37, A/8/55, A/8/62 and A/8/66 against Standard BT2 (BTRI, 2000-2013).

The plants of this trial were light skiffed at 79 cm in 2013. There were 30 plucking rounds in 2013. The yield data were analyzed and presented in Table 11 and Made tea production in kg/ha in Fig. 6.

Table 11. Yield of green leaves (g/plant)

Clone	Year	A/8/37	A/8/55	A/8/62	A/8/66	BT2
Treatment mean	2013	1189.90	960.39	765	1118.71	1159.75

Treatment difference: LSD at 5% = 163.28

The analytical results reveal that yield difference was significant in 2013; the yield potential of the Test clones A/8/37 and A/8/66 were comparable to the Control BT2 while performances of remaining two were lower than the control. The cup qualities of Made tea for all the Test clones were assessed through organoleptic test. The average scores are presented in Table 12.

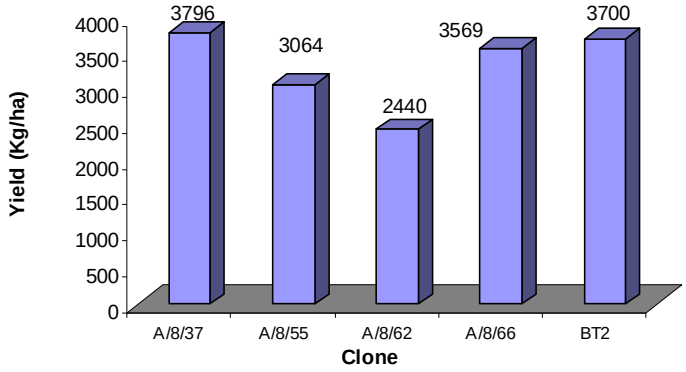

Fig. 6. Comparative yield of the clones (made tea kg/ha)

Table 12. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Brisknes s	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/37	7.56	7.53	7.76	7.65	2.92	33.42	AA
A/8/55	7.52	7.33	7.39	7.24	2.71	32.19	AA
A/8/62	7.11	7.23	7.49	7.12	2.61	31.56	A
A/8/66	7.65	7.76	7.52	7.49	2.79	33.21	AA
BT2	7.51	7.49	7.42	7.26	2.56	32.24	AA

All the Test clones excepting A/8/62 were comparable in terms of cup quality while A/8/82 was found inferior to the control. The flavoury character of BT2 was not considered in case of assessing cup quality.

B2-42: Yield and Quality Trial of Four Test Clones Selected from Phulcherra, Amo and Shumshernugger T. Es.; Test Clones – A/17/16, Ph/9/1, Ph/9/9 and Sh/B/6/46 against Standard BT1 (BTRI, 2001-2013).

The plants of this trial were medium skiffed at 76 cm in 2013. There were 30 plucking rounds in 2013. The yield data were analyzed and presented in Table 13 and Made tea production in kg/ha in Fig. 7.

Table 13. Yield of green leaves (g/plant)

Clone	Year	A/17/16	Ph/9/1	Ph/9/9	Sh/B/6/46	BT1
Treatment mean	2013	936.04	715.83	887.11	799.87	870.71

Treatment difference: Insignificant

The analytical results reveal that yield difference was not significant in 2013; all the Test clones were comparable in terms of yield with the Control BT1. The cup qualities of Made tea for all the Test clones were assessed organoleptically and the average scores are shown in Table 14.

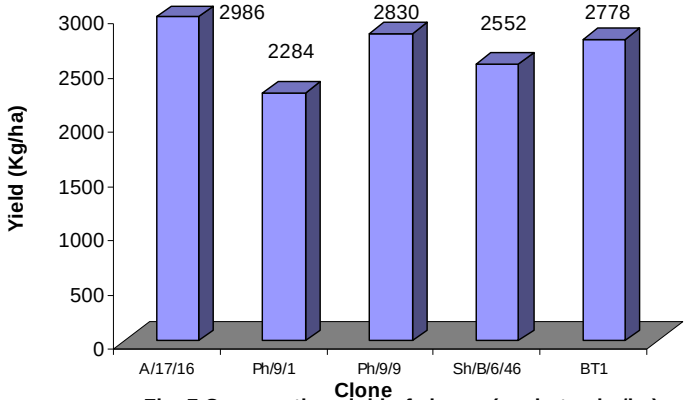

Fig. 7. Comparative yield of the clones (made tea kg/ha)

Table 14. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/17/16	7.57	7.61	7.52	7.49	2.78	32.97	AA
Ph/9/1	7.14	7.19	7.11	7.09	2.51	31.04	A
Ph/9/9	7.42	7.42	7.45	7.51	2.54	32.34	AA
Sh/B/6/46	7.62	7.51	7.48	7.43	2.82	32.86	AA
BT1	7.55	7.66	7.72	7.35	2.83	33.11	AA

All the Test clones excepting Ph/9/1 were comparable in cup with the Control. The Test clone Ph/9/1 was found inferior to the control BT1.

B2-43: Yield and Quality Trial of Four Test Clones Selected from Phulcherra and Hybrid Progeny; Test Clones– Ph/9/4, Ph/9/25, Ph/9/40 and BS/67 against Standard BT5 (BTRI, 2001-2013).

The plants of this trial were medium skiffed at 76 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table 15 and Made tea production in kg/ha in Fig. 8.

Table 15. Yield of green leaves (g/plant)

Clone	Year	Ph/9/4	Ph/9/25	Ph/9/40	BS/67	BT5
Treatment mean	2013	1062.56	841.09	1025.00	977.78	1067.15

Treatment difference: LSD at 5% =159.11

The statistical results reveal that all the test clones excepting Ph/9/25 are comparable in terms of yield with the control. The yield performance of Test clone Ph/9/25 was lower than the control BT5. The cup qualities of Made tea for all the Test clones were assessed through organoleptic test. The average scores are presented in Table 16.

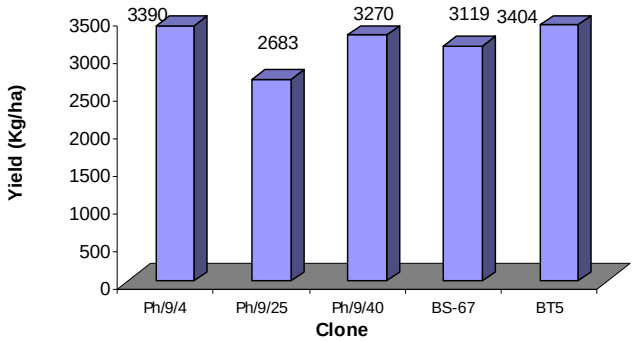

Fig. 8. Comparative yield of the clones (made tea kg/ha)

Table 16. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/4	7.23	7.19	7.56	7.39	2.79	32.16	AA
Ph/9/25	7.39	7.48	7.57	7.46	2.46	32.36	AA
Ph/9/40	7.12	7.09	7.21	7.11	2.53	31.06	A
BS/67	7.46	7.56	7.58	7.62	2.78	33.00	AA
BT5	7.49	.41	7.44	7.39	2.82	32.55	AA

All the Test clones were comparable in terms of cup quality with the Control BT5 excepting Ph/9/40 which was inferior to the Control.

B2-44: Yield and Quality Trial of Three Test Clones Selected from Amo and Phulcherra T. Es.; Test Clones– A/8B/1, Ph/9B/1, Ph/9/11 and against Standard BT1 (BTRI, 2003-2013).

The plants of this trial were light pruned at 58 cm in 2013. There were 27 plucking rounds in 2013. The yield data were analyzed and presented in Table 17 and Made tea production in kg/ha in Fig.9.

Table 17. Yield of green leaves (g/plant)

Clone	Year	A/8/B/1	Ph/9/B/1	Ph/9/11	BT1
Treatment mean	2013	772.3	1108.0	1020.0	834.0

Treatment difference: 2013- LSD at 5% =194.5

The analytical results reveal that yield difference was significant in 2013. All the Test clones excepting Ph/9/B/1 were comparable in terms of yield with the Control BT1. Test clone Ph/9/B/1 was significantly high yield over the Control BT1. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 18.

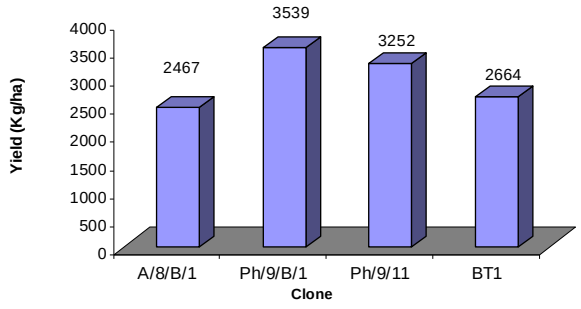

Fig. 9. Comparative yield of the clones (made tea kg/ha)

Table 18. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/B/1	7.26	7.18	7.05	7.11	2.28	30.88	A
Ph/9/B/1	7.37	7.46	7.34	7.21	2.81	32.19	AA
Ph/9/11	7.25	7.41	7.29	7.33	2.91	32.19	AA
BT1	7.68	7.56	7.37	7.51	2.83	32.95	AA

All the Test clones were comparable in terms of cup quality with the Control BT1 excepting A/8/B/1 which was average in cup.

B2-45: Yield and Quality Trial of Three Test Clones Selected from Amo, Phulcherra and Shumshernugger T. Es.; Test Clones- A/8/61, Ph/9/68A, Sh/D/11/18 (retrial from Expt. B2-26) and One Introduced Clone SC/12/28 against Standard BT2 (BTRI, 2005-2015).

The plants of this trial were medium skiffed at 71 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table-19 and Made tea production in kg/ha in Fig. 10.

Table 19. Yield of green leaves (g/plant)

Clone	Year	Ph/9/68A	Sh/D/11/18	A/8/61	SC/12/28	BT2
Treatment mean	2013	747.5	628.8	748.5	795.7	772.3

Treatment difference: Insignificant

The analytical results reveal that yield difference was not significant in 2013; all the Test clones A/8/61, SC/12/28, Sh/D/11/18 and Ph/9/68A gave similar yield with the Control BT2. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 20.

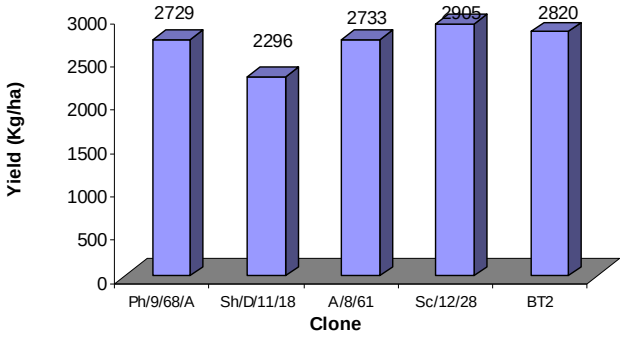

Fig. 10. Comparative yield of the clones (made tea kg/ha)

Table 20. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/61	7.51	7.28	7.49	7.38	2.87	32.53	AA
Ph/9/68A	7.36	7.35	7.54	7.52	2.76	32.53	AA
Sh/D/11/18	7.43	7.36	7.57	7.46	2.78	32.60	AA
SC/12/28	7.13	7.11	7.23	7.18	2.73	31.38	A
BT2	7.47	7.58	7.48	7.56	2.81	32.90	AA

All the Test clones excepting SC/12/28 were comparable in cup. The Test clone SC/12/28 was inferior than the Control in terms of cup quality. However, the flavoury character of BT2 was not considered in the case of assessing cup quality.

B2-46: Yield and Quality Trial of Four Test Clones Selected from BTRI Farm (Dulia Section); Test Clones – D1/8, D/6, D/10 and D/12 against Standard BT5 (BTRI, 2005-2015).

The plants of this trial were medium skiffed at 71 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table-21 and Made tea production in kg/ha in Fig. 11.

Table 21. Yield of green leaves (g/plant)

Clone	Year	D1/8	D/6	D/10	D/12	BT5
Treatment mean	2013	827.9	760.5	801.3	799.1	861.5

Treatment difference: Insignificant

The analytical results reveal that yield difference was not significant in 2013; all the Test clones gave similar yields with the Control BT5. The cup quality of Made tea for all the test clones was assessed through organoleptic test. The average scores are shown in Table 22.

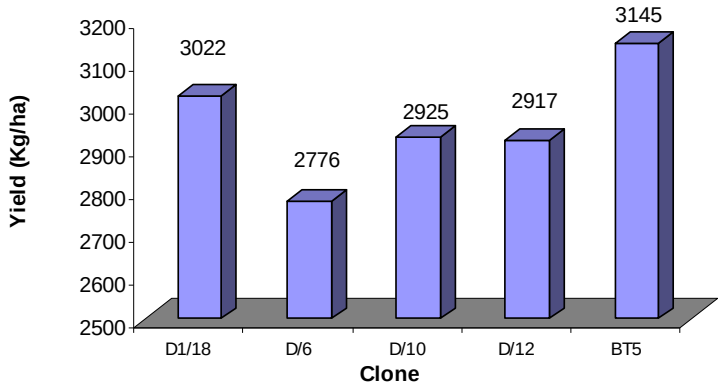

Fig. 11. Comparative yield of the clones (made tea kg/ha)

Table 22. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
D1/8	7.21	7.23	7.11	7.54	2.65	31.74	A
D/6	7.43	7.29	7.22	7.13	2.96	32.03	AA
D/10	7.26	7.45	7.45	7.21	2.76	32.13	AA
D/12	7.05	7.21	7.16	7.13	2.71	31.26	A
BT5	7.41	7.65	7.75	7.41	2.82	32.94	AA

Test clones D/6 and D/10 are comparable with the Control while the remaining two are inferior to the Control.

B2-47: Yield and Quality Trial of Four Test Clones Selected from Phulcherra T. E. and BTRI Germplasm Bank; Test Clones-Ph/9/92, BS/3, Ph/9/108 and G/61/8 against Standard BT15 (BTRI, 2006-2016).

The plants of this trial were deep skiffed at 66 cm in 2013. There were 27 plucking rounds in 2013. The yield data were analyzed and presented in Table-23 and Made tea production in kg/ha in Fig. 12.

Table 23. Yield of green leaves (g/plant)

Clone	Year	Ph/9/92	BS/3	Ph/9/108	G/61/8	BT15
Treatment mean	2013	687.5	534.2	532.5	606.6	440.5

Treatment difference: Insignificant

The analytical results reveal that yield difference was not significant in 2013. The performances of all the Test clones similar with the control BT15. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 24.

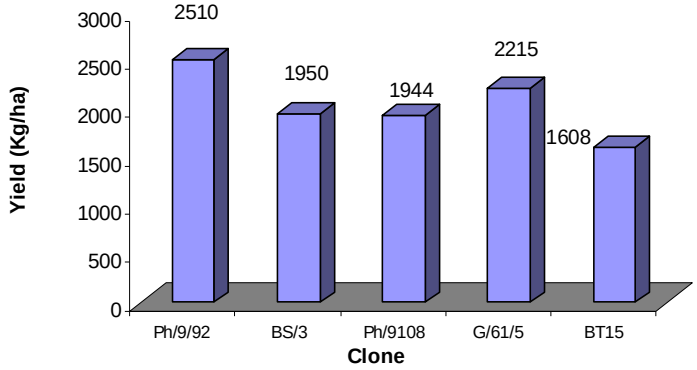

Fig. 12. Comparative yield of the clones (made tea kg/ha)

Table 24. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/92	7.33	7.46	7.45	7.56	2.79	32.59	AA
BS/3	7.54	7.43	7.46	7.56	2.19	32.18	AA
Ph/9/108	7.55	7.61	7.45	7.56	2.76	32.93	AA
G/61/5	7.52	7.45	7.34	7.56	2.79	32.66	AA
BT15	7.42	7.56	7.76	7.34	2.94	33.02	AA

All the test clones were comparable in terms of cup quality with the Control BT15.

B2-48: Yield and Quality Trial of Four Test Clones Selected from Shumshernugger and Amo T. Es. Test Clones – A/8/124, Sh/10/2, A/8/125 A/11/38 against Standard BT2 (BTRI, 2009-2019).

The plants of this trial were skiffed at 71cm in 2013. There were 22 plucking rounds in 2013. The yield data were analyzed and presented in Table-25 and Made tea production in kg/ha in Fig. 13.

Table 25. Yield of green leaves (g/plant)

Clone	Year	A/8/124	Sh/10/2	A/8/125	A/11/38	BT2
Treatment mean	2013	450.6	489.89	408.8	550.4	470.7

Treatment difference: Insignificant

The analytical results reveal that yield difference was not significant in 2013. All the Test clones gave similar yield with the Control BT2. The cup quality of Made tea for all the Test clones was assessed through organoleptic test. The average scores are shown in Table 26.

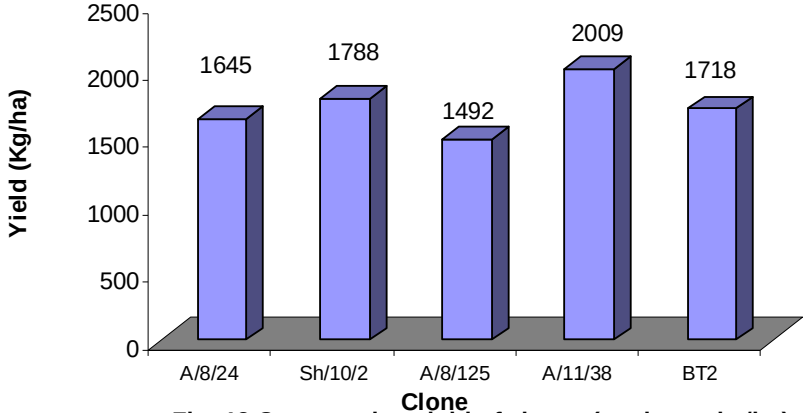

Fig. 13. Comparative yield of the clones (made tea kg/ha)

Table 26. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/124	7.34	7.37	7.35	7.89	2.70	32.65	AA
Sh/10/2	7.38	7.41	7.36	7.31	2.77	32.23	AA
A/8/125	7.49	7.73	7.56	7.36	2.78	32.92	AA
A/11/38	7.46	7.45	7.37	7.24	2.76	32.28	AA
BT2	7.56	7.34	7.34	7.46	2.81	32.51	AA

All the Test clones were similar in respect of cup quality. However, the flavoury character of BT2 was not considered in case of assessing cup quality.

B2-49: Yield and Quality Trial of Four Test Clones Selected from Shumshernugger T.E.(Sh/10/5, Sh/D/13/4and Amo T. Es. Test Clones – A/8/128, BS/91/6, against Standard BT2 (BTRI, 2011-2019).

The experiment was initiated in May 2011 at BTRI Farm under Latin Sqaure Design with 105cm x 60cm spacing. Normal cultural practices were followed. The plants were skiffed at 50cm in January 2013 and tipping were done at 55 cm.

B) Programme Area B3: *No. of Experiments - 5*
Breeding of Tea:

B3-1.1: Controlled Pollination between Selected Clones/Agrotypes and Selection of Generative Clones for the Establishment of Clonal Seed Reserve (1964-).

Hybridization between the following clone pairs were done in order to identify new biclonal combinations for hybrid seed production as well as to select vegetative clones from the progenies.

Hybridization between the following parents was done in 2013:

BT4 X TV23, TV23 X BT4, BT6 X TV23, TV23 X BT6, BR2/55 X BT2, Ph/9/14 X TV1, BT1 X BT2, TV18 X BT2, Harin X TV23, Lal2 X TV23, TS450 X TV1, SI-1 X TV1, Lal-2 X TV1

Back Cross (1) TV1 X BT2, X TV1, (2) BT1 X AN1, X BT1, TV19 X BT2, X BT2

The plants raised from earlier crosses are being preserved in Germplasm Bank. Yield, quality and other performance criteria of the progeny are being recorded.

B3-1.5: Establishment of a Biclonal Seedbarie with Clones TV18 and BT3.

Seedlings from the stock are being observed in the trial plots. Seeds are being collected and distributed to the Tea Estates.

Seedbarie (B3-1.5) comprising TV18 and BT3 have been kept under observation. Comparative yield and quality potential of the hybrid progeny (TV 18 and BT3) are being assessed against other standard biclonal seeds (B3-1.8 & B3-1.9).

B3-1.8: Comparative Yield and Quality Trial of BTRI Released Biclonal Stock BTS1, Biclonal Stock T18B3, Allynugger Polyclonal Stock (ANPS), Phulbari General Seed Stock (PBS) and Clone BT1 (BTRI, 1999-2013).

The plants of this trial were deep skiffed at 74cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table-27.

Table 27. Yield of green leaves (g/plant)

Clone	Year	BT1	BTS1	PBS	ANPS	T18B3
Treatment mean	2013	897.98	977.58	870.39	897.68	1060.94

Treatment difference: Insignificant

The analytical results reveal that there was no significant yield difference between the biclonal seed stocks and the control. All the biclonal stocks were comparable with the Control BT1. Estimated Made tea production in kg/ha is presented in Fig. 14. The cup quality of Made tea for all the treatments was assessed through organoleptic test. The average scores are shown in Table 28.

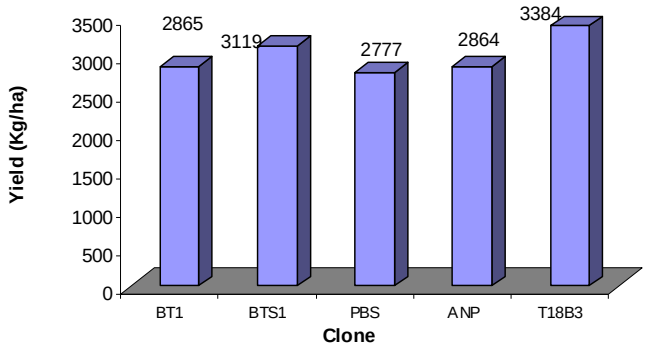

Fig. 14. Comparative yield of the clones (made tea kg/ha)

Table 28. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT1	7.45	7.66	7.39	7.69	2.84	33.03	AA
BTS1	7.44	7.53	7.67	7.35	2.88	32.87	AA
PBS	7.11	7.16	7.23	7.31	2.87	31.68	A
ANPS	7.56	7.63	7.31	7.47	2.89	32.86	A
T18B3	7.66	7.65	7.57	7.55	2.84	33.27	AA

The biclonal stock BTS1 and T18B3 are comparable in cup with the Control BT1 while the remaining two are inferior to the control.

B3-1.9: Comparative Trial of 4 Biclonal Seed Stocks (BTS1, BTS3, TV18 × BT3 & TS463) and 3 Parental Clones (BT1, TV1 & TV19) (2002-2013).

The plants of this trial were deep skiffed at 68 cm in 2013. There were 28 plucking rounds in 2013. The yield data were analyzed and presented in Table-29.

Table 29. Yield of green leaves (g/plant)

Clone	Year	BTS1	BTS3	TV18 × BT3	TS463	BT1	TV1	TV19
Treatment mean	2013	902.2	1011	927.4	1079	966.5	1049	1105

Treatment difference: 2013- Insignificant

The statistical results reveal that there was no significant yield difference between the seedling jats. All the biclonal progenies were comparable with the parent-lines. Estimated Made tea production is presented in Fig. 15. The cup quality of Made tea for all the treatments was assessed through organoleptic test.

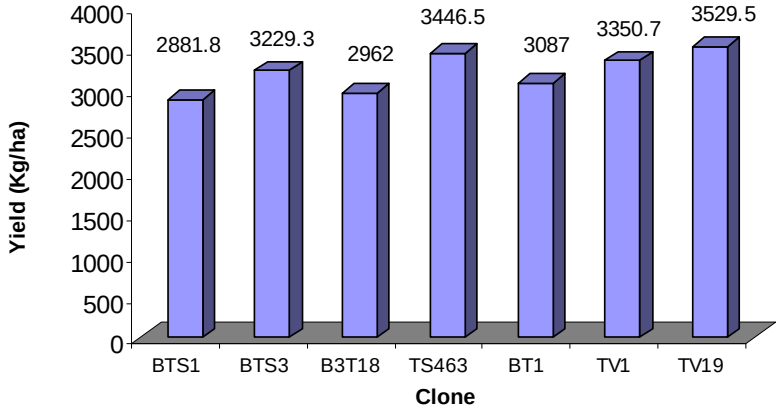

Fig. 15. Comparative yield of the clones (made tea kg/ha)

Table 30. Quality scores (average of one year).

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.32	7.61	7.49	7.61	2.93	32.96	AA
BTS3	7.34	7.15	7.12	7.51	2.69	31.81	A
TV18 × BT3	7.43	7.39	7.18	7.59	2.76	32.36	AA
TS463	7.61	7.38	7.42	7.34	2.78	32.53	AA
BT1	7.29	7.35	7.34	7.45	2.79	32.22	AA
TV1	7.51	7.31	7.53	7.61	2.89	32.85	AA
TV19	7.39	7.32	7.51	7.47	2.79	32.48	AA

In all the treatments excepting BTS3 the cup qualities were "Above Average" while BTS3 was just "Average".

B3-8: Survey and Conservation of Gene Resources of Tea in Bangladesh (BTRI, 1981-)

A total of 516 tea germplasm has been maintained (*ex-situ* conservation) in the Germplasm Bank in order to use in future for varietal improvement.

TOURS

During 2013 Principal Scientific Officer and Senior Scientific Officer of the Division paid visits to different Tea Estates and other related places for the experimental, advisory and official purposes, which are summarized below:

Year	Experimental	Advisory	Others	Total
2013	16	6	-	22

COURSES ON TEA CULTURE

Principal Scientific Officer of the Division gave comprehensive lectures and practical demonstration on the method of tea improvement, clonal identification, establishment of biclonal seedbaries and NCP, tea tasting, nursery management, etc. at the 48th Annual Course arranged at BTRI for the covenanted staff of Tea Estates. Principal Scientific Officer also gave lectures on tea improvement and nursery management in the Annual Courses held at Fatickcharri and at Panchagarh Sub-stations. He delivered lectures as resource speaker at the Management Training Center (MTC) for the Post-Graduate Diploma course and Tea Production Course organized by Project Development Unit (PDU) of Bangladesh Tea Board.

TEA TASTING SESSIONS

There were five tea tasting sessions organized in 2013 under the supervision of the Division. Representatives from tea broking houses and tea planters from different Tea Estates participated in the sessions. Summary of the tea tasting sessions are tabulated below:

Table 31. Tea Tasting Sessions: 2013

Open day/Valley Tea Tasting Sessions	Date	Venue	No. of Estate participated	No. of participants
1. BTRI	06.07.13	BTRI	65	85
2. Lungla Valley	23.08.13	Oottarbhag Tea Factory	10	24
3. Juri Valley	31.08.13	Juri Valley Club	16	23
4. BTRI Sub-station Oodaleah	08.09.13	BTRI Sub-station Oodaleah	12	24
5. North Sylhet Valley	14.09.13	Lackkatoorah Golf Club	10	14

AGRONOMY DIVISION

S.M. Altaf Hossain

Chief Scientific Officer
Department of Crop Production

STAFF

The posts of Principal Scientific Officer, Scientific Officer and Field Assistant were lying vacant during the period under report. During the year Mr. Mohammad Masud Rana (S.S.O) is on study leave from the month of September for higher studies leading to PhD in China. And Mr. Toufiq Ahmed, Senior Scientific Officer is still on study leave to complete his PhD from the University of Peradeniya, Sri Lanka.

RESEARCH

The Division carried out five long-term experiments during the reporting year under two research programme areas, namely- Standardization of cultural practices and Development of soil fertility. Results on the basis of collected data are briefly discussed below:

Programme area: *Standardization of Cultural Practices*
Long Term: 3, Short Term: 1
Ag 9.4-8c: Effect of different pruning cycles on the yield of mature clonal tea BT1, BT2, BT5, BT11, BT12 and BT13 (BTRI Farm, Long term: 2010-2023)

Objectives of the study:

- To find out appropriate pruning cycle for the specific clones/bush architecture.

Treatments:

T_1 : LP -DS-MS
T_2 : LP -DS-MS-LS
T_3 : LP -LS -DS-MS
T_4 : LP -LS -DS-MS -DS-LS
T_5 : LP -DS-MS-LS -DS-MS-LS

Planting materials: The clones BT1, BT2, BT5, BT11, BT12 and BT13 were used in the experiment. The experiment was laid out in a Split Plot Design with three replications and total number of plots under the experiment is 45.

The plants were pruned according to the combination of pruning of the treatments. Yield data were recorded at weekly interval. Yields obtained from the treatments in the year 2010 to 2013 are presented in the Tables 1 and 2. It was observed that yield was increasing gradually with advancement of age of plants for all clones. It is seen that BT1, BT2, BT5 and BT13 produced insignificant higher yield in the treatment 1 (T1). In case of BT11 and BT12 highest yields were obtained in T2 and T5 respectively. However, before finishing a couple of pruning cycles of all treatments, it is premature to make any comment. The experiment is continued.

Table 1. Yearly yield (kg/ha) of different clones in different treatments from 2010 – 2013

Treatment	Year	Made tea (kg/ha) of different clones					
		BT1	BT2	BT5	BT11	BT12	BT13
T1	2010	2955	3052	2973	2732	2811	2991
	2011	2462	2337	2533	2401	2582	2523
	2012	3274	3272	3103	3480	3249	3259
	2013	3756	3825	4038	3004	2786	3475
	Mean	3111.75	3121.50	**3161.75**	2904.25	2857.00	3062.00
T2	2010	3158	2736	3063	2866	2968	2748
	2011	2278	2391	2377	2306	2111	2245
	2012	2935	2921	2787	2931	3061	3148
	2013	3592	3584	4001	3720	3649	3844
	Mean	2990.75	2908.00	**3057.00**	2955.75	2947.25	2996.25
T3	2010	3018	2988	3032	2941	3026	2973
	2011	2203	2227	2195	2193	2211	2168
	2012	2882	2910	2947	2921	2825	3115
	2013	3495	3583	3773	3535	3781	3696
	Mean	2899.50	**2987.00**	**2987.75**	2897.50	2960.75	**2988.00**
T4	2010	2700	2574	2629	2493	2456	2968
	2011	2028	2119	2093	2231	2241	1925
	2012	2750	2882	2775	2919	2797	2953
	2013	3943	3836	4092	3878	3888	3903
	Mean	2855.25	2852.75	2897.25	2880.25	2845.50	**2937.25**
T5	2010	2923	3178	3107	2973	3286	2931
	2011	2030	2059	1969	1941	2119	2001
	2012	3069	2957	3083	2900	2945	2955
	2013	3855	4026	4223	3872	3915	4156
	Mean	2969.25	3055.00	**3095.50**	2921.50	3066.25	3010.75

Table 2. 4 years mean yield in kg/ha at different treatments and clones

Treatment	BT1	BT2	BT5	BT11	BT12	BT13
T_1 (LP-DS-MS)	3111.75	3121.50	**3161.75**	2904.25	2857.00	3062.00
T_2 (LP-DS-MS-LS)	2990.75	2908.00	3057.00	**2955.75**	2947.25	2996.25
T_3 (LP-LS-DS-MS)	2899.50	2987.00	2987.75	2897.50	2960.75	**2988.00**
T_4 (LP-LS-DS-MS-DS-LS)	2855.25	2852.75	2897.25	2880.25	2845.50	**2937.25**
T_5 (LP-DS-MS-LS- DS-MS-LS	2969.25	3055.00	**3095.50**	2921.50	3066.25	3010.75
Clone wise mean yield	2965.30	2984.85	**3039.85**	2911.85	2935.35	2998.85

Ag. 12.2b: Management of shade plant canopy for sustainable tea production in Bangladesh (BTRI Farm, Long term: 2011-2017)

Objectives of the study:

- To find out suitable shade canopy management practices for sustainable production.

Treatments:

T_1: Control (normal practice)
T_2: Pruning at 2 meter height
T_3: Pruning at 2 and 3 meter height (in the consecutive years)
T_4: Pruning at 2, 3 and 4 meter height (in the consecutive years)
T_5: Pruning at 2, 3, 4 and 5 meter height (in the consecutive years)

Parameters to be studied:

a) Canopy size of shade trees
b) No. of effective branches of shade trees
c) Base diameter of shade trees
d) Yield data of tea (green leaf in kg/ha)

The experiment was laid out at BTRI farm with *Albizia odoratissima* as shade tree. Increment of canopy coverage in the pruned shade plants was encouraging but in the treatments T4 and T5 pruning operations are not yet completed. The experiment is continued. The recorded data are presented in table-3 and table-4.

Table 3. Treatment wise canopy measurement (spreading m^2) of shade tree in 2013

Treatment	Area coverage m^2 of replicated shade plant			Mean area coverage m^2
	R1	R2	R3	
T1	3.01	2.95	2.92	2.96
T2	3.35	3.95	4.52	3.94
T3	4.05	5.62	4.82	4.83
T4	4.14	5.50	4.22	4.62
T5	5.19	4.69	5.33	**5.07**

Table 4. Comparative increase of canopy in different years at different treatments

Treatment	Comparative increase of canopy in different years (m^2)			Rate of increase	
	2011	2012	2013	Initial to 1st year	1st year to 2nd year
T1	0.64	1.037	2.96	1.62	2.85
T2	0.77	1.125	3.94	1.46	3.50
T3	0.77	1.267	4.83	1.65	3.81
T4	0.66	0.985	4.62	1.49	**4.69**
T5	0.89	1.556	5.07	1.75	3.26

Ag 12.2c: Effect of some exotic plants on tea soil, water and yield of tea (BTRI Farm, Long Term: 2011-2018)

Objectives of the study:

- To observe the effect of Akashmoni, Mangium and Eucalyptus plantations on tea soil and water properties.
- To observe the effect of Akashmoni, Mangium and Eucalyptus plantations on the yield of tea.

Treatments:

T_1 : Only *Albizia odoratissima* within the tea plantation
T_2 : Only Akashmoni (*Acacia auriculiformis*) within the tea plantation
T_3 : Only Mangium (*Acacia mangium*) within the tea plantation
T_4 : Only Eucalyptus (*Eucalyptus camaldulensis*) within the tea plantation

The experiment was laid out in a Latin Square Design (LSD) with 4 replications and total number of plots under the experiment is 16.

The experiment was laid out within the main farm of BTRI. Sixteen plots were made according to the design of the experiment. Existing tea plants within the plots were of seedling type. Tree saplings were planted within the plots on 15 May 2011. Soil samples were collected and analyzed. Data are presented in Table- 5. No significant differences were observed. Plants which are used in the experiment as shade practically not used in the tea garden. Those plant species are well known as detrimental to tea plantation. So, the RSC members suggested to close the experiment. The experiment is discontinued.

Table 5. Soil analysis report 2013

Properties of soil	Critical Values	Treatment			
		T1 (control)	T2 (Akashmoni)	T3 (Mangium)	T4 (Eucalyptus)
Texture		SCL -75% SL – 25%	SCL– 50% SL-50%	SCL – 100%	SCL- 75% SL – 25%
PH	4.5–5.5	4.40	4.40	4.40	4.45
Organic carbon %	1%	1.04	1.06	1.04	1.01
Total Nitrogen %	0.1%	0.115	0.113	0.121	0.113
Available Phosphorus (ppm)	10 ppm	8.45	12.51	13.43	12.63
Available Potassium (ppm)	80 ppm	32.70	38.60	38.35	28.65
Available Calcium (ppm)	90 ppm	83.60	77.95	72.05	91.30
Available Magnasium(ppm)	25 ppm	23.20	20.60	18.25	24.20

Programme area: *Development of Soil Fertility*

Title: Necessity of rehabilitation of old tea soil for replanting and its effect on the growth and yield of tea.

Objectives of the study:

1. To observe the growth and yield of tea plants in the rehabilitated and non-rehabilitated soil.
2. To observe the time taken to canopy coverage of tea bushes in rehabilitated and non-rehabilitated soil.
3. To estimate the organic matter, lime and nutrient requirement in the case of non-rehabilitated soil.

Treatment: 4

T_1: Without rehabilitation and replanting (without additional organic matter)
T_2: Without rehabilitation and replanting with recommended organic matter
T_3: One year rehabilitation and replanting
T_4: Two years rehabilitation and replanting

Initial soil samples were collected and analyzed in BTRI soil Laboratory. On the basis of soil analysis report dolomite was applied to all the plots at the rate of 1000 kg/ha during the land preparation. Additional cow dung at the rate of 18000 kg/ha was added only in the plots under the treatment T2. The plots under T1 and T2 were planted (Planting date 2/7/2012) immediate after uprooting and preparation of land. Rest of the plots under T3 and T4 were planted with guatemala grass as rehabilitation crop. All other cultural practices remained same as normal practices.

At the end of 2013, soil samples were collected and analyzed. Base diameter/plant, number of brunches/plant initiated up to height of 25cm from ground level and mortality rate in treatments T1 and T2 were measured carefully and presented in the Tables 6. Strong base diameter and higher survival rate of the plants were observed in T2. Though observed number of branches was equal in both treatments, more weak branches were observed in the treatment T1. Analytical report of soil was shown in the Tables 7 and 8. There were no significant differences in the soil analysis reports of 2012-2013.

Table 6. **Recorded parameters of 2013**

Treatment	Parameters	Replications				Mean
		R1	R2	R3	R4	
T1	Base diameter(cm / plant)	1.34	1.34	1.18	1.12	1.25
	Number of branch / plant	4.40	3.8	4.40	5.20	4.45

	Mortality %	**62.00**	**66.00**	**60.00**	**76.00**	**66.00**
T2	**Base diameter(cm / plant)**	**1.26**	**1.68**	**1.74**	**1.44**	**1.53**
	Number of branch / plant	**4.80**	**4.60**	**4.40**	**4.00**	**4.45**
	Mortality %	**8.00**	**8.00**	**22.00**	**42.00**	**20.00**

Table 7. Initial soil sample analysis report 2012

Properties of soil	Critical Values	Treatment			
		T1	T2	T3	T4
Texture		SCL	SCL	SCL	SCL
PH	4.5 – 5.5	4.65	4.63	4.50	4.58
Organic carbon %	1%	1.21	1.21	1.21	1.19
Total Nitrogen %	0.1%	0.13	0.13	0.12	0.11
Available Phosphorus (ppm)	10 ppm	2.44	2.26	3.02	3.10
Available Potassium (ppm)	80 ppm	42.65	35.90	38.20	26.50
Available Calcium (ppm)	90 ppm	106.10	103.85	69.95	67.05
Available Magnasium(ppm)	25 ppm	18.60	22.30	14.60	10.95

Table 8. Soil sample analysis report for 2013

Properties of soil	Critical Values	Treatment			
		T1	T2	T3	T4
Texture		SCL	SCL	SCL	SCL
PH	4.5 – 5.5	4.55	4.48	4.45	4.48
Organic carbon %	1%	1.49	1.40	1.44	1.44
Total Nitrogen %	0.1%	0.16	0.12	0.14	0.12
Available Phosphorus (ppm)	10 ppm	1.78	1.64	1.34	1.76
Available Potassium (ppm)	80 ppm	40.15	35.60	37.20	26.90
Available Calcium (ppm)	90 ppm	105.20	101.25	68.32	66.00
Available Magnasium(ppm)	25 ppm	17.50	21.55	14.56	10.88

VISIT

Members of the Division paid 47 visits to different Tea Estates and places for experimental, advisory and other official purposes during the reporting year (2013). Number of visits for the year is presented in the Table below.

Table 9. Nos. of visit paid by the members of the Division during the reporting year

Reporting year	Nos. of experimental visits	Nos. of advisory visits	Nos. of other official tours
2013	36	4	7

ANNUAL COURSE

Scientific personnel of the Division delivered lectures on tea culture in the 49th BTRI Annual Course.

POST GRADUATE DIPLOMA AND CERTIFICATE COURSE

Scientific personnel of the Division delivered 30 hours lectures in the year 2013 on tea culture in the Post-Graduate Diploma Course arranged by MTC, PDU for the management staff of Tea Estates.

BTRI MAIN FARM

Farm Supervisor was promoted to Assistant Superintendent of Bilashcherra Experimrntal Farm and Mr. Md. Majibur Rahman, Senior Farm Assistant took over the charge of Farm Supervisor. There was no other change of staff position in the Institute Main Farm during the year under report. The Institute is spread over an area of 34.90 hectare and breakup of the land is as follows:

UNDER TEA

1) Young clonal tea	: 0.33 ha
2) Mature clonal tea	: 4.64 "
3) Mature seedling tea	: 4.15 "
4) Mother bush, seed bari etc.	: 1.48 "
5) Tea nursery	: 0.62 "
Total	**: 11.22 ha**

OTHER CROPS

1) Rehabilitation crops	: 0.16 ha

2) Nursery	: 1.09 "
3) Mixed forest, Orchard, Lemon, Guava etc.	: 5.21 "
Total	**: 6.46 ha**
OTHERS	
Office, Laboratory, Guest house, Mosque, School, Factory, Club house, labour line, roads etc.	: 17.22 ha
Grand total	**: 34.90 ha**

Improved planting materials supplied:

Year of supply	No. of fresh cuttings
2013	8,43,400

Green leaf production and earning from other farm products:

Reporting year	Green leaf production in kg	Earning from other farm products in Tk
2013	74,848	1,58,318

Independence Day and Victory Day were observed with due solemnity during the reporting year.

Meteorological Data for the year 2013

Month	No. of rainy days	Rainfall (mm)	Evapora-tion (mm)	Temperature (°C)		Dew point (°C)	Sun-shine hrs.	R.H. (%)
				Max.	Min.			
January	0	0	89.40	25.16	7.53	10.83	6.49	66.35
February	1	9.0	120.30	29.79	12.08	12.78	7.49	58.82
March	2	31.0	155.90	33.56	17.43	15.74	7.36	54.01
April	11	104.0	164.90	33.73	21.24	20.36	7.22	63.42
May	22	785.0	88.00	31.31	22.55	23.15	4.25	79.78
June	16	301.0	78.60	33.58	25.48	25.47	5.18	78.15
July	27	493.0	79.60	33.49	25.51	25.35	4.73	78.95
August	22	447.0	77.20	33.67	24.99	25.13	4.25	81.71
September	15	244.0	87.70	32.95	24.85	25.31	4.82	81.50
October	10	159.0	89.20	31.73	23.32	23.61	6.17	80.87
November	0	0	80.60	30.38	14.20	16.47	8.75	71.63
December	1	5.0	59.03	26.51	11.55	14.33	4.75	74.31
Average	10.58	214.83	97.54	31.32	19.23	11.54	5.96	72.46

ENTOMOLOGY DIVISION

Mohammad Shameem Al Mamun
Senior Scientific Officer

STAFF

Mr. Mohammad Shameem Al Mamun was promoted to Senior Scientific Officer and joined in the post on 20 March 2013. The posts of Principal Scientific Officer, Scientific Officer and Senior Farm Assistant were lying vacant during the period under report.

RESEARCH

Eight experiments under six programme areas were conducted during the year 2013. The experiments were: *In vitro* and *in vivo* screening of tea clones at nursery level during clonal selection stage for nematode susceptibility; Susceptibility of red spider mite to different agro types and clones; Evaluation of some indigenous plant extracts against major pests of tea; Studies on physiological and biochemical changes in tea leaves due to mite infestation; Searching and identification of bio-control agents for the control of pests of tea; Bioefficacy of entomopathogenic fungi against major pests of tea; Screening of pesticides against *Helopeltis*, red spider mites, termites, nematodes & aphids in tea and Determination of pesticide residue in Made tea of different tea agro-types. Details of the experiments together with their findings are furnished below:

ENT 1. ENTOMOLOGICAL RESEARCH ON CLONAL VARIETIES OF TEA

ENT 1.1. *In vitro* and *in vivo* screening of tea clones at nursery level during clonal selection stage for nematode susceptibility (2008-2014)

An experiment was initiated with Complete Randomized Design (CRD) at BTRI nursery to identify the resistance/susceptibility of a particular clone to nematode in 2008. Pathogenic nematode culture was prepared in a suitable medium and was kept as stock sample. Pathogen free medium or soil substrate by sterilization as control treatment was also prepared. The pathogenicity of the nematodes was observed regularly. Screening was done of released clones (T1-BT15, T2-BT16 and T3-BT17) as well as test clones (T4-A/8/8, T5-A/17/7 and T6-A/22/40) for nematode susceptibility in previous years. In this year, BTRI released clones i.e. BT2, BT5, BT6, BT11, BT13 were planted in the primary bed. Data were collected at monthly interval. Nematodes were analyzed through Baermann Funnel Method and counted under trinocular compound microscope. Mortality of tested clones due to nematode attack were also observed. Rest of the clones will be planted in the next year and the experiment will be continued up to 2014.

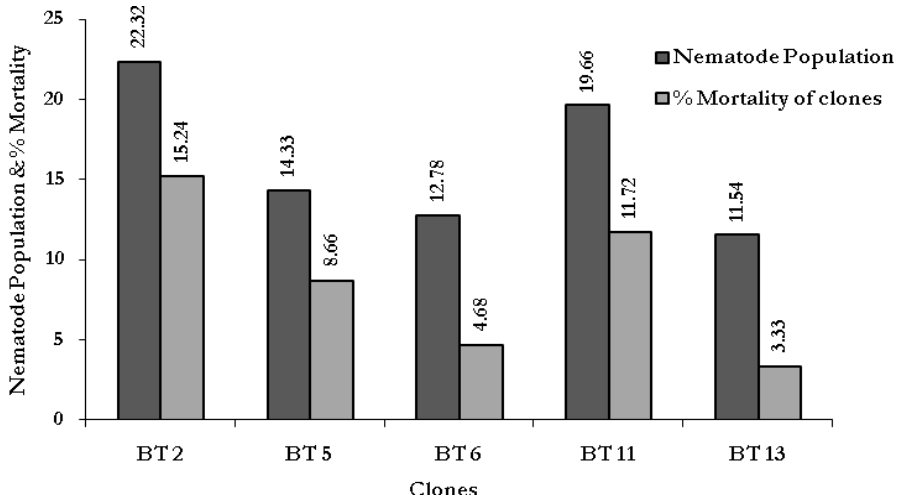

Fig. 1. Mortality percentage due to nematode infestation in tea saplings at primary bed

ENT 1.2. Susceptibility of red spider mite to different agro types and clones (2013-2014)

Studies were carried out on the susceptibility of different tea agrotypes to red spider mite infestation during January 2013 to December 2013 at the clonal block of BTRI Main Farm. Susceptibility to red spider mites of different tea agrotypes such as China, Assam, Burma, Monipuri, Hybrids and tea clones namely, BT1, BT2, BT3, BT4, BT5, BT6, BT7, BT8, BT9, BT10, BT11, BT12, BT13, BT14, BT15, BT16, BT17, BT18, TV1 & Seedlings were evaluated. From the clonal block of BTRI, the mite population was estimated every month by sampling randomly 10 mature leaves per plot and transporting to the laboratory in poly bags where mites were then extracted from the leaves using a mite brushing machine (Model–Leedom Engineering, USA) and the number of mites were counted under the stereomicroscope. The experiment is in progress. The experiment will be continued up to December 2014.

ENT 2. STUDIES ON INDIGENOUS PLANT EXTRACTS

ENT 2.1. Evaluation of some indigenous plant extracts against *Helopeltis*, Red spider mites & nematodes in tea (2008-2014)

Laboratory screening of some plant extracts against Helopeltis (2008-2012)

An experiment was conducted to evaluate the toxicity of six indigenous plant extracts, Bur weed (*Xanthium strumarium*), Datura (*Datura metel*), Kata-mehedi (*Duranta erecta*), Lantana (*Lantana camara*), Mahogani (*Swietenia mahagoni*) and Neem (*Azadirachta indica*) against tea mosquito bug, *Helopeltis theivora* under laboratory condition. The concentrations of the extracts were 2.5, 5.0 and 10.0% (w/v) diluted with acetone and water solvent. The plant preparations were applied to *Helopeltis* by topical application method. Data were collected at 24HAT, 48HAT & 72HAT. All the plant extracts showed toxic effect on tea mosquito bug under laboratory condition. Among the test plants, Bur weed extracts showed the highest (62.97%) toxic effect whereas Katamehedi

showed the lowest (18.52%) toxic effect against *Helopeltis*. Detailed results were published in Annual Report 2012.

Laboratory and field screening of some plant extracts against red spider mites (2008-2012)

An experiment was conducted to evaluate the toxicity of six indigenous plants, Bishkatali (*Polygonum hydropiper*), Bur weed (*Xanthium strumarium*), Datura (*Datura metel*), Lantana (*Lantana camara*), Mahogani (*Swietenia mahagoni*) and Neem (*Azadirachta indica*) against red spider mite, *Oligonychus coffeae* in tea under both laboratory and field conditions. The concentrations of the extracts were 2.5, 5.0 and 10.0% (w/v). The plant preparations were applied to red spider mite by spraying method. Data were collected at 24HAT, 48HAT & 72HAT at laboratory condition and at weekly interval for field experiment. All the plant extracts showed toxic effect on red spider mite under both laboratory and field conditions. The toxicity of *X. strumarium* was found to be highest (87.36%) whereas *D. metel* was found to be lowest (65.52%) against red spider mites in the laboratory condition. In field evaluation of plant extracts, 52.51-73.46% infestation reduction of red spider mite was recorded at 5.0% and 61.04-83.72% at 10.0% concentration. More acaricidal activity was noticed in *X. strumarium* and *S. mahagoni* under field condition. The detailed results were published in Annual Report 2012.

Pot experiment on plant cakes against nematodes (2013)

Another experiment on some plant cakes against nematodes was conducted at Entomology Laboratory, BTRI. The dose of tested plant cakes @ 50g/pot and synthetic chemicals i.e. Furadan 5G @ 35g/pot, Fipronil 3GR @ 35g/pot and Rynaxapyr 0.4G @ 15g/pot were used in this experiment.

Table 1. Effectiveness of Bishkatali, Mahogani, Neem, Carbofuran 5G, Fipronil 3GR and Rynaxypyr 0.4G against nematodes in tea

Treatments	Dose/ m^3 soil	Pre-treatment observation (No. of nematodes/ 10g of soil)	% effectiveness of plant cakes and chemicals against nematodes				Overall mean (%)
			after 1st application		after 2nd application		
			1st wk	2nd wk	3rd wk	4th wk	
T_1 Bishkatali	50g	46	73.68	63.90	83.24	78.44	74.82d
T_2 Mahogani	50g	53	78.78	70.64	89.27	80.89	79.89c
T_3 Neem	50g	43	63.10	62.28	82.59	78.30	71.57e
T_4 Carbofuran 5G	165g	41	83.58	75.39	90.04	77.83	81.71b
T_5 Fipronil 3GR	165g	49	85.98	75.12	88.10	78.80	82.00b
T_6 Rynaxypyr 0.4G	70g	47	89.24	78.30	94.29	81.36	85.80a
T_7 Control (No. of nematodes)	-	38	46	57	65	73	-

Mean of 3 replications.
Figures in a column having the different letters are not statistically identical by DMRT (p>0.05)

Result reveals that all the treatments had the toxic effect on nematodes and significantly reduced nematode population from the soil. The nematode population in the soil treated with Rynaxypyr 0.4G was the lowest due to the highest mortality of nematodes (85.80%) followed by Fipronil 3G

(82.00%), and Carbofuran 5G (81.71%) which was satisfactory. Among the plant cakes, Mahogani cake showed the highest (79.89%) mortality of nematodes in the treated soil. The cakes of Bishkatali (74.82%) and Neem (71.57%) also reduced the nematode population significantly. Rynaxapyr and Mahogani Cake can be used as soil treatments for the management of nematodes to get nematode free soil or safe soil with less nematode for establishing tea nursery. The experiment will be continued up to 2014 for other plants and pests. Experiment on another four indigenous plants, *Clerodendron, Leucas, Ipomea* and *Adathoda* is in progress.

ENT 3. PEST INFESTATION AND QUALITY OF TEA

ENT 3.1. Studies on physiological and biochemical changes in tea leaves due to mite infestation (2013-2014)

A study was undertaken to determine physiological and biochemical changes in tea leaves as well as black tea due to the attack of red spider mites in tea at the Main Farm of Bangladesh Tea Research Institute (BTRI), Srimangal, Moulvibazar. The tea shoots comprising "two leaves and a bud" were collected where the plots are divided into four categories such as T_1) Fresh leaf plot, T_2) Low infested plot, T_3) Medium infested plot and T_4) Highly infested plot considered as treatments. The biochemical analysis was done at the Laboratory of the Department of Food Engineering and Tea Technology, Shahjalal University of Science and Technology (SUST), Sylhet. Calculations of chlorophyll a, chlorophyll b and carotenoids were done using the specific formula.

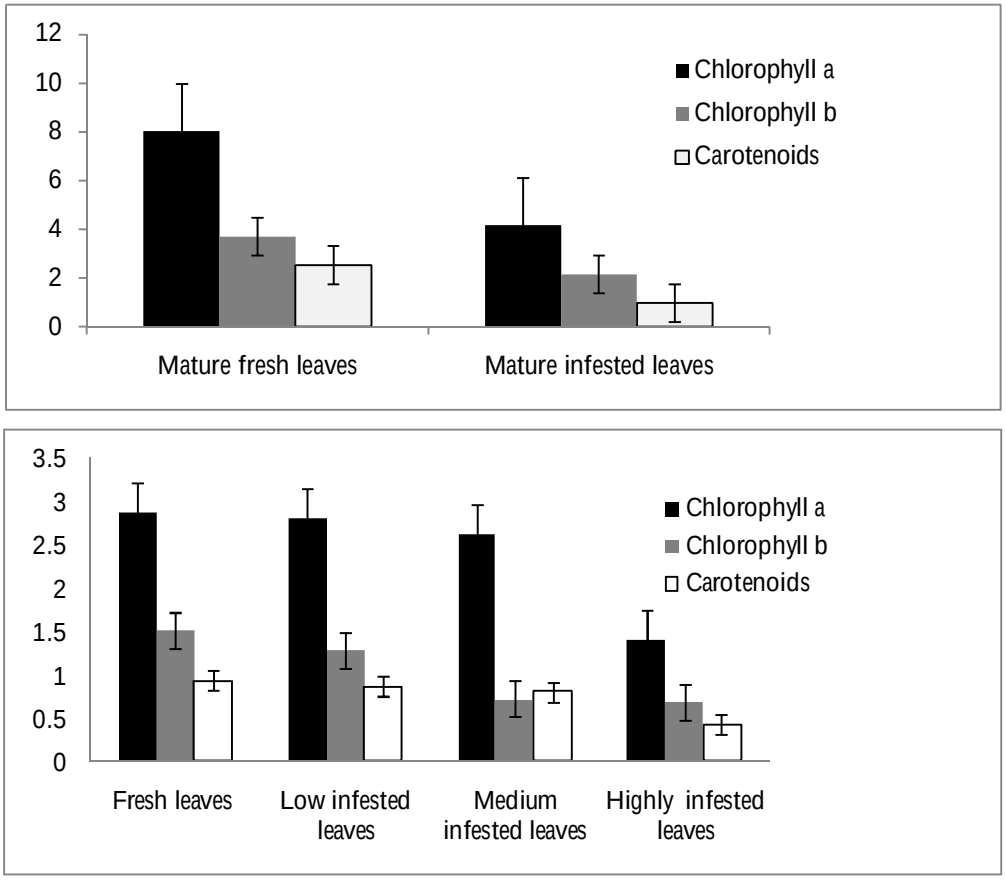

Fig. 2. Chlorophyll and Carotenoids contents (mg/g) in different treatments

Table 2. Changes in biochemical parameters in Tea Leaves and Made Tea due to mite infestation

Treatment	Polyphenol (%)	Catechin (%)	Lipid (%)	Reducing sugar (%)	TF (%)	TR (%)	HPS (%)	TLC (%)	Colour index	Caffeine (ppm)	Total ash (%)	Moisture (%)
T1- Fresh	76.22	21.20	4.70	55.57	0.53	5.31	9.81	4.25	3.50	62.04	5.21	3.45
T2- Low	57.44	20.60	4.49	53.64	0.52	5.78	8.73	4.17	3.58	56.82	5.36	3.08
T3- Moderate	46.00	19.60	3.94	40.07	0.49	7.40	6.86	2.38	3.44	56.68	5.53	2.88
T4- High	45.56	10.40	3.77	34.57	0.43	7.00	6.16	2.20	3.27	54.68	5.70	0.635

Results reveal that the fresh tea leaves contain more photo pigments like chlorophyll a, chlorophyll b and carotenoids. These parameters subsequently decreases in low infested to highly infested tea leaves. Other biochemical parameters were also found to be low in the Made Tea produced form mite infested leaves. The biochemical changes of Made Tea due to other pests will be assessed in the following years.

ENT 4. BIO-CONTROL OF PESTS

ENT 4.1. Searching and identification of bio-control agents for the control of pests of tea (2011-2014)

An investigation was carried out at Bangladesh Tea Research Institute (BTRI) Main Farm during 2011-2014 to document the arthropod natural enemies in the tea ecosystem. Frequent visits were made to search bio-control agents in the field. The survey was conducted twice in a month. A good number of natural enemies such as spiders, preying mantids, beetles, and some other insects were collected from the field and enlisted in this communication, of which most of the species were found to be intimately associated with tea pests or occurred as their hosts (List was presented in Annual Report 2012). Among the natural enemies, Coccinellid was dominant. No new species was identified other than the previous year. Monitoring, searching and collection are being continued. The experiment will be continued up to 2014.

ENT 4.2. Bioefficacy of entomopathogenic fungi against major pests of tea (2013-2014)

An experiment was carried out to evaluate the bioefficacy of some microbial pesticides viz., two entomopathogenic fungi i.e. *Beauveria bassiana, Metarhizium anisopliae,* one soil actinomycete i.e. *Streptomyces avermitilis* against red spider mite *Oligonychus coffeae* Nietner (Tetranychidae: Acarina) infesting tea under both in the Entomology Laboratory and Main Farm of Bangladesh Tea Research Institute (BTRI), Srimangal, Moulvibazar during the period from March 2013 to June 2013. The Red spider mites were collected from different sections of the Farm and reared in the Entomology Laboratory at 27°-30°C temperature and 70-80% relative humidity on a susceptible tea clone BT2 following detached leaf culture method of Helle and Sabelis (1985) with slight modifications.

Laboratory test for acaricidal activity of entomopathogens

Data from the Laboratory on the pathogenecity of the fungi are given in Table 3. The study revealed that there was a distinct difference in the susceptibility of red spider mites in tea to certain entomopathogens.

Table 3. Evaluation of certain entomopathogens against red spider mites of tea in the laboratory

Treatment	Dosage	Percent Mortality*		
		24 HAT	48 HAT	72 HAT
T_1- *Beauveria bassiana*	5.0 g/L	37.78d	44.44d	52.22d
T_2- *Streptomyces avermitilis*	2.0 ml/L	56.67b	63.33b	71.11b
T_3- *Metarhizium anisopliae*	5.0 g/L	45.55c	51.11cd	56.67d
T_5-Omite (Standard)	1.0 ml/L	66.67a	72.22a	82.22a
$\overline{Sx}$		2.122	2.522	1.648
Probability level		0.05	0.05	0.05
CV%		7.16	7.56	4.37

*Mean of three observations (30 adults/observation)
HAT= Hours after treatment
Within column values followed by different letter(s) are significantly different by DMRT (p>0.05)

Result reveals that the highest percentage of mortality of mites was found to be 66.67, 72.22 & 82.22% by spraying of chemical pesticide, Omite 57EC at 24, 48 & 72HAT respectively. Among the biopesticides, the highest mortality of red spider mites was observed in *S. avermitilis* (56.67%) followed by *M. anisopliae* (45.55) at 24 HAT (Table 3). In 48 HAT, the maximum mortality of red spider mites was also observed in *S. avermitilis* (63.33%). Similar trend was also found at 72 HAT after spraying of biopesticides. The order of toxicity of the tested biopesticides on adult red spider mite was *S. avermitilis*>*M. anisopliae*>*B. bassiana*.

Field evaluation of entomopathogens against red spider mite

Results reveal from the field evaluation of different entomopathogens against red spider mites that all the entomopathogens had the acaricidal value to reduce the infestation of red spider mite in tea.

Table 4. Field evaluation of certain entomopathogens against red spider mite in tea

Treatment	Dosage /ha	Pre-treatment (No. of mites)	% effectiveness of biopesticides after application*				
			After 1st spray		After 2nd spray		Overall Mean (% effectiveness)
			1st wk	2nd wk	3rd wk	4th wk	
T_1-*Beauveria bassiana*	5000g	38	60.51c	76.84c	86.20c	92.48c	79.01d
T_2-*Streptomyces avermitilis*	2000ml	36	81.83a	91.14a	96.34a	98.89a	92.05a
T_3-*Metarhizium anisopliae*	5000g	42	66.53b	80.91b	89.43b	95.99b	83.22c
T_5-Omite (Standard)	1000ml	48	84.53a	92.69a	97.03a	99.60a	93.46a
$\overline{Sx}$			1.713	0.9835	0.8266	0.8285	0.6983
Probability level			0.05	0.05	0.05	0.05	0.05
CV%			4.09	2.00	1.55	1.48	1.39

*Mean of three observations
Within column values followed by different letter(s) are significantly different by DMRT (p>0.05)

Analysis of data from the field trial reveals that the application of *Streptomyces avermitilis* @ 2000ml/ha reduced the mite incidence significantly to the tune of 81.83-98.89% followed by *Metarhizium anisopliae* in the tune of 66.35-95.99%. The study indicated that spraying of these formulations significantly reduced the percentage of red spider mite infestation in tea.

Metarhizium anisopliae against termites in tea

An experiment was conducted to determine the bioefficacy of *Metarhizium anisopliae* (Bio-terminator) against termites infesting tea at the Main Farm of Bangladesh Tea Research Institute, Phulbari Tea Estate and Baraoora Tea Estate, Srimangal, Moulvibazar during January 2013 to October 2013.

The results achieved from the trials at three different locations are presented in Tables 5, 6 and 7. It would be apparent from the results of the trials in Table 5, 6 and 7 that Bio-Terminator was found to be highly effective (85.21, 84.91 & 85.97% respectively) in controlling termites and maintain their effectiveness to the desired level up to 9 months.

Table 5. Effectiveness of Bio-Terminator against Termites in tea at BTRI Main Farm

Treatments	Dose/ ha	Pre-treatment obs. (% infested bushes)	% effectiveness of the treatments at different periods									Overall mean (% effectiveness)
			Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
T_1 Bio-Terminator	5.00 kg	53	54.25	67.71	78.89	86.82	90.23	94.23	96.77	97.95	100.0	85.21
T_2 Admire 200SL	1.50 lit	51	96.48	92.01	86.84	83.57	78.43	76.03	74.23	71.24	70.57	81.04
T_3 Dursban 20EC	10.0 lit	48	94.39	88.12	81.36	76.72	74.39	71.99	69.05	67.18	66.57	76.64
T_4 Control	-	44	49	54	59	63	68	72	77	81	85	-

Table 6. Effectiveness of Bio-Terminator against Termites in tea at Phulbari T.E.

Treatments	Dose/ ha	Pre-treatment obs. (% infested bushes)	% effectiveness of the treatments at different periods									Overall mean (% effectiveness)
			Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
T_1 Bio-Terminator	5.00 kg	48	57.13	67.96	76.21	83.54	88.67	94.62	97.38	98.74	100.0	84.91
T_2 Admire 200SL	1.50 lit	54	95.03	91.01	87.31	82.71	78.59	76.09	74.35	71.89	70.69	80.85
T_3 Dursban 20EC	10.0 lit	46	92.22	87.68	81.80	75.02	70.43	67.72	65.78	64.36	63.04	74.23
T_4 Control	-	51	57	63	67	71	75	79	81	84	87	-

Table 7. Effectiveness of Bio-Terminator against Termites in tea at Baraoora T.E.

Treatments	Dose/ ha	Pre-treatment obs.	% effectiveness of the treatments at different periods									Overall mean (% effectiveness)
			Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
T_1 Bio-Terminator	5.00 kg	45	57.35	69.63	80.48	86.33	91.72	95.01	96.54	97.78	98.94	85.97
T_2 Admire 200SL	1.50 lit	46	96.21	89.51	85.68	82.17	78.39	76.80	74.05	71.74	69.94	80.50
T_3 Dursban 20EC	10.0 lit	38	88.52	80.96	76.88	69.43	67.30	66.01	63.12	61.84	59.85	70.44
T_4 Control	-	41	47	51	56	60	66	73	79	82	86	-

The overall performance of the tested Bio-terminator against termites of tea was found 'satisfactory' @ 5.0 kg/ha (84.91 - 85.97% effectiveness) up to 9 months. Hence, the Bio-terminator may be efficiently used as the component of IPM for the management of termites in tea in Bangladesh condition.

Bacillus thuringiensis against looper caterpillar in tea

A laboratory experiment was conducted to determine the bioefficacy of *Bacillus thuringiensis* against looper caterpillar at Entomology Laboratory, BTRI and the field evaluation was made at Bilashcherra Experimental Farm of BTRI during January 2013 to December 2013. The experiment is in progress and will be continued up to 2014.

ENT 5. SCREENING OF PESTICIDES

ENT 5.1. Screening of pesticides against *Helopeltis*, Red spider mites, Termites, Nematodes, Aphids, Flushworm, Jassids and Thrips in tea (2012-2013)

One hundred and thirty four (134) pesticides under different groups against *Helopeltis*, Red spider mites, Termites, Nematodes and Aphid in tea were received from Plant Protection Wing, Department of Agricultural Extension (DAE), Ministry of Agriculture for conducting field trial in 2013. The experiment was conducted at Baraoora T.E. and BTRI Main Farm at CRD & RCBD with three replications. Data on percent infestation were collected at weekly, fortnightly and monthly intervals for *Helopeltis*, Red spider mites, Termites, Nematodes respectively in tea. A total of twelve data were recorded. Abbott's formula, Henderson and Tilton formula, Lubischeb analytical method, Baermann funnel method etc. were applied for determining the effectiveness of the pesticides. The tested chemicals were found 'good' i.e. >80% effectiveness against the mentioned pests of tea. Trial reports were sent to PTASC for standardization. The experiment will be continued for other chemicals for the year of 2014.

Control of *Helopeltis* in tea

Evaluation of the performance of the pesticides, viz. Shoddaprid 200SL, Knock-Down 2.5EC, GC-thrin 2.5EC, Beer 2.5EC, Maxthrin 10EC, Alif 10EC, Perkthrin 10EC, Uday Serathrin 10EC, Lal Gitto 10EC, Tatathrin 10EC, Maxim 10EC, Oromethrin 10EC, Rexitako 40WG, Proxam 25WG, Anthoate 40EC, Tartar 400SC, Rizik 10EC, Chamak 2.5EC, N-thrin 10EC, Kilbaryl 85WP, Rthion 57EC, Hallowthrin 10EC, Lamsolve 2.5EC, Acivin 85WP, Asalam 2.5EC, Delco Lambda 2.5EC & Seakil 10EC against *Helopeltis* in Tea.

Progress: Twenty seven insecticides including Imidacloprid, Dimethoate, Lambda Cyhalothrin, Cypermethrin, Chlorantraniliprole+Thiamethoxam, Thiamethoxam, Burpofezin, Carbaryl & Malathion were received from Plant Protection Wing, DAE in controlling *Helopeltis*. Data were collected regularly at 7 days interval. The trial reports had been sent to PTASC to consider their standardization. The efficacy of the tested chemicals was >80%.

Control of Red Spider Mite in tea

Evaluation of the effectiveness of pesticides viz. Carbofun 20EC, Agrotec 1.8EC, Pafec 1.8EC, Mitten 1.8EC, Hosot 1.8EC, Fasal Max 1.8EC, Prado 2.15 EC, Mirror 5WG, Avoclam 5%SG, Serput 2.5EC, Sulfostar 80DF, Solbavit 80WDG, Biotin M 1.2EC, Talstar 2WP, Simectin 1.8EC, Urogent 50SC, S-vet 80WG, Merge 4EC, Fasalvit 80WDG, G-vit 80WDG, Apex 80WDG, Renitol 10EC, Zero Mite 40EC, Sul-vit 80WDG, Mitigate 5EC, Killmate Plus, Shyvit 80WG, Intrepid 10SC, Netsul 80WDG, Badhan 40EC, Matrine 0.6%. Symvita 80WDG, Pro-sul 80WDG, Lurk 5SG, Delcoben 5%SG, Provit 80WDG, Mite Scavenger 10EC, Emamer 5SG, Neurovit 80WG & Tornedo 4EC against Red Spider Mite in tea.

Progress: Forty miticides including sulphur based compounds, Carbosulfan, Abamectin, Emamectin Benzoate, Bifenthrin, Fipronil, Abamectin+Acetamiprid, Fenpopathrin, Abamectin+Propargite, Fenpyroximate, Chlorfenapyr, Dimethoate, Oxymatrine, Hexythiazox & one Biopesticides were received from Plant Protection Wing for field trial against red spider mite in tea. Data were collected regularly at weekly interval. The trial reports had been sent to PTASC to consider their standardization. The efficacy of the tested chemicals was >80%.

Control of Termites in tea

Evaluation of effectiveness of the insecticides viz. Bold Out 55EC, Agronil 3GR, Safety II 55EC, Vorosha 55EC, Rudder 550EC, Ashaphos 55EC, Ritap 50SP, Amiraj 200SL, Admiral 200SL, Mettle 50SC, Sulban 48EC, Clear 48EC, Fasalfos 48EC, Fast 48EC, Lirifos 480EC, Vitaban 48EC, Radar 48EC, Phosthrin 50.5EC, Cuma 505EC, Imicon 200SL Unitoplus 55EC, Sulbo 55EC, Seaprid 20SL, B-Prid 20SL, Miclephos 48EC, G.R Fos 48EC, Confidence 70WG, Imida Fasal 20SL, Perkfos 48EC, Pro-fos 48EC, Onetouch 550EC, Nabik 55EC, Semitaf 20SL, Cyperfos 55EC, Ravnil 20SL & Mega 55EC against Termites in Tea.

Progress: Thirty six insecticides including Chlorpyrifos+Cypermethrin, Fipronil, Cartap, Imidacloprid & Chlorpyrifos were received from Plant Protection Wing for field trial against termites in tea. The termiticides were applied in the field against termites and data were collected regularly at monthly interval. The trial reports had been sent to PTASC to consider their standardization. The efficacy of the tested chemicals was >80%.

Control of Nematodes in tea

Evaluation of effectiveness of nematicides viz. Dhamfuran 5G, Agrozan 5G, Heridan 5G, Everfuran 5G, Z-furan 5G, Sundan 3G, Kingfuran 5G, Payfuran 5G, Suzinon 10G, Lagent 3GR, Uday Seradhan 5G, Tatafuran 5G, Biszeen 5G, Abfuran 3G, Al-furan 5G, Raidan 5G, Perkfuran 5G & Digifuran 5G against Nematodes in tea.

Progress: Eighteen nematicides comprising Carbofuran, Diazinon & Fipronil were received from Plant Protection Wing, for field trial. The nematicides were applied in the pot against nematodes. Data were collected regularly at 15 days interval. Trial reports were sent to PTASC for standardization. The efficacy of the tested chemicals was >80%.

Control of Aphid in tea

Evaluation of effectiveness of insecticides viz. Ortap 50SP, Meemtap 50SP, Patap 50SP, Dizin 60EC, Dhumtara 25WG, Deltrimet 36EC, Paratap 50SP, Runner 2.5EC, Jaction 40WG, Access 20EC, Bentec G 5SG, Hiclame 5SG & Macet 75SP against Aphid in tea.

Progress: Thirteen insecticides including Cartap, Diazinon, Thiamethoxam, Deltamethrin+Triazophos, Lambda Cyhalothrin, Chlorantraniliprole+Thiamethoxam, Tebuconazide, Emamectin Benzoate, Acephate were received from Plant Protection Wing, for field trial against aphid. Data were collected regularly at weekly interval. Trial reports were sent to PTASC for standardization. The efficacy of the tested chemicals was >80%.

ENT 6. PESTICIDE RESIDUE ANALYSIS

ENT 6.1. Determination of pesticide residue in Made Tea of different tea agro-types (2012-2013)

An experiment was initiated to determine the pesticide residue in Made Tea of different tea agro-types such as Assam, China, Monipuri Hybrid, BT1, TV1 and Seeding. As tea is a consumable product, the presence of pesticide residue in Made Tea is harmful to human health. The purpose of this study is to find out the degradation rate of pesticide residue in different tea agro-types. Endosulfan (Thiodan 35EC), a very common insecticide was applied on pluckable shoots at BTRI approved dose i.e. @1.5/ha. Pluckable shoots were collected from selected plots of different tea agro-types of BTRI germplasm centre and pesticide residue plot at 0th, 7th & 14th days interval after the application of pesticides and subsequently manufactured in the manufacturing unit of the Pesticide Residue Analytical Laboratory of the Institute. The residue analysis was done according to the methods developed by Ahmed & Sarker (2002) at Central Science Laboratory (CSL) in U.K. (Method reference: PGD-95/01-07). The determination of residue was done by Electron Captured Detector (ECD) and Flame Thermoionic Detector (FTD) using Gas Chromatograph (Shimadzu 14-B) with DB-5 Capillary Column. Nitrogen gas (99.997% pure) was used as carrier gas. Hexane and Acetone were used as extracting reagents and Florisil as Clean-up reagent. The experiment is in progress.

PLANT PATHOLOGY DIVISION

Dr. Mohammad Ali
Chief Scientific Officer
Department of Pest Management
&
Mohammed Syeful Islam
Senior Scientific Officer
Plant Pathology Division

STAFF

Mr. Moshiur Rahman Akanda, Scientific Officer left for Tamil Nadu, India on 1 December 2013 to attend a three months' training course in "Advanced Certificate Course on Computer Application for Plantation". Mohammed Syeful Islam Senior Scientific Officer was transferred to Fatickchari Sub-station, Chittagong on 13 December 2013. The posts of one Principal Scientific Officer, one Scientific Officer, one Field Assistant and one MLSS were remained vacant. There was no other change in the staff position of this division.

RESEARCH

Five experiments under 03 program areas were conducted during the year 2013. All these experiments were ongoing.

PP 3: DISEASE MANAGEMENT

PP 3.4: Economics and integrated management of Gall disease in tea (2006-2013, BEF).

Progress

The treatments were applied in the plots according to the schedule of experiment. Data were collected in terms of weight of green leaves and scoring of disease intensity. All collected data were compiled and analyzed statistically.

Table 1. Production of Made Tea (Kg ha^{-1}) and Percent Disease Index (PDI) against different treatments during 2013

Treatment	Made Tea (Kg/ha) (Mean of 3 replications)	% Disease Index
T_0= Untouched (Control)	1,075.74 i	17.66 a
T_1= T_0+ Carbendazim @ 750 gm ha^{-1}	1,126.46 h	15.44 b
T_2= LP	1,156.06 gh	14.82 c
T_3= LP+ Carbendazim @ 750 gm ha^{-1}	1,171.96 g	10.67 f
T_4= DSK	1,450.22 b	8.43 i
T_5= DSK+ Carbendazim @ 750 gm ha^{-1}	1,564.54 a	7.77 j
T_6= MSK	1,318.36 d	9.84 c
T_7= MSK+ Carbendazim @ 750 gm ha^{-1}	1,375.38 c	8.44 h
T_8= LSK	1,225.97 f	13.63 d
T_9 = LSK+ Carbendazim @ 750 gm ha^{-1}	1,267.64 e	12.24 e

Table 2. Production of Made Tea (Kg/ha) and Percent Disease Index (PDI) against different treatments during (2007-2013)

Treatment	Made Tea (Kg/ha) (Mean of 3 replications)	% Disease Index
T_0= Untouched (Control)	1,464.72 f	22.83 a
T_1= T_0+ Carbendazim @ 750 gm ha^{-1}	1,538.02 f	20.60 ab
T_2= LP	1,809.74 de	16.60 bcd
T_3= LP+ Carbendazim @ 750 gm ha^{-1}	2,080.62 bc	12.89 de
T_4= DSK	2,094.32 bc	14.38 cd
T_5= DSK+ Carbendazim @ 750 gm ha^{-1}	2,392.45 a	7.95 f
T_6= MSK	1,859.16 cde	14.96 cd
T_7= MSK+ Carbendazim @ 750 gm ha^{-1}	2,204.02 ab	9.37 ef
T_8= LSK	1,675.14 ef	18.38 bc
T_9= LSK+ Carbendazim @ 750 gm ha^{-1}	1,927.57 cd	15.95 cd

Table 3. Partial budget for different treatments used for controlling Gall disease in tea

Treatment	Yield (Kg/ha)	Variable cost (Tk/ha)	Gross Return (Tk/ha)	Gross Margin (Tk/ha)
T_0	1,464.72	0	2,93,000	2,96,000
T_1	1,538.02	1,565	3,07,600	3,06,035
T_2	1,809.74	7,752	3,62,000	3,54,248
T_3	2,080.62	9,317	4,16,200	4,06,883
T_4	2,094.32	5,574	4,18,800	4,13,226
T_5	2,392.45	7,036	4,78,400	4,71,364
T_6	1,859.16	3,484	3,71,800	3,68,316
T_7	2,204.02	5,049	4,40,800	4,35,751
T_8	1,675.14	3,049	3,35,000	3,31,951
T_9	1,927.57	4,613	3,85,600	3,80,987

Table 4. Marginal analysis of different treatments used for controlling Gall disease in tea

Treatment	Gross Margin ((Tk/ha)	Variable cost ((Tk/ha)	Margin Gross Margin ((Tk/ha)	Margin Variable cost (Tk/ha)	Margin Rate of Return (%)
T_5	4,71,364	7,036	35,613	1,987	1,792
T_7	4,35,751	5,049	22,525	(-) 525	-
T_4	4,13,226	5,574	-	-	-

The highest significant ($p=0.05$) response was found in T_5 followed by T_4 and T_7. Accordingly the lowest disease index was observed in the same treatments (Tables 1 & 2). High infection and low production was found in T_0 which was completely untouched or untreated condition. The highest (1,792%) marginal rate of return was obtained in the treatment T_4 receiving DSK operation and following application of Carbendazim @ 750 g/ha (Table 4).

It can be concluded from the experiment that Deep Skiff (DSK) operation and following application of systemic fungicide- Carbendazim gave the better result to minimize the Gall disease as well as in achieving higher yield over other treatments.

PP 3.5: Evaluation of antifungal activities of some plant extracts against different foliar diseases of Tea (2011- 2015)

Progress

Three concentrations (1, 1.5 and 2.0%) of leaf extracts of Neem (*Azadirachta indica*), Bishkatali (*Polygonum barbatum*), Bashok (*Adatoda vasica*) and Arjun (*Terminalia arjuna*) were tested in the laboratory against *Pestalotia theae* and *Colletotrichum gloeosporioides* using food poisoning technique. The mycelial growth (cm) was compared among the treatments. The highest growth inhibition (86.67%) was found with Bashok at 2.0% for controlling *Pestalotia theae.* Neem (2.0%) and Bashok (1.5%) showed more than 60% growth inhibition for the same (Table 5). In case of *Colletotrichum gloeosporioides* no mycelial growth was found at all concentrations of Bashok. All other extracts with highest concentration (2.0%) gave $\geq$ 50% inhibition (Table 5). The experiment will be continued.

Table 5. Effect of leaf extracts of Neem (*Azadirachta indica*), Bishkatali (*Polygonum barbatum*), Bashok (*Adatoda vasica*) and Arjun (*Terminalia arjuna*) diluted in distilled water at different concentrations on the growth of *Pestalotia theae* and *Colletotrichum gloeosporioides* after 120 hrs of plating

Treatments	Concentrations	Mycelial growth in cm (Average of three replications)			
		Pestalotia theae	% growth inhibition	*C. gloeosporioides*	% growth inhibition
Neem	1.0%	7.90 d	12.22	4.90 d	45.55
	1.5%	7.20 f	20.00	4.80 e	46.67
	2.0%	3.40 k	62.22	4.50 g	50.00
Bishkatali	1.0%	8.40 b	6.67	5.50 b	38.88
	1.5%	8.10 c	10.00	5.10 c	43.33
	2.0%	7.50 e	16.67	4.50 g	50.00
Bashok	1.0%	5.90 h	34.44	0.00 i	100.00
	1.5%	2.90 e	67.78	0.00 i	100.00
	2.0%	1.20 m	86.67	0.00 i	100.00
Arjun	1.0%	6.90 g	23.33	4.50 d	50.00
	1.5%	5.70 i	36.67	4.60 f	48.88
	2.0%	4.10 j	54.44	4.10 h	54.44
Control	-	9.00 a	00	9.0 a	00

PP 3.3: Screening of new fungicides and herbicides against different diseases and weeds in tea. Short term: BTRI/BEF/ T.Es.

Progress

A total of ten fungicides of different groups were received from different pesticide companies through PTASC to test their efficacy against diseases in tea. All the supplied fungicides were tested against Red rust, Die back, Black rot, Branch canker diseases both in field and laboratory condition (Table 6). Efficacies of the fungicides were compared with previously standardized fungicides. More than 80% efficacy of fungicides under trial was found. Reports were sent to PTASC for necessary action at their end.

Table 6. Efficacy of fungicides against different diseases in tea.

Sl. No.	Group	Fungicides	Dose ha^{-1}	Diseases
01	(Azoxystrobin + Difenoconazole)	Amistar Top 325 SC	750 ml	Branch canker, Die-back, Black rot, Red rust.
02		Topstar 325 SC	750 ml	
03	Azoxystrobin	Rezobin 50 WG	500 gm	
04	(Difenoconazole + Propiconazole)	Diezole 300 EC	750 ml	
05	Hexaconazole	Fayjol 5 EC	750 ml	
06	Carbendazim+Thiram	Taopath 60 WP	1.00 kg	
07	Thiram	Rexithiram 50 SC	750 ml	
08	Copper Oxychloride	Copper Blue 50 WP	2.80 kg	
09	Tebuconazole+ Trifloxystrobin	Rativo 75 WG	500 gm	
10	Mancozeb	Bondage 80 WP	2.00 kg	

A total of twenty herbicides of different groups were received from different pesticide companies through PTASC to test their efficacy against diseases in tea. All the supplied herbicides were tested against mixed weeds (monocot & dicot) in tea (Table 7). Efficacy of the herbicides was compared with previously standardized one. Reports were sent to PTASC for necessary action.

Table 7. Efficacy of herbicides against different weeds in tea.

Sl. No.	Group	Herbicides	Dose ha^{-1}	Weeds
01	Paraquat	Wellweeder 27.6 SL	2.5 L	Non selective, mixed stand, monocot and dicot weeds.
02		Parason 20 SL	2.8 L	
03		Paraclean 20 SL	2.8 L	
04		Newraxon 20 SL	2.8 L	
05		G-moxone 20 SL	2.8 L	
06		Saraquat 20 SL	2.8 L	
07		Clear 20% SL	2.8 L	
08		Para Link 20 SL	2.8 L	
09		Prestige 200 SL	2.8 L	
10		Fairquat 20 SL	2.8 L	
11		Aroquat 200 SC	2.8 L	
12		Feat 13SL	4.0 L	
13	Glyphosate	Ginphosate 41SL	3.7L	

14		Vanish 41SL	3.7 L	
15	Glyphosate 34%+ MCPA 6.50%	Rapid 40.50%	3.5 L	
16	2,4-D Amine	Wellamain	2.8 L	
17		Kolmine 480SL	2.8 L	
18	Metsulfuron-Methyl	Ornet 20WDG	400g	
19	Bispyribac Sodium + Bensulfuron-methyl	Relt 300 WP	2.0 kg	
20	Ethoxy Sulfuron	Moon Rise 150 WG	3.5 kg	

PP 4.5: Determination of critical period of weed competition in young tea (2011-2015, BEF)

Progress

The maximum number of weeds was found in the plots which are kept weed free from T_{10} (15th June- 30th September) and then declined due to environmental condition. Weed height and canopy size are also statistically noticeable in that time. Number of effective branches was more or less statistically similar with T_1 and T_{10}. Highest canopy size was found in T_{10} which was identical with T_{11} to T_{15}. Though yield was found lower as increasing the number of weeds, but in T_8, T_9, T_{10} and T_{11} it showed statistically identical. So, primarily it can be said, in young tea, weed free from 15th June- 30th September is statistically identical (Table 8).

Table 8. Effect of different intervals of weed control (2013)

Treatments	Number of weeds	Height (cm)	Canopy size (cm)	No. of branch	Yield (Kg)
T_1= Weed free (1st March- 30th Sept.)	1.33 l	6.67 j	14.76 e	16.00 a	10.16 a
T_2= Weed free (15th March- 30th Sept.)	9.00 k	9.00 i	15.16 e	15.60 ab	9.98 b
T_3= Weed free (1st April- 30th Sept.)	20.33 j	13.67 h	15.90 e	15.00 abc	9.86 c
T_4= Weed free (15th April- 30th Sept.)	33.00 i	18.00 g	18.06 de	15.00 abc	9.27 d
T_5= Weed free (1st May- 30th Sept.)	42.33 g	18.67 g	20.08 d	14.80 abc	9.13 e
T_6= Weed free (15th May- 30th Sept.)	64.00 e	21.67 f	24.86 c	14.80 abc	8.96 f
T_7= Weed free (1st June- 30th Sept.)	74.33 d	26.33 e	28.20 b	14.40 bc	8.74 g
T_8= Weed free (15th June- 30th Sept.)	86.67 c	29.00 d	30.12 b	14.40 bc	8.46 h
T_9= Weed free (1st July- 30th Sept.)	95.67 b	33.00 c	30.14 b	14.20 bc	8.44 h
T_{10}= Weed free (15th July- 30th Sept.)	109.00 a	36.33 b	35.30 a	13.80 c	8.44 h
T_{11}= Weed free (1st Aug.- 30th Sept.)	82.67 c	40.33 a	35.06 a	13.60 cd	8.40 h
T_{12}= Weed free (15th Aug.- 30th Sept.)	74.00 d	40.67 a	35.74 a	13.60 cd	8.22 i
T_{13}= Weed free (1st Sept.- 30th Sept.)	56.67 f	41.33 a	35.40 a	12.40 de	8.21 i
T_{14}= Weed free (15th Sept.- 30th Sept.)	37.67 h	41.66 a	35.62 a	12.20 e	8.06 j
T_{15}= Weed free up to 0 day (control)	17.67 j	41.33 a	35.90 a	12.00 e	7.78 k

PP 5: ARBUSCULAR MYCORRHIZAL FUNGI IN TEA

PP 5.2: Effect of AM fungi on growth and development of tea (BTRI: 2010-2014).

Progress

All plant growth parameter like Plant height, Length of roots, Weight of plants and Weight of roots were found to be significantly higher in T_4 which was treated with only Mycorrhiza followed by T_3 (Nursery mixture + Mycorrhiza) (Table 9). The experiment will be continued.

Table 9. Effect of AM fungi on growth parameter of tea saplings in the nursery (2013, BTRI)

	Plant height (cm)	Length of roots (cm)	Weight of plants (gm)	Weight of roots (gm)
	Mean of five replications			
T_1= Control (Only soil)	47.80	16.30	4.80	2.08
T_2= Nursery mixture	51.40	17.30	6.14	2.40
T_3= T2 + Mycorrhiza	56.60	19.92	6.80	3.32
T_4= Mycorrhiza	63.00	23.30	7.70	3.46
LSD (0.05)	*2.563*	*0.246*	*0.344*	*0.203*
CV	*3.40%*	*0.93%*	*3.93%*	*5.23%*

TECHNOLOGY DIVISION

Dulal Chandra Dey
Scientific Officer

STAFF

Mr. Mahamudul Hasan joined the Division on 30/12/2013 as Fitter and Mr. Saddam Mia joined on 26/12/2013 as Guard. There was no other change in the Personnel Position of the division during the period under report.

RESEARCH

Three experiments were carried out by this Division during the period under report. The progress is of these experiments are summarized below.

Withering

T1-11: Effect of heat in the withering trough on the quality of tea.

Objective:

1. To compare the quality of Made Tea with and without use of heat in the withering trough.

Findings:

a. During excess humidity, application of heat improves quality.
b. At low humidity application of heat decreases quality.
c. Broken percentage is high at without heat and dust percentage is high with heat.

Table 1. **Scoring of tea quality parameter with and without heat**

RH (%)		Infused leaf	Color	Strength	Briskness	Total	Average quality
70	Without heat	6.50	7.50	6.50	7.50	28.00	7.00
	With heat	7.00	6.50	7.00	6.50	27.00	6.75
75	Without heat	6.00	6.50	6.50	6.00	25.00	6.25
	With heat	6.50	7.00	6.50	6.00	26.00	6.50
80	Without heat	6.00	6.50	5.50	6.00	24.00	6.00
	With heat	6.50	7.50	6.50	6.50	27.00	6.75
90	Without heat	6.00	6.50	5.50	6.00	24.00	6.00
	With heat	7.50	6.50	7.00	7.00	28.00	7.00
95	With heat	5.50	6.00	5.50	5.50	22.50	5.63
	With heat	6.00	6.50	7.50	7.00	27.00	6.75

Table 2. Grade percentage of Made Tea

Without heat	With heat
52% Broken	50% Broken
22% Fanning	21% Fanning
12% Dust	17% Dust
14% Over	12% Over

Leaf Composition

T1-12: Study the effect of different physical leaf composition on the tea quality and its grade percentage

Objectives:

1. To find out the quality of Made Tea according to plucking variation.
2. To find out the grade percentage according to plucking variation.

Findings:

a. Highest quality of Made Tea from one bud and one leaf.

b. Lowest quality of Made Tea from one bud and three leaves.

Table 3. **Scoring of tea quality parameter with leaf composition**

Sl. No.	Leaf	Infused leaf	Color	Strength	Briskness	Total	Average quality
1	One leaf & a bud &	6.50	7.50	6.50	7.50	28.00	27.83
		7.00	7.00	6.50	7.50	28.00	
		6.50	6.50	7.50.	7.00	27.50	
2	Two leaves & a bud &	6.50	6.00	6.50	6.50	25.50	25.83
		7.00	6.50	6.00	6.00	25.50	
		6.00	7.50	6.00	7.50	26.50	
3	Three leaves & a bud &	5.50	6.00	6.50	5.50	23.50	23.67
		6.00	5.50	5.50	6.00	23.00	
		5.50	6.00	6.00	6.50	24.00	

Temperature of CTC Rollers

T1-13: Determination of Made Tea quality at different temperature of CTC Rollers.

Objective:

1. To find out the quality of Made Tea according to temperature variation of CTC roller.

Findings:

a. Highest quality of Made Tea from lowest temperature of CTC roller.

b. Lowest quality of Made Tea from highest- temperature of CTC roller.

Table 1. **Scoring of tea quality parameter with different temperature of CTC roller**

Sl. No.	Average Temperature	Infused leaf	Color	Strength	Briskness	Total	Average
1	41º c	7.00	7.50	7.00	6.00	27.50	6.88
	43º c	6.50	6.00	6.50	6.50	25.50	6.37
	46º c	6.00	5.50	6.50	5.50	23.50	5.88
2	42º c	6.50	7.50	6.50	7.00	27.50	6.88
	45º c	6.50	7.00	6.00	6.50	26.50	6.50
	47º c	6.00	6.50	5.50	5.50	25.50	5.88
3	43º c	7.50	6.00	7.00	7.50	28.00	7.00
	46º c	6.00	6.00	6.00	6.50	24.50	6.13
	47º c	5.50	5.00	6.00	5.50	22.00	5.50

FACTORY

Maintenance and repair works of the factory machinery were done as usual. Re-sharpening of CTC rollers was done at workshop with high degree of standard. Maintenance of power house and different kinds of vehicles was done as usual.

BILASHCHERRA EXPERIMENTAL FARM

BTRI, SREEMANGAL

STAFF

Mr. Mohammad Sayadul Huq, Farm Supervisor of BTRI Farm was promoted to Assistant Farm Superintendent of Bilashcherra Experimental Farm on 20 March, 2013. Mr. Md. Zayed Imam Siddique, Senior Farm Assistant has been transferred to BTRI Regional Station, Panchagarh on 01 April, 2013. The post of Assistant Store Keeper was lying vacant during the reporting period. There was no other change in the staff position.

FARM

1. Land Distribution

Sl. No.	Description	Area (ha)	
(a)	*Under Tea*	*106.36*	
	I. Plucking Area 1. Immature Tea (under 5 years) 2. Tea bushes 5 to 10 years 3. Tea bushes 11 to 40 years 4. Tea bushes 41 to 60 years	 5.88 2.50 50.16 40.82	99.36
	II. Seed Bari	6.00	
	II. Seed Nursery	0.50	
	III. Clone Nursery	0.50	
(b)	*Under Subsidiary Crops*	*19.26*	
	I. Fruit Tree	4.65	
	II. Soft and Hard Wood Timber Garden	10.56	
	III. Agar	4.05	
(c)	Office/Bungalow/Godown, Staff Quarter, Labour Line, School, Hospital, Graveyard, Masjid/Mandir/Church and Roads	29.60	
(d)	Cultivable, Fellow and Waste Land	73.14	
Total Area of the Farm		**228.36**	

2. Crop Production

a. Green Leaf (kg)	8,49,170
b. Made Tea (kg)	1,93,696
c. Average Production (kg /ha)	2,072

3. Monthly Crop Production of the Farm in the Year 2013

Name of the Month	Month-wise crop production in 2013 (kg)
January	-
February	-
March	1,017
April	25,385
May	66,603
June	1,14,123
July	1,55,912
August	1,42,229
September	1,17,773
October	1,08,974
November	70,706
December	46,448

4. Production of Improved Bi-clonal Seed, Planting Materials and Sales of Farm Products

Bi-Clonal Seed (kg)	Sales of Bi-Clonal Seed (Tk.)	Sales of Different Fruit (Tk.)
260	26,000.00	58,000.00

5. Extension and Development

1.38 ha of new plantation was extended in 2013. Six (06) new pucca labor houses were built along with structural development of four (04) kancha houses during the year. It has a nursery with the average capacity of 50,000 plants. Water supply, labor houses, roads and bridges were regularly maintained. Experiments of different Divisions had been facilitated at the period.

6. Miscellaneous

The Victory Day as well as the Independence Day were celebrated with due solemnity during the year. Prizes for sports and sweets were distributed among the labors of the farm and their children on both the occasions. Blankets were distributed among the labors as incentive of the year.

BTRI SUB-STATIONS

FATICKCHERRI, CHITTAGONG

STAFF

Mr. Md. Moshiur Rahman Akonda, Scientific Officer was transferred to BTRI and Mr. Md. Syeful Islam, Senior Scientific Officer took over the charge of Officer in-Charge of the Sub-station since December, 2013. There was no other change in personnel position of the Division during the reporting year.

PRODUCTION

42,019 Kgs green leaves were produced during the year 2013. Harvested green leaves were sent to Oodaleah Tea Estate for manufacturing.

DISTRIBUTION OF IMPROVED PLANTING MATERIALS

Year	Items	Tea Estate		CHT Project	Bashkhali	Total (No./Kg)
		No.	Quantity (No./Kg)			
2013	Fresh Cuttings	8	18,10,000	73,500	-	18,83,500
	Rooted Cuttings	2	25,000	1,300	-	26,300
	Biclonal Seeds	7	380	-	-	380

Besides the above mentioned items, Bet (cane) and Jackfruits were sold at worth of Tk. 2,900.00 and 12,000.00 respectively during the year.

KALITI, KULAURA

STAFF

There was no change in the personnel position of the Sub-station during the year 2013.

PRODUCTION

Green leaves produced during 2013 and total numbers of fresh cuttings distributed to different Tea Estates are given below:

Year	Production of green leaf (Kg)	Fresh cutting supplied (nos.)	Callus cuttings supplied (nos.)
2013	26,486	14,000	36,000

REGIONAL STATION

PANCHAGARH

14,865 Rooted cuttings were supplied to Tea Estates @ 3.00 Taka.

Other activities of the divisions during 2013

Sl.	Item	Soil Science	Biochemistry	Botany	Agronomy	Entomology	Plant Pathology	Technology
01	No. of experiments	4	01	23	4	8	5	3
02	No. of experimental visits	28	-	16	33	17	30	
03	No. of advisory visits	9	-	6	6	11	9	3
04	No. of advisory correspondence	228	-	6	-	14	-	-
05	No. of nursery soil, water & cowdung samples analyzed for nematodes	-	-	-	-	98	-	-
06	No. of pesticide residue analysis (commercial)	-	-	-	-	3	-	-
07	No. of pesticide residue analysis (Experimental)	-	-	-	-	3	-	-
08	No. of circulars/pamphlets/leaflets issued to T. E.	1	-	-	-	1	-	-
09	No. of pesticides tested in tea fields	-	-	-	-	135	30	-
10	No. of workshop/seminar conducted	2	-	-	6	1	1	3
11	MTC module conducted (Hours/year)	24 hrs.	-	16 hrs.	30 hrs.	2 hrs.	8 hrs.	21 hrs.
12	Attended national seminar, conference, symposium & workshop	-	-	-	-	2	-	-
13	Attended international seminar, conference & symposium	-	-	-	-	1	-	-
14	Attended Training/Course	1	01	3	-	1	1	-
15	No. of research paper published	-	-	-	1	3	-	-
16	No. of Fresh cutting supplied	-	-	700		-	-	-
17	No. of Rotted cutting supplied	-	-	2942		-	-	-
18	Biclonal seed supply to T. E.	-	-	1993 Kg.		-	-	-
17	Tea tasting			5				1