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# ANNUAL REPORT 2016

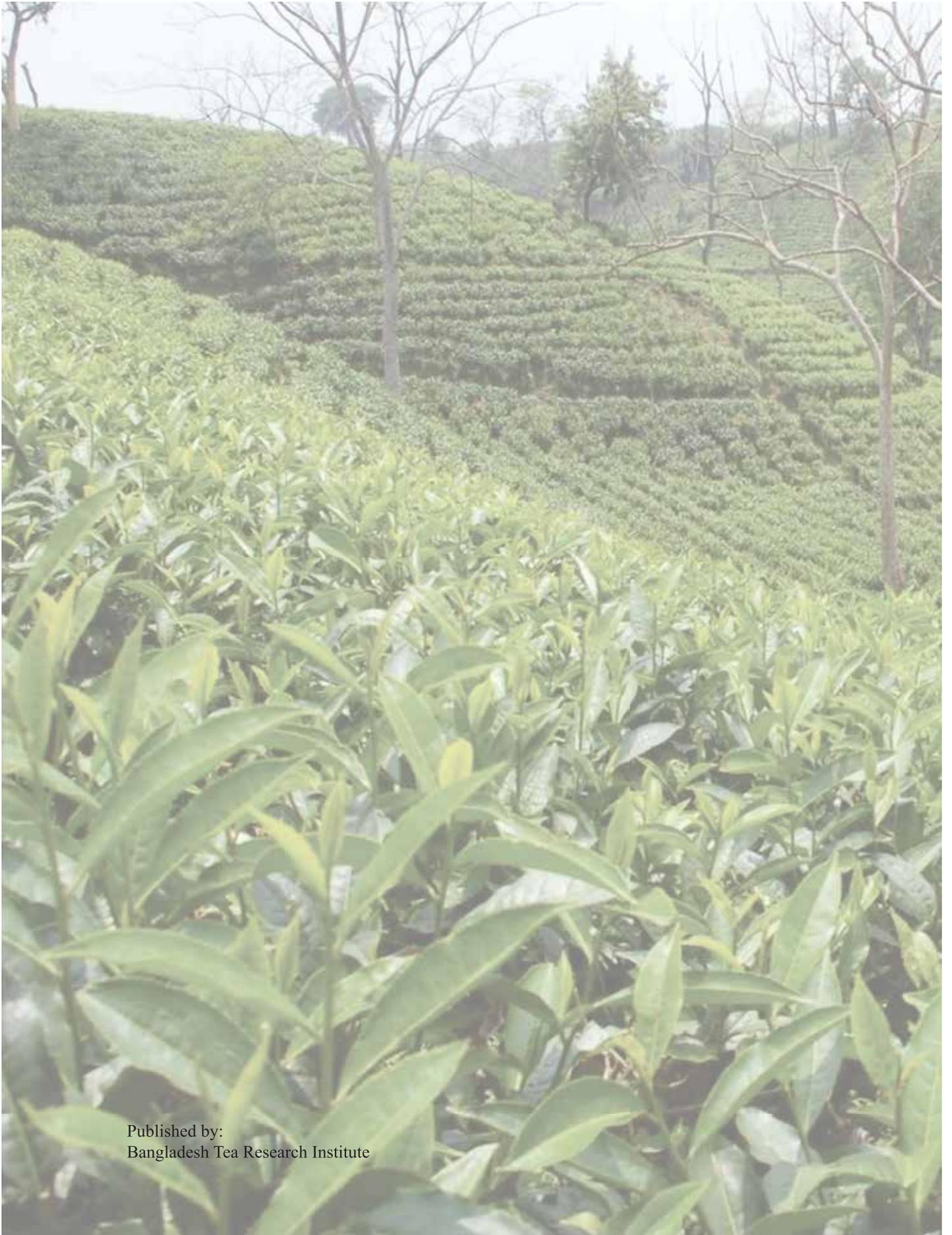


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**BANGLADESH TEA RESEARCH INSTITUTE**  
SRIMANGAL-3210, MOULVIBAZAR

An organ of

**BANGLADESH TEA BOARD**  
171-172, Baizid Bostami Road  
Nasirabad, Chittagong  
[www.btri.gov.bd](http://www.btri.gov.bd)



Published by:  
Bangladesh Tea Research Institute

Annual Report 2017

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Annual Report 2017

## ANNUAL REPORT 2017

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### RATE OF SUBSCRIPTION

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*A complimentary copy is given to each of the enlisted tea estates only once at the time of publication.  
Additional copy is supplied on request with half the inland price if prints are available.*

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## DIRECTOR'S REPORT

### STAFF

The report of the technical staff shows the position as on 31 December 2017

Director : **Dr. Mohammad Ali**  
B.Sc. (Hons), M.Sc. (CU), M.Sc. (Newcastle, UK)  
PGD (India), Ph.D

### TECHNICAL DIVISIONS

#### 1. DEPARTMENT OF CHEMISTRY

Chief Scientific Officer : **Vacant**

##### A. SOIL SCIENCE DIVISION

Principal Scientific Officer : **Abdul Qayyum Khan**  
B.Sc. (Hons), M.Sc. (DU)  
M.Sc (Reading, UK)

Senior Scientific Officer : **Apu Biswas**  
B.Sc. (Hons), M.S. (DU), PGD (India)

Scientific Officer : **Kanij Fatema Tuz Zohora**  
B.Sc. (Hons), M.S. (CU)

Scientific Officer : **Naim Mustafa Ali**  
B.S. (Hons), M.S. (DU)

Scientific Officer : **Md. Arifur Rahman Bhuiyan**  
B.S. (Hons), M.S. (DU)

##### B. BIOCHEMISTRY DIVISION

Scientific Officer : **Md. Arif Mahmud Howlader**  
B.Sc. (Hons), M.S. (DU)

#### 2. DEPARTMENT OF CROP PRODUCTION

Chief Scientific Officer : **Md. Ismail Hossain**  
B.Sc.Ag.(Hons), M.S. (BAU)

##### A. BOTANY DIVISION

Principal Scientific Officer : **Dr. Md. Abdul Aziz**  
B.Sc. (Hons), M.Sc. (RU), Dipl. (China), Ph.D. (RU)

Scientific Officer (Deputation in Nilphamari) : **Md. Abul Kashem**  
B.Sc. (Hons), M.Sc. (CU)

Scientific Officer : **Md. Riyadh Arefin**  
B.Sc.Ag.(Hons), M.S. (BSMRAU)

Scientific Officer : **Ishrath Jahan**  
B.Sc. (Hons), M.S. (CU)

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

**B. AGRONOMY DIVISION**

Principal Scientific Officer	: <b>Dr. Toufiq Ahmed</b> B.Sc. Ag. (Hons), M.S. (BAU), Ph.D. (Sri Lanka)
Senior Scientific Officer	: <b>Dr. Mohammad Masud Rana</b> B. Sc. Ag.(Hons), M.S. (BAU), Ph.D (Chaina)
Scientific Officer	: <b>Md. Imran Hossen</b> B.Sc.Ag.(Hons), M.S. (SAU)
Scientific Officer	: <b>Sultan Md.Monwarul Islam</b> B.Sc.Ag.(Hons), M.S. (BAU)
Farm Supervisor	: <b>Roni Debnath</b> M.Sc.Ag. (Hons), M.S (SAU)

**3. DEPARTMENT OF PEST MANAGEMENT**

Chief Scientific Officer	: <b>Vacant</b>
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**A. ENTOMOLOGY DIVISION**

Scientific Officer	: <b>Shovon Kumar Paul</b> B.Sc.Ag. (Hons.) (KU), M.S. (BSMRAU)
Scientific Officer	: <b>Md. Jahangir Alam</b> B.Sc.Ag.(Hons), M.S. (BAU)
Senior Farm Assistant	: <b>Md. Abul Kalam Azad</b> Dip.-in-Agric. (Dhaka)

**B. PLANT PATHOLOGY DIVISION**

Senior Scientific Officer	: <b>Mohammed Syeful Islam</b> B.Sc.Ag., M.S. (BAU)
Scientific Officer	: <b>Md. Moshiur Rahman Akonda</b> B.Sc.Ag. (Hons), M.S. (BAU)

**TECHNOLOGY DIVISION**

Scientific Officer (Deputation in Bandarban)	: <b>Dulal Chandra Dey</b> B.Sc. Engg. Mech. (BUET)
Senior Tea Maker	: <b>Md. Amir Ali</b> B.Sc. (RU)
Assistant Engineer (Civil)	: <b>Md. Sohel Rana</b> B.Sc.Engg. Civil (KUET)
Foreman (PRL)	: <b>Nazrul Islam Chaudhury</b> Dip-in-Engg. Elect. (Sylhet)

**STATISTICS & ECONOMICS DIVISION**

Senior Scientific Officer	: <b>Dr. Shefali Boonerjee</b> B.Sc. (Hons), M.Sc. (RU) Ph.D (DU)
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**BTRI SUB-STATION, FATIKCHARI, CHATTOGRAM**

Senior Scientific Officer & Officer in-charge	: <b>Ashim Kumar Saha</b> B.Sc. (Hons), M.Sc. (DU)
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Scientific Officer	: <b>Raihan Mujib Himel</b> B.Sc.Ag. (Hons.), M.S. (BSMRAU)
Senior Farm Assistant	: <b>Ajit Chandra Choudhury</b> B.A. (NU)
<b>BTRI SUB-STATION, KALITI, KULAURA</b>	
Field Assistant	: <b>Aminul Islam Mandal</b> Dip.-in-Agric. (Sherpur)
<b>BTRI REGIONAL STATION, PANCHAGARH</b>	
Senior Scientific Officer & Officer in-charge	: <b>Dr. Mohammad Shameem Al Mamun</b> B.Sc.Ag. (Hons.), M.S. (BAU), PGD (India), Ph.D (SUST)
Senior Farm Assistant	: <b>Md. Zayed Imam Siddique</b> Dip.- in- Agric. (Rangpur)
<b>BILASHCHERRA EXPERIMENTAL FARM</b>	
Assistant Farm Superintendent	: <b>Mohammad Sayadul Huq</b> M.Sc (NU)
Field Assistant	: <b>Ajit Kumar Sarker</b> Dip.- in- Agric. (Mymensingh)
Field Assistant	: <b>Zobayer Ahamed</b> Dip.- in- Agric. (Rangpur)
Field Assistant (Deputation in Bandarban)	: <b>Md. Sabbir Mahedi Joy</b> Dip.- in- Agric. (Rangpur)
Field & Store Assistant	: <b>Rajib Ahmed</b> Dip.- in- Agric. (Dhaka)
<b>LIBRARY &amp; PUBLICATION</b>	
Librarian & Publication Officer	: <b>Mohammad Kamal Uddin</b> M. Sc. (RUD), M.S.S. (NU), LL.B (NU) PGD in Lib. Sc. (Dhaka)

## RESEARCH

The importance of research and technology transfer system has also increased many folds. The research activities are designed and carried out keeping in view of the need of the industry towards maximum yield as well as the quality tea. Like previous years all out efforts were made by the Institute to maintain standard of the work relating to research, advisory, training, workshops, seminars, tea tasting session etc. Similar services were also extended from the Fatikcharri and Panchagarh sub-station.

This report of Bangladesh Tea Research Institute covers the period from January to December, 2017.

During the year under report, a total of 60 experiments on different aspects of tea culture were in progress in different disciplines research divisions. The salient 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. The importance of organic fertilizers and its sources were also encompassed. Experiments on effect of vermicompost on soil properties, growth and yield of mature tea; status of micronutrients in tea soils and its effects on the growth and yield of young and mature tea was started during the reporting year. 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 analyses. A total of 2657 soil, fertilizer including lime samples were analyzed during 2017.

Plant improvement received top priority as usual amongst the research activities of Botany Division. Several new test clones were under different stages of long term yield and quality trials. Hybridization between clones and agrotypes, collection and preservation of germplasms of tea from home and exotic sources were continued.

Agronomy Division carried out research activities on various cultural practices e.g. planting, pruning, tipping, plucking and related agro-techniques in tea field. During the reporting year, a new experiment was initiated on mechanization of tea plucking. Labour crisis is becoming a problem in many of the tea growing area of Bangladesh as well as in many of the tea estates. To cope up the upcoming problem of the tea industry, it may be needed to change the harvesting policy of tea.

The Research of Entomology Division includes cultural and mechanical control of insect pests, studies on indigenous plant extracts, bio-control of insect pests, screening of pesticides, pesticide residue analysis in tea. This Division also rendered all sorts of advisory services to tea estates on problems arising out of pests of tea and analyzed soil and water for nematode count. This Entomology Division also engaged in analyzing made tea samples for the detection of pesticide residue received from different tea estates, companies and organizations.

Plant Pathology Division was mainly concerned with the isolation, culture & identification of major disease causing organisms of tea and ancillary crops, Screening of different fungicides & herbicides, Bio-ecology of disease causing organisms, Integrated disease and weed management, Assessment of arbuscular mycorrhizal (AM) fungi in tea & tea associated plants. Microbial effect on made tea quality, Use of Plant Growth Promoting Rhizospheric (PGPR) Microbes in controlling different tea diseases were the new areas of research of the division.

Statistics and Economics division was engaged on the economic analyses of tea cultivation and to study economic way of small holding tea cultivation in Bangladesh. The division also assisted in designing experiments and related statistical analyses of data of other research divisions as and when required.

Normal manufacture of tea in the factory from the green leaves harvested from its Main station and Bilashcherra experimental farm was conducted by Technology Division.

The supply of improved planting materials in the form of fresh as well as rooted cuttings and biclonal seeds were continued from BTRI and sub-stations (including CHT project) during 2017. A total of 32,02,200 fresh cuttings, 33,775 rooted cuttings and 395 kg, bi-clonal seeds were distributed to different tea estates in the year 2017. Technology disseminations through seminars, workshops and advisory visits were continued in the Main station and Sub-stations during the year.

## Annual Report 2017

### TEA TASTING SESSIONS

As a regular annual feature and group exercise, two general tea tasting sessions were conducted for the tea planters to improve further the manufacturing of quality tea from the tea factories as a whole at BTRI Tea Tasting Room for Sylhet. In addition, Open Day Tea Tasting Sessions were also arranged in each of the four valley circle clubs.

### VISITS

Scientific personnel of the institute and sub-stations paid a total of 246 experimental and 118 advisory visits to different tea estates in order to solve various local problems connected with tea culture and experimental purposes during the period under report.

### PUBLICATIONS

Annual Report 2016 was published in July 2017 and Tea Journal of Bangladesh (Vol. 45), 2016 was published in July 2017. Circular no. 141 and Circular no. 142 were also published in June 2017.

### ANNUAL COURSE / SEMINAR / WORKSHOP

The 52<sup>nd</sup> Annual course (6 day-duration) was held on 'Tea Culture' at the Institute for the covenanted staff of Tea Estates of greater Sylhet. Same courses were held at Chattogram and Panchagarh Sub-stations having two-day duration each. In these courses, Managers, Assistant Managers, Proprietors of different Tea Estates, small tea growers, Scientific Officers of BTRI 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 staffs of different Tea Estates during the period under report.

### OFFICIAL CORRESPONDENCE

Total receipts - 2201  
Total issues - 1990

### LIBRARY

BTRI Library contained 4,925 books and 9,136 Journals, Annual Report, Pamphlets, Circulars, Newsletter, Proceedings and Research highlights, etc.



**(Dr. Mohammad Ali)**  
Director, BTRI.

## SOIL SCIENCE DIVISION

**Abdul Qayyum Khan**  
Principal Scientific Officer

### STAFF

Mr. Abdul Qayyum Khan was promoted as Principal Scientific Officer and Mr. Apu Biswas was promoted as Senior Scientific Officer on 09 July 2017. Mr. Ashim Kumar Saha, Senior Scientific Officer was transferred from Bangladesh Tea Research Institute, Srimangal to BTRI-Substation, Fatikcherri, Chattogram on 12 March 2017. Mr. Md. Arifur Rahman Bhuiyan joined as Scientific Officer on 04 December 2017. There was no other change in the personnel position of the division during the period under report

### RESEARCH

A total of four experiments were conducted during the year 2017 by Soil Science Division. Progress of the experiments is given below.

#### SS 1: RESPONSE OF DOLOMITE LIME AND ITS EFFECT ON THE CHANGES OF SOIL PROPERTIES AND YIELD OF MATURE TEA (2016-2019)

To estimate the effect of dolomitic lime on the yield of mature tea, a field experiment was conducted at Srigobindpur Tea Estate. The experiment was laid out in a RBD having seven treatments and three replications. Dolomite was applied after a good shower in the 1<sup>st</sup> week of March, 2017. The experiment was laid out in the year 2016 and will be continued upto 2019. Each plot size is 14.00 m<sup>2</sup>. Usual cultural operations and pest control measures were taken as and when needed. Regular weekly harvesting data were recorded during the cropping season. Treatment combinations were as follows:

T <sub>1</sub> = Control	T <sub>5</sub> = 2000 kg/ha dolomite
T <sub>2</sub> = 500 kg/ha dolomite	T <sub>6</sub> = 2500 kg/ha dolomite
T <sub>3</sub> = 1000 kg/ha dolomite	T <sub>7</sub> = 3000 kg/ha dolomite
T <sub>4</sub> = 1500 kg/ha dolomite	

In every experimental plot basal dose of chemical fertilizers (N<sub>220</sub>, P<sub>40</sub>, K<sub>105</sub> & Zn<sub>10</sub> kg/ha) were applied. Fertilizer was applied in two split doses. The 1<sup>st</sup> dose was applied after a good shower of monsoon and the 2<sup>nd</sup> dose was applied in the 1<sup>st</sup> week of August, 2017.

**Table 1.** Initial fertility status of soils of the experimental plots

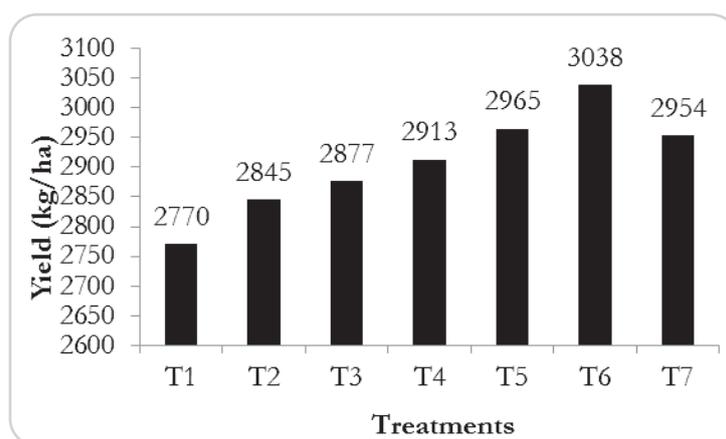
Location	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
Srigobindpur T.E	SCL	4.7 5	1.08	0.125	7.95	51.26	78.61	19.20
Critical value	SL - L	4.5- 5.5	1.0	0.1	10	80	90	25

SCL- Sandy Clay Loam, SL- Sandy Loam L- Loam, O.C-Organic Carbon

**Table 2.** Soil analytical results at the end of the year 2017

Treatment	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
T <sub>1</sub>	SCI	4.2	1.05	0.104	5.09	60.27	69.75	10.85
T <sub>2</sub>	SCI	4.6	1.07	0.107	6.88	67.44	77.29	17.23
T <sub>3</sub>	SCI	4.7	1.14	0.113	11.10	71.87	84.50	17.87
T <sub>4</sub>	SCI	4.8	1.15	0.118	11.92	73.51	86.02	20.92
T <sub>5</sub>	SCI	4.8	1.20	0.122	12.07	75.68	88.18	21.17
T <sub>6</sub>	SCI	5.0	1.22	0.125	16.86	78.32	92.64	27.79
T <sub>7</sub>	SCI	5.4	1.17	0.120	6.21	62.49	135.71	39.40

The result shows that, increase of yield was recorded in every treatment over the control. The highest yield of made tea (3038 kg/ha) was recorded in treatment T<sub>6</sub> where 2500 kg/ha dolomite with basal doses of chemical fertilizers were applied. The rate of increase over the control was 9.68% in case of treatment T<sub>6</sub>. But the increase of yield due to different treatment was statistically insignificant.

**Fig 1.** Effect of different dolomite lime doses on the yield of tea (Srigobindpur T.E, 2017)

## **SS 2: EFFECT OF VERMICOMPOST ON SOIL PROPERTIES, GROWTH AND YIELD OF MATURE TEA (2016-2019)**

The long term (2016-2019) experiment has been undertaken to observe the effect of vermicompost on soil properties, growth and yield of mature tea at Bilashcherra Experimental Farm. Evaluation of the dose and efficiency of vermicompost on tea production as well as minimize the use of chemical fertilizer is the prime goal of this experiment. Dolomitic lime and NPK were applied on the soil after a good shower,

simultaneously vermicompost was also applied and mixed with the soil by light forking. Usual cultural practices and pest control measures were taken as and when needed. Regular weekly plucking data were recorded during the plucking season of the year 2017. The experiment will be continued upto 2019. There are eight treatments in a Randomized Block Design with three replications. The unit plot size is 13.40 m<sup>2</sup>. The treatment combinations are presented below.

T <sub>1</sub> = Control	T <sub>5</sub> = Vermicompost (6.0 tons/ha)
T <sub>2</sub> = 100% Recommended fertilizer dose	T <sub>6</sub> = Vermicompost (1.5tons/ha) + 100% Recommended fertilizer dose
T <sub>3</sub> = 80% Recommended fertilizer dose	T <sub>7</sub> = Vermicompost (3.0tons/ha) + 80% Recommended fertilizer dose
T <sub>4</sub> = 60% Recommended fertilizer dose	T <sub>8</sub> = Vermicompost (6.0tons/ha) + 60% Recommended fertilizer dose

(Recommended Fertilizer dose: N<sup>100</sup>, P<sup>30</sup>, K<sup>60</sup> kg/ha)

**Table 3.** Initial fertility status of soils of the experimental plots

Location	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
BEF	SCI	4.5	1.01	0.120	5.49	48.31	49.26	9.52
Critical value	SL - L	4.5-5.5	1.0	0.1	10	80	90	25

SCL- Sandy Clay Loam, SL- Sandy Loam L- Loam, O.C-Organic Carbon

**Table 4.** Soil analytical results at the end of the year 2017

Treatment	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
T <sub>1</sub>	SCI	4.5	1.11	0.115	6.35	50.76	68.85	11.73
T <sub>2</sub>	SCI	4.7	1.04	0.109	30.42	81.25	81.92	16.81
T <sub>3</sub>	SCI	4.7	1.07	0.110	24.59	77.61	82.11	16.57
T <sub>4</sub>	SCI	4.6	1.10	0.114	18.91	71.43	79.37	14.48
T <sub>5</sub>	SCI	4.6	1.35	0.139	20.22	70.19	77.50	13.96
T <sub>6</sub>	SCI	4.8	1.18	0.121	33.86	142.68	81.35	17.85
T <sub>7</sub>	SCI	4.9	1.24	0.129	38.72	97.82	85.44	22.64
T <sub>8</sub>	SCI	4.8	1.31	0.134	43.56	85.30	82.61	19.95

The result shows that, increase of yield was recorded in every treatment over the control. The highest yield of made tea (3120 kg/ha) was recorded in treatment T<sub>7</sub> where 3.0 tons/ha vermicompost with 80% of the recommended doses of chemical fertilizers were applied (Fig. 2). The rate of increase over the control was 7.00% in case of treatment T<sub>7</sub>. The increase of yield due to different treatment was statistically insignificant.

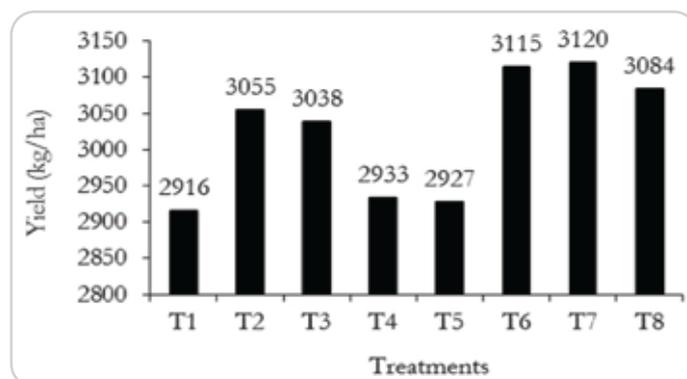


Fig 2. Effect of vermicompost on the yield of tea (BEF, 2017)

### SS 3: STATUS OF MICRONUTRIENTS (B, Mo, Zn, Mn, Fe & Cu) IN SOME SELECTED TEA SOILS & ITS EFFECTS ON THE GROWTH AND YIELD OF YOUNG TEA AND MATURE TEA.

Micronutrients are very important for plants to complete their life cycles but need only in a small amount. Micronutrients such as Fe, Mn, Cu, Zn etc function in the enzyme systems in tea plant. They also play an important role in chlorophyll production, oxidation- reduction system, co-enzymatic factor etc. which is ultimately influence on growth, yield and quality of tea. Though very small application of micronutrient may produce dramatic result but the effects of micronutrient deficiency may be severe in term of stunted growth, low yield, dieback and even plant death.

So, it is very important to know the status of micronutrients (B, Mo, Zn, Mn, Fe & Cu) in tea soils of Bangladesh which will be helpful for the proper nutrient management.

**Methodology:** Soil samples were collected randomly from tea sections of BTRI and BEF and analyzed accordingly to estimate the status of micronutrients. The treatments of the experiment will be fixed after knowing the status of micronutrients. Both pot and field experiments will be done.

**Duration:** 2017-2022

**Location:** BTRI, BEF and different tea gardens of Bangladesh

**Progress:** Micronutrient analysis of the collected 50 (fifty) soil samples of BTRI farm, Bilashcherra Experimental farm and Luskerpore Tea Estate has been done. Zinc, Iron, Manganese and copper analysis of the soil samples has been completed. Minimum content of Zn, Fe and Cu were 0.053, 0.14 and 0.015 ppm respectively. Among 50 soil samples Manganese content of 19 soil samples were in Below Detection Level (BDL). Maximum content of Zn, Fe, Mn and Cu were 1.64, 16.99, 6.54 and 0.47 ppm respectively. Some soil samples from Bilashcherra Experimental Farm (BEF) has been collected and the analysis is going on. Soil samples from different tea estates will be collected to estimate the present status of micronutrients.

**Table 5:** Micronutrient status of some collected tea soils

Tea Estate	Sec. No.	Topography	Sample No.	Depth (in)	Zn	Fe	Mn	Cu
BTRI Farm	A2 (BT2)	H. Flat	1	0-9	0.87	15.72	0.83	0.17
			2	9-18	0.39	16.99	0.07	0.11
			3	18-36	0.40	3.88	BDL	0.081
	A2 (BT5)	H. Flat	4	0-9	0.78	9.26	0.81	0.19
			5	9-18	0.64	7.45	1.16	0.13
			6	18-36	0.08	0.14	0.68	0.075
	A2 (BT6)	H. Flat	7	0-9	0.61	6.08	1.77	0.14
			8	9-18	0.18	6.65	BDL	0.13
			9	18-36	0.19	3.36	BDL	0.12
	A2 (BT8)	H. Flat	10	0-9	0.75	7.78	1.29	0.15
			11	9-18	0.42	12.03	0.62	0.19
			12	18-36	0.71	7.30	6.54	0.47
	Ph.D Plot	H. Flat	13	0-9	1.64	12.73	1.45	0.38
			14	9-18	0.62	15.66	0.67	0.19
			15	18-36	0.33	14.99	BDL	0.31
			16	0-9	0.50	4.24	1.63	0.19
			17	9-18	0.38	15.34	0.02	0.26
			18	18-36	0.74	10.25	BDL	0.34
			19	0-9	0.91	8.79	1.48	0.28
			20	9-18	0.34	13.46	0.08	0.22
			21	18-36	0.28	11.41	BDL	0.14
			22	0-9	1.47	6.15	0.73	0.12
			23	9-18	0.71	9.23	BDL	0.47
			24	18-36	0.53	7.81	BDL	0.29
	D1	L. Flat	25	0-9	0.68	4.85	2.76	0.15
			26	9-18	0.72	7.19	BDL	0.28
			27	18-36	0.40	6.01	BDL	0.23

Tea Estate	Sec. No.	Topography	Sample No.	Depth (in)	Zn	Fe	Mn	Cu
BTRI Farm	66	T.Top	28	0-9	0.38	4.92	2.63	0.27
			29	9-18	0.53	3.28	1.42	0.47
			30	18-36	0.26	1.62	0.40	0.30
	Project Area	H. Flat	31	0-9	0.58	6.56	0.09	0.058
			32	9-18	0.25	14.37	BDL	0.42
			33	18-36	0.24	8.46	BDL	0.16
	Saloon	T. Flat	34	0-9	0.21	1.93	0.48	0.16
			35	9-18	0.25	7.65	0.23	0.31
			36	18-36	0.053	1.11	BDL	0.14
	New Tillah	T. Slope	37	0-9	0.40	4.29	2.49	0.058
			38	9-18	0.11	4.26	0.76	0.14
			39	18-36	0.22	2.49	0.20	0.19
	B2	T. Flat	40	0-9	0.80	4.32	2.08	0.10
			41	9-18	0.19	7.11	0.14	0.023
			42	18-36	0.23	2.12	BDL	0.020
	C Area (Block-A)	Flat	43	0-9	0.37	7.91	BDL	0.064
			44	9-18	0.069	4.73	BDL	0.015
			45	18-36	0.16	2.56	BDL	0.039
C Area (Block-B)	Flat	46	0-9	0.10	1.66	0.48	0.10	
		47	9-18	0.30	2.52	BDL	0.040	
		48	18-36	0.38	0.74	BDL	0.043	
Lusker pore T.E	10	H. Flat	49	0-9	0.89	2.27	2.69	0.046
			50	0-9	1.16	1.13	2.43	0.040

#### SS 4: Studies on physical properties of some selected tea soils of Bangladesh and their influence on chemical properties and yield of tea

The life cycle of tea plant is long, yields tend to decline after four or five decades and plant death or stunted growth is a common occurrence in above 40 years old tea fields. The decline in yield, as well as the increase in plant mortality or stunted growth under long-term tea cultivation, however, may also reflect degradation of soil health. So this research will help assess the long-term impact of growing tea on soil physical properties and how it correlates with crop yield.

### Methodology

This research will be conducted by selecting some tea gardens with old, mature and young tea plantation randomly. The following physical properties of soils of those selected gardens will be assessed by using standard methods:

- a) Texture
- b) Structure
- c) Bulk Density
- d) Particle Density
- e) Compaction
- f) Hydraulic Conductivity

Chemical properties will be determined also. All the data will be statistically analyzed by using standard statistical packages.

**Location:** BTRI, Bilashcherra Experimental Farm and different tea gardens of Bangladesh

**Duration:** 2017-2022

**Progress:** For physical test some new tools like aluminum cup, stainless steel core and wooden hammer has been made. Collection of soil sample is going on.

### Advisory services

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 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 2506 soil samples and 151 other samples from 83 tea estates were analyzed for different purposes, the breakup of which is presented in table 6.

**Table 6.** Number of samples analyzed

Year	Soil	Fertilizer	Lime/Dolomite	Water	Compost	Total (others)	(Soil & others)
2017	2506	105	40	03	03	151	2657

**Table 7.** List of Tea Estates from where soil and other samples were received or collected and analyzed during the year 2017

Amo	Dinarpur	Kapnapahar	New Samanbagh	Sreebari
Amrail	Etah	Khan	Nalua	Surma
Amtali	Fyzabad	Kodala	Nurjahan	Sabari
Ayeshabagh	Fatehbagh	Kaiyacherra Dalu	Neptune	Srigobindpur
Allynugger	Ghazipore	Karimpore	Oodalea	Sallylunn
Baraoora	Habibnagar	Lallakhal	Ootterbagh & Indanugger	Shumshernugger
Bidyabheel	Hossainabad	Lalchand	Phulcherra	Saif
Baliseria	Hajinagar	Luayuni-holicherra	Pooteacherra	Sathgao
Baban	Hafiz	Luskerpore	Patharia	Silloah
Baikanthapur	Hatimara	Lungla	Patrakhola	Udnacherra
Chatlapore	Hooglicherra	Mertinga	Phulbari	Zarreen
Clevedon	Horincherra	Marina	Rampore	
Chundeecherra	Imam	Mirzapore	Rajghat	
Chandpore	Junglebari	Mazdehee	Rasidpur	
Chandbagh	Jagcherra	Malnicherra	Rajnagar	
Deundi	Jafflong	Monipur	Rasheedabad	
Deanston	Jhemai	Madhupur	Rajkie	
Dauracherra	Kalikabari	Noyapara	Ruthna	

## OTHER ACTIVITIES

### Advisory correspondence

A total of 226 advisory letters to different tea estates on soil, fertilizers, dolomite, compost and other soil related aspects were sent during the year 2017.

### Tours

During the year under report officers of the division paid a total 74 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 and workshops organized by BTRI for the covenanted staff of tea estate during 2017. 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.

**BOTANY DIVISION**

**Dr. Md. Abdul Aziz**  
Principal Scientific Officer

**STAFF**

Mr. Md. Ismail Hossain, Principal Scientific Officer was promoted to Chief Scientific Officer and Dr. Md. Abdul Aziz, Senior Scientific Officer was promoted to Principal Scientific Officer on 20<sup>th</sup> April 2017. Miss. Ishrath Jahan joined as Scientific Officer on 4 December, 2017. The post of one Senior Scientific Officer and one Field Assistant were vacant. There were no other change in personnel position of the division during the period under report.

**RESEARCH**

A total of 31 experiments were in progress during the period under report. Results of these experiments are briefly described below.

**B1: PRELIMINARY SELECTION OF VEGETATIVE CLONES**

**B1-27-7: Selection of Vegetative Clones at Shumshernugger T. E., Section Main Div. Sec. No. 9 (1993-2019).**

A total of 3,328 cuttings from 18 selected bushes from Shumshernugger T.E. were collected and put into the rooting trial.

**B1-28: Selection of Vegetative Clones at Amo T. E., Section No. 8 (1993-2019)**

Thirty one new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings and for rooting trial. A total of 3,068 cuttings from 13 bushes of section no. 1 of Amo Tea Estate were collected and planted in the nursery.

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

**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 2020).**

The plants of this trial were light skiffed at 86 cm in 2017. The yield data were analyzed and presented in Table-1.

Table 1. Yield of green leaves

Clone	A/8/01	A/17/22	A/22/27	A/22/40	BT1
Treatment mean	802.2	732.8	760.4	827.3	868

Treatment difference: Insignificant

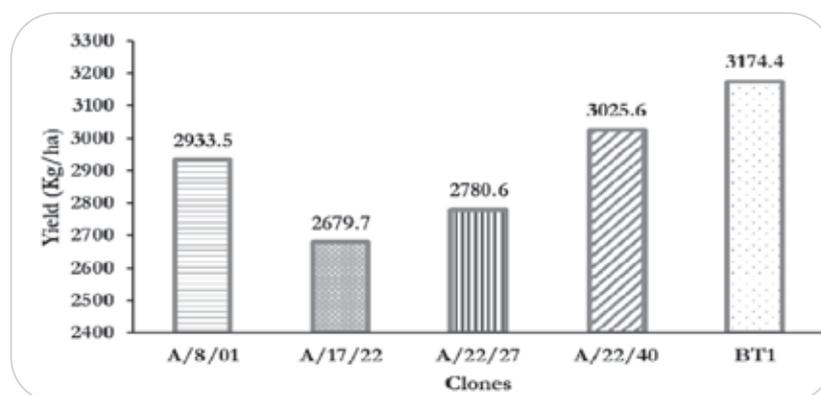


Fig. 1. Comparative yield of clones made tea (kg/ha)

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 1. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in table 2.

Table 2. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/01	7.54	7.59	7.23	7.42	2.35	32.22	AA
A/17/22	7.24	7.23	7.15	7.24	2.49	31.35	A
A/22/27	7.65	7.49	7.39	7.32	2.20	32.48	AA
A/22/40	7.53	7.53	7.43	7.37	2.87	32.73	AA
BT1	7.54	7.71	7.47	7.41	2.91	33.14	AA

(A: Average, AA: Above Average cup quality)

All the test clones except A/17/22 were comparable with the control BT1 in case of quality, test clone A/17/22 was inferior in cup than that of 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, 1997-2021).**

The plants of this trial were medium skiffed at 81 cm in 2017. The yield data were analyzed and presented in Table-3 and the estimated made tea production in kg/ha is presented in Fig. 2.

Table 3. Yield of green leaves

Clones	CHA/J1/10	Sh/B/6/59	Sh/B/6/62	A/8/24	BT2
Treatment mean	1045.6	1095.1	963	1397	1026.7

Level of significance: Significant. (LSD at 5% level of significance= 252.2)

The analytical results reveal that yield difference was significant at 5% level in 2017. All the test clones except A/8/24 were comparable in respect of yield with the control BT2. The test clone A/8/24 performed significant higher 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 4.

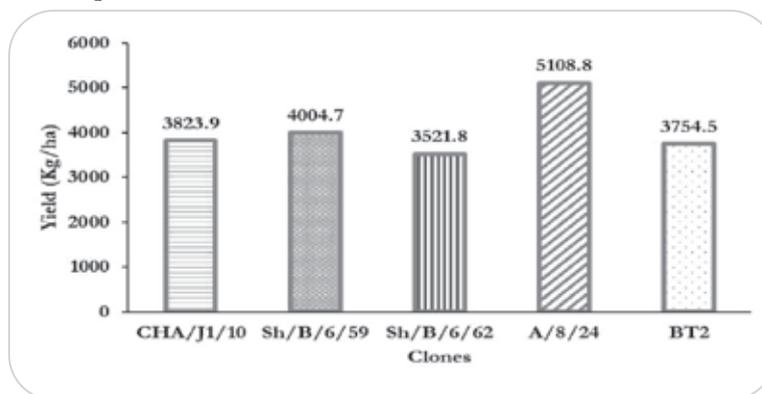


Fig. 2. Comparative yield of clones made tea (kg/ha)

Table 4. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
CHA/J1/10	7.67	7.34	7.38	7.40	2.84	32.44	AA
Sh/B/6/59	7.11	7.19	7.28	7.25	2.47	31.43	A
Sh/B/6/62	7.32	7.32	7.84	7.67	2.84	33.22	AA
A/8/24	7.40	7.34	7.48	7.39	2.68	32.28	AA
BT2	7.51	7.63	7.39	7.24	2.93	32.74	AA

(A: Average, AA: Above Average cup quality)

All the test clones except Sh/B/6/59 have got comparable cup quality with the control BT2 except the unique flavoury character. The test clone Sh/B/6/59 was inferior to the control BT2 in case of cup quality.

**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, 1998-2022).**

The plants of this trial were deep skiffed at 76 cm in 2017. The yield data were analyzed and presented in Table-5. The estimated made tea production in kg/ha is presented in Fig. 3.

Table 5. Yield of green leaves

Clone	Sh/B/6/36	Sh/B/6/38	Sh/B/6/55	Sh/B/6/67	BT1
Treatment mean	611.3	802.04	679.2	691.01	612.5

Treatment difference- Insignificant.

The analytical results revealed that all test clones are comparable in terms of yield. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 6.

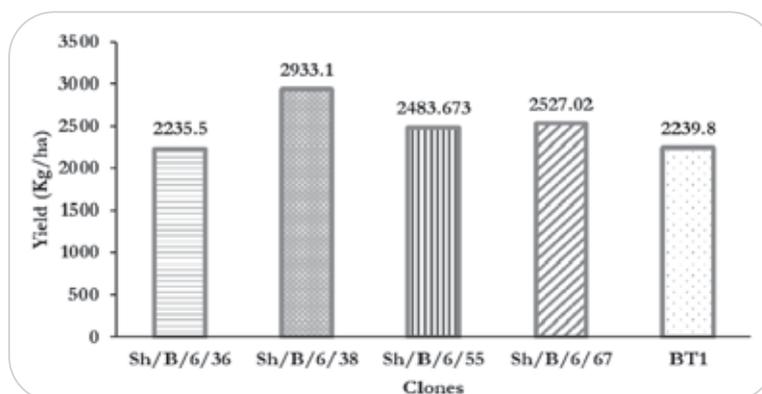


Fig. 3. Comparative yield of clones made tea (kg/ha)

Table 6. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/B/6/36	7.12	7.31	7.95	7.24	2.90	32.52	AA
Sh/B/6/38	7.36	7.41	7.56	7.35	2.75	32.43	AA
Sh/B/6/55	7.12	7.13	7.02	7.15	2.79	31.20	A
Sh/B/6/67	7.77	7.40	7.15	7.37	2.82	32.51	AA
BT1	7.26	7.42	7.54	7.34	2.96	32.52	AA

(A: Average, AA: Above Average cup quality)

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 the 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, 2000-2021).**

The plants of this trial were light skiffed at 81 cm in 2017. The yield data were analyzed and presented in Table-7.

Table 7. Yield of green leaves

Clone	MZ/39	E/4	D/13	B2T1	BR2/97	SDL/1	BT2
Treatment mean	1065	1078.8	951.3	1080.6	940.8	1076.7	1091.1

Treatment difference- Insignificant.

The analytical results revealed that all test clones are comparable in terms of yield. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in table 8. The estimated made tea production in kg/ha is presented in Fig. 4.

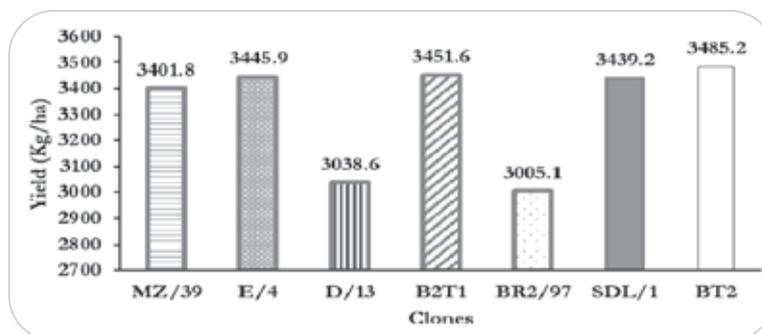


Fig. 4. Comparative yield of clones made tea (kg/ha)

Table 8. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
MZ/39	7.49	7.45	7.54	7.45	2.70	32.63	AA
E/4	7.49	7.68	7.44	7.37	2.61	32.59	AA
D/13	7.61	7.50	7.42	7.43	2.84	33.81	AA
B2T1	7.27	7.38	7.31	7.28	2.61	32.24	AA
BR2/97	7.61	7.38	7.43	7.42	2.74	32.59	AA
SDL/1	7.32	7.51	7.47	7.33	2.58	32.78	AA
BT2	7.41	7.48	7.44	7.33	2.67	32.23	AA

(AA: Above Average cup quality)

All the test clones were comparable in cup with the control BT2. However, the unique flavour character of BT2 was not considered in the 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, 2000-2021).**

The plants of this trial were light skiffed at 81 cm in 2017. The yield data were analyzed and presented in Table-9.

Table 9. Yield of green leaves

Clone	A/8/37	A/8/55	A/8/62	A/8/66	BT2
Treatment mean	972.6	907.2	778.01	997.5	917.04

Treatment difference- Insignificant.

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 5. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in table 10.

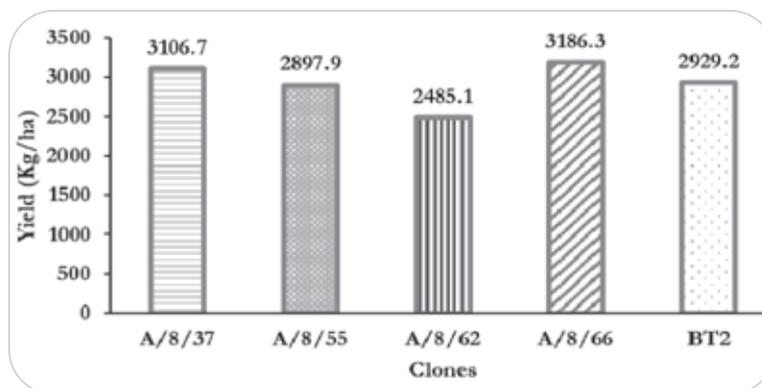


Fig. 5. Comparative yield of clones made tea (kg/ha)

Table 10. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/37	7.52	7.37	7.74	7.61	2.79	33.04	AA
A/8/55	7.32	7.36	7.29	7.31	2.25	31.53	A
A/8/62	7.40	7.55	7.67	7.40	2.81	32.64	AA
A/8/66	7.50	7.53	7.36	7.44	2.76	32.57	AA
BT2	7.56	7.75	7.38	7.38	2.67	32.44	AA

(A: Average, AA: Above Average cup quality)

All the test clones except A/8/55 were comparable in terms of cup quality. The test clone A/8/55 was found inferior to the control. The flavoury character of BT2 was not considered in the 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, 2001-2022).**

The plants of this trial were medium skiffed at 79 cm in 2017. The yield data were analyzed and presented in Table-11

Table 11. Yield of green leaves

Clone	A/17/16	Ph/9/1	Ph/9/9	Sh/B/6/46	BT1
Treatment mean	1008.2	725.03	914.2	981.5	915.1

Level of significance: Significant. (LSD at 5% level of significance= 158.32)

The analytical results reveal that yield difference was significant at 5% level in 2017. All the test clones excepting Ph/9/1 were comparable in respect of yield with the control BT1. Ph/9/1 was performed lower yield than the control. The estimated made tea production in kg/ha is presented in Fig. 6. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 12.

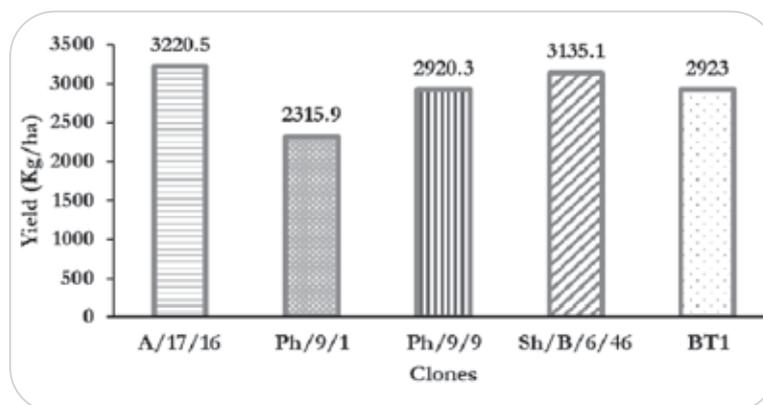


Fig. 6. Comparative yield of clones made tea (kg/ha)

Table 12. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/17/16	7.35	7.39	7.35	7.34	2.90	32.33	AA
Ph/9/1	7.32	7.28	7.28	7.22	2.53	31.63	A
Ph/9/9	7.42	7.56	7.60	7.31	2.57	32.42	AA
Sh/B/6/46	7.44	7.36	7.46	7.26	2.77	32.31	AA
BT1	7.38	7.59	7.75	7.33	2.87	32.92	AA

(A: Average, AA: Above Average cup quality)

All the test clones except 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, 2001-2022).**

The plants of this trial were medium skiffed at 79 cm in 2017. The yield data were analyzed and presented in Table-13. The estimated made tea production in kg/ha is presented in Fig. 7.

Table 13. Yield of green leaves

Clone	Ph/9/4	Ph/9/25	Ph/9/40	BS/67	BT5
Treatment mean	889.01	645.2	914.9	967.7	746.9

Treatment difference- Insignificant.

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 7. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 14.

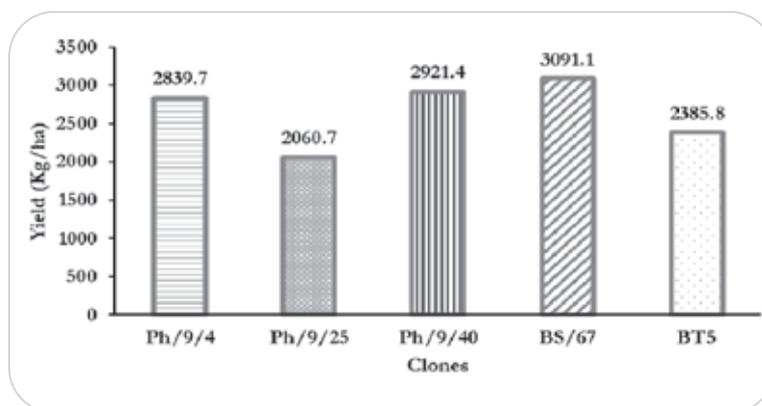


Fig. 7. Comparative yield of clones made tea (kg/ha)

Table 14. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creamin g down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/4	7.14	7.49	7.51	7.36	2.76	32.26	AA
Ph/9/25	7.28	7.56	7.35	7.53	2.46	32.18	AA
Ph/9/40	7.43	7.22	7.20	7.16	2.68	31.69	A
BS/67	7.51	7.60	7.54	7.51	2.80	32.96	AA
BT5	7.61	7.35	7.53	7.46	2.65	32.82	AA

(A: Average, AA: Above Average cup quality)

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, 2003-2021).**

The plants of this trial were light pruned at 61 cm in 2017. The yield data were analyzed and presented in Table-15.

Table 15. Yield of green leaves

Clone	A/8B/1	Ph/9B/1	Ph/9/11	BT1
Treatment mean	943.9	1322.8	1118.8	978.2

Treatment difference- Insignificant.

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 8. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 16.

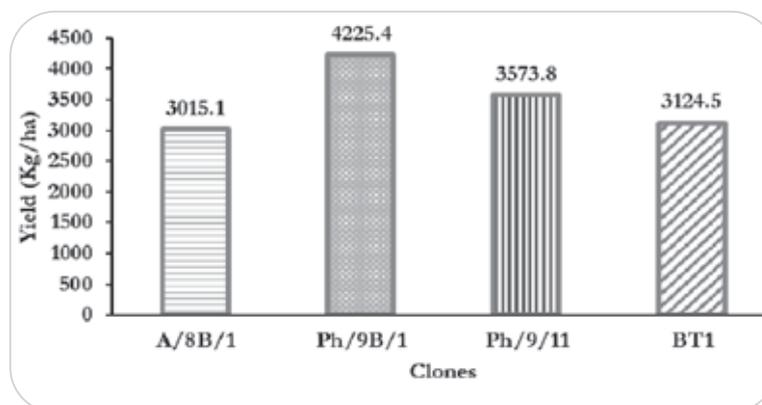


Fig. 8. Comparative yield of clones made tea (kg/ha)

Table 16. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8B/1	7.10	7.72	7.35	7.15	2.29	31.61	A
Ph/9B/1	7.30	7.37	7.40	7.44	2.84	32.95	AA
Ph/9/11	7.73	7.38	7.11	7.31	2.89	32.42	AA
BT1	7.71	7.63	7.68	7.40	2.85	33.29	AA

(A: Average, AA: Above Average cup quality)

All the test clones were comparable in terms of cup quality with the control BT1 except A/8B/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, 2005-2022).**

The plants of this trial were medium skiffed at 74 cm in 2017. The yield data were analyzed and presented in Table-17.

Table 17. Yield of green leaves

Clone	Ph/9/68A	Sh/D/11/18	A/8/61	SC/12/28	BT2
Treatment mean	723.3	1098.6	1010	941.7	1130.8

Treatment difference: Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 9. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 18.

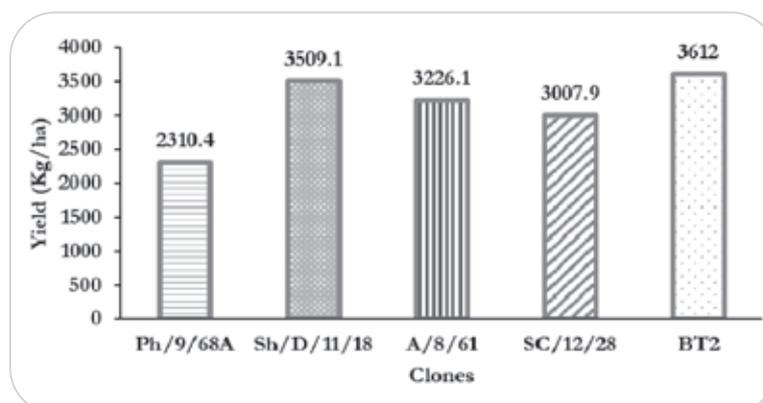


Fig. 9. Comparative yield of clones made tea (kg/ha)

Table 18. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/61	7.32	7.32	7.52	7.39	2.87	32.42	AA
Ph/9/68A	7.46	7.38	7.60	7.28	2.58	32.54	AA
Sh/D/11/18	7.21	7.37	7.66	7.27	2.82	32.33	AA
SC/12/28	7.19	7.20	7.35	7.49	3.01	32.24	AA
BT2	7.2	7.46	7.67	7.72	2.70	33.10	AA

(AA: Above Average cup quality)

All the test clones were comparable in terms of cup quality. However, the flavour character of BT2 was not considered in case of assessing cup quality.

**B2-46: Yield and Quality Trial of Four Test clones Selected from BTRI Farm (Dulia Section); Test clones – D1/18, D/6, D/10 and D/12 against Standard BT5 (BTRI, 2005-2022).**

The plants of this trial were medium skiffed at 74 cm in 2017. The yield data were analyzed and presented in Table-19.

Table 19. Yield of green leaves

Clone	D1/18	D/6	D/10	D/12	BT5
Treatment mean	1209.6	1226.4	949.5	677.5	1031.5

Treatment difference: Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 10.

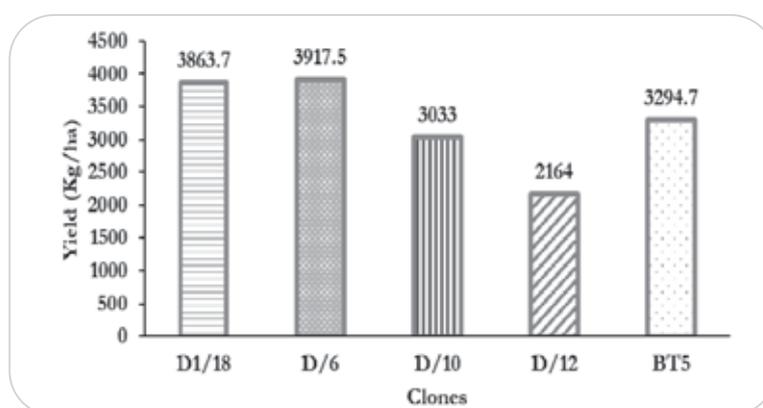


Fig. 10. Comparative yield of clones made tea (kg/ha)

The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 20.

Table 20. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
D1/18	7.71	7.41	7.63	7.56	2.79	33.10	AA
D/6	7.54	7.33	7.65	7.78	2.82	33.12	AA
D/10	7.14	7.56	7.35	7.68	2.65	32.38	AA
D/12	7.23	7.15	7.29	7.26	2.30	31.23	A
BT5	7.16	7.25	7.64	7.43	2.79	32.27	AA

(A: Average, AA: Above Average cup quality)

All the test clones except D/12 are comparable with the control while D/12 is 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, 2006-2023).**

The plants of this trial were deep skiffed at 71 cm in 2017. The yield data were analyzed and presented in Table-21.

Table 21. Yield of green leaves

Clone	Ph/9/92	BS/3	Ph/9/108	G/61/8	BT15
Treatment mean	829.5	647.3	677.01	805.2	727.1

Treatment difference: Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 11. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 22.

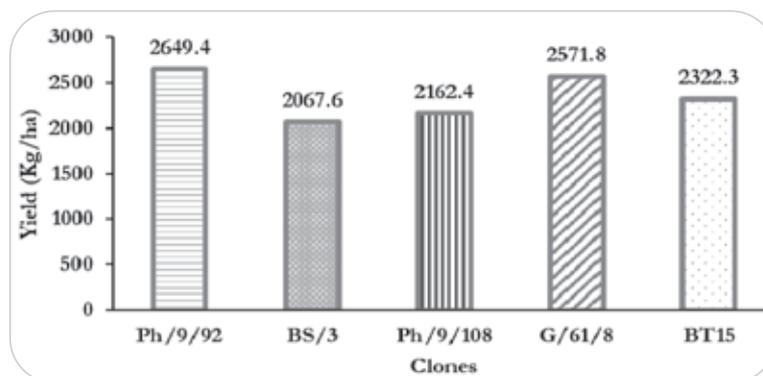


Fig. 11. Comparative yield of clones made tea (kg/ha)

Table 22. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/92	7.60	7.30	7.53	7.37	2.75	32.55	AA
BS/3	7.20	7.40	7.19	7.11	2.27	31.17	A
Ph/9/108	7.45	7.61	7.31	7.47	2.76	32.60	AA
G/61/5	7.41	7.57	7.66	7.68	2.85	33.17	AA
BT15	7.83	7.78	7.84	7.70	3.48	34.63	E

(A: Average, AA: Above Average, E: Excellent cup quality)

The test clones Ph/9/92, Ph/9/108 and G/61/5 gave above average cup quality while the control BT15 gave excellent cup quality. The test clone BS/3 gave average cup quality with the control.

**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, 2009-2026).**

The plants of this trial were skiffed at 71 cm in 2017. The yield data were analyzed and presented in Table-23.

Table 23. Yield of green leaves

Clone	A/8/124	Sh/10/2	A/8/125	A/11/38	BT2
Treatment mean	474.2	761.5	467.6	501.2	849.6

Treatment difference: Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 12. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 24.

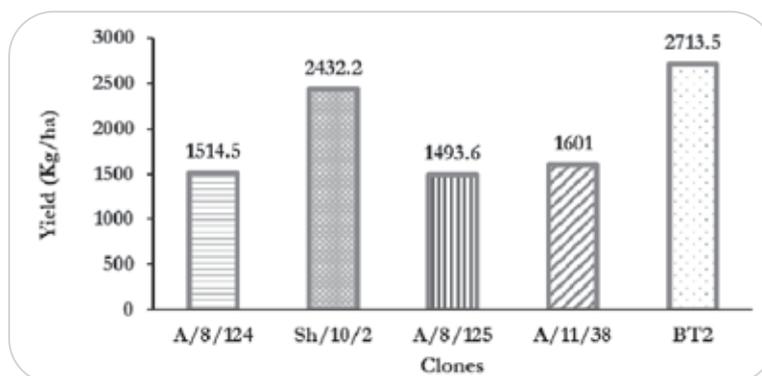


Fig. 12. Comparative yield of clones made tea (kg/ha)

Table 24. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/124	7.42	7.52	7.37	7.43	2.85	32.59	AA
Sh/10/2	7.34	7.63	7.73	7.34	2.78	32.83	AA
A/8/125	7.57	7.59	7.79	7.32	2.78	33.05	AA
A/11/38	7.51	7.14	7.24	7.53	2.84	32.27	AA
BT2	7.51	7.64	7.40	7.64	2.74	32.93	AA

(AA: Above Average cup quality)

All the test clones were similar to the control BT2 in respect of cup quality. However, the flavoury character of BT2 was not considered in the 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/13/4 and Amo T. Es. Test clones – A/8/128, BS/91/6, against Standard BT2 (BTRI, 2011-2028).**

The plants were skiffed at 71 in 2017 and tipping was done at 77 cm. The yield data were analyzed and presented in Table-25.

Table-25. Yield of green leaves

Clone	Sh/D/13/4	BS/91/6	Sh/10/5	A/8/128	BT2
Treatment mean	787.8	489.2	482.6	683.8	580.6

Treatment difference- Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 13. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 26.

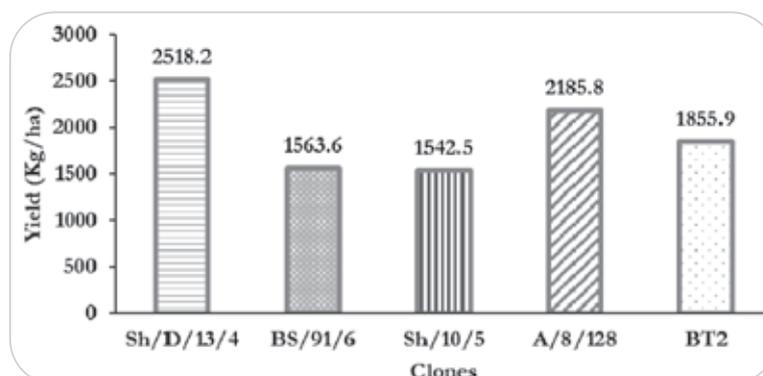


Fig. 13. Comparative yield of clones made tea (kg/ha)

Table 26. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/D/13/4	7.30	7.34	7.31	7.86	2.67	32.48	AA
BS/91/6	7.32	7.42	7.34	7.30	2.76	32.20	AA
Sh/10/5	7.46	7.70	7.51	7.31	2.73	32.69	AA
A/8/128	7.41	7.42	7.33	7.18	2.76	32.10	AA
BT2	7.47	7.33	7.33	7.43	2.79	32.33	AA

(AA: Above Average cup quality)

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

**B2-50: Yield and Quality Trial of Three Test Clones Selected from Baraoorah T.E. and Shumshernugger T.E. Test Clones – B/8/79, Sh/9/43 and B/8/93 against Standard BT2 and BT17 (BTRI, 2014-2032).**

The experiment was initiated in May 2014 at BTRI farm under Latin Square Design with 105cm x 60cm spacing normal cultural practices were followed. The yield data were analyzed and presented in Table 27.

Table 27. Yield of green leaves

Clone	BT17	B/8/79	Sh/9/43	B/8/93	BT2
Treatment mean	260.5	240.8	195.4	220.6	235.9

Treatment difference- Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 14.

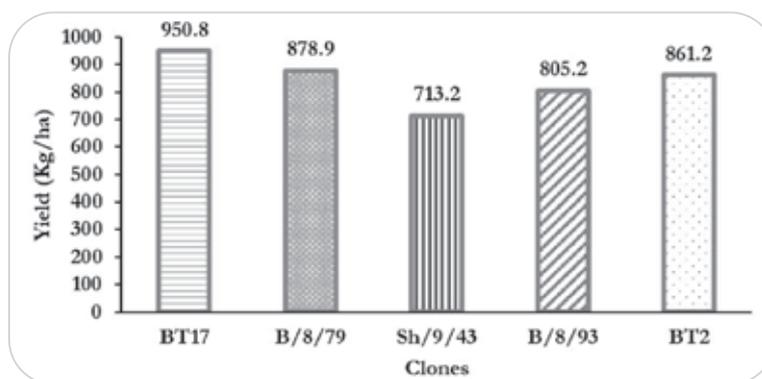


Fig. 14. Comparative yield of clones made tea (kg/ha)

**B2-51: Yield and Quality Trial of Two Test Clones Selected from Amo T.E., and Shumshernugger T.E. Test Clones – A/8/194 and Sh/9/65 against Standard BT2, BT17 and BTS1. (BTRI, 2015-2032).**

The experiment was initiated in May 2015 at BTRI farm under Latin Square Design with 105cm x 60cm spacing normal cultural practices were followed. The yield data were analyzed and presented in Table 28.

Table 28. Yield of green leaves

Clone	BTS1	A/8/194	Sh/9/65	BT17	BT2
Treatment mean	165.5	185.4	184.1	160.5	195.8

Treatment difference- Insignificant

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 15.

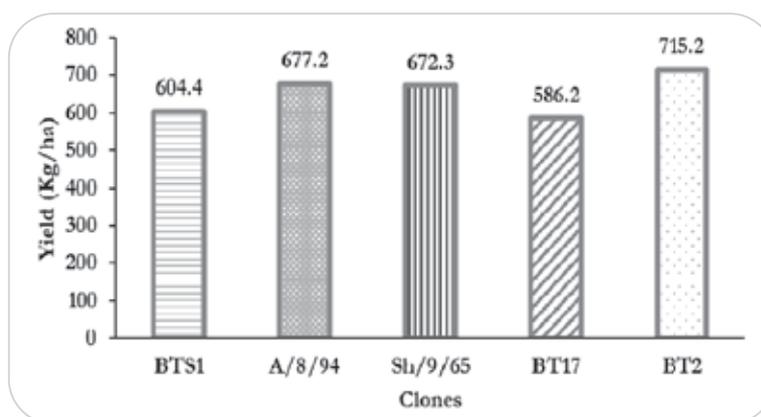


Fig. 15. Comparative yield of clones made tea (kg/ha)

**B2-52: Yield and Quality Trial of Four Test Clones Selected from Amo T.E., Baraoorah T.E., and Shumshernugger T.E. Test Clones–T2, T3, T4 and T5 against Standard BT2 (BTRI, 2017-2029).**

The experiment was initiated in May 2017 at BTRI farm under Latin Square Design with 105cm x 60cm spacing normal cultural practices were followed.

**B2-53: Yield and Quality Trial of Four Test Clones Selected from Amo T.E., Baraoorah T.E., and Shumshernugger T.E. Test Clones–D1, D2, D3 and D4 against Standard BT2 (BTRI, 2017-2029).**

The experiment was initiated in May 2017 at BTRI farm under Latin Square Design with 105cm x 60cm spacing normal cultural practices were followed.

**B2-54: Yield and Quality Trial of Four Test Clones Selected from Baraoorah, Shumshernugger and Mirzapure T.E. (T1, T2, T3 and T4 against Standard BT2 (BTRI Fatikchori Sub-Station, 2016-ongoing).**

The experiment was initiated in February 2016 at BTRI Fatikchori Sub-Station under Latin Square Design with 105cm x 60cm spacing.

**B3: BREEDING OF TEA (NO. OF EXPERIMENTS-6)**

**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 2017:**

BT2 X TV23, TV23 X BT2, BT8X TV23, TV23 X BT8, BT17 X BT2, BT2 X BT17, BT4 X TV23, TV23 X BT4, BT6 X TV23, TV23 X BT6, BT1 X BT2, TV18 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 (TV18 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, 1999-2017)**

The plants of this trial were deep skiffed at 69 cm in 2017. The yield data were analyzed and presented in Table-29. The estimated made tea production in kg/ha is presented in Fig. 16.

Table 29. Yield of green leaves

Clone	BT1	BTS1	PBS	ANPS	T18B3
Treatment mean	760.4	631.94	731.86	699.96	766.68

Treatment difference- Insignificant

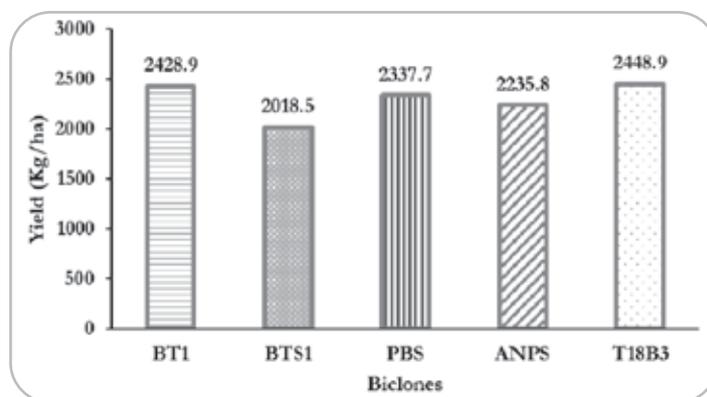


Fig. 16. Comparative yield of clones made tea (kg/ha)

The analytical results reveal that there was no significant yield difference between the biclonal seed stocks. All the biclonal stocks were comparable with the control BT1. The cup quality of made tea for all the treatments was assessed through organoleptic test. The average scores are shown in Table 30.

**Table 30.** Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT1	7.38	7.61	7.35	7.63	2.78	32.75	AA
BTS1	7.45	7.50	7.66	7.35	2.87	32.84	AA
PBS	7.15	7.19	7.27	7.34	2.88	31.75	A
ANPS	7.51	7.58	7.27	7.42	2.84	32.62	AA
T18B3	7.63	7.66	7.58	7.56	2.84	33.31	AA

(A: Average, AA: Above Average cup quality)

The biclonal BTS1 and T18B3 are comparable in cup with the control clone BT1 while PBS was 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) (2002-2017)

The plants of this trial were deep skiffed at 71 cm in 2017. The yield data were analyzed and presented in Table-31.

**Table 31.** Yield of green leaves (g/plant)

Clone	BTS1	BTS3	TV18 × BT3	TS463	BT1	TV1	TV19
Treatment mean	703.9	865.6	817.8	832.5	912.9	1117.9	885.1

Treatment difference- Insignificant

The analytical results reveal that there was no significant yield difference between the biclonal seed stocks. The cup quality of made tea for all the treatments was assessed through organoleptic test. The average scores are shown in Table 32. The estimated made tea production in kg/ha is presented in Fig. 17.

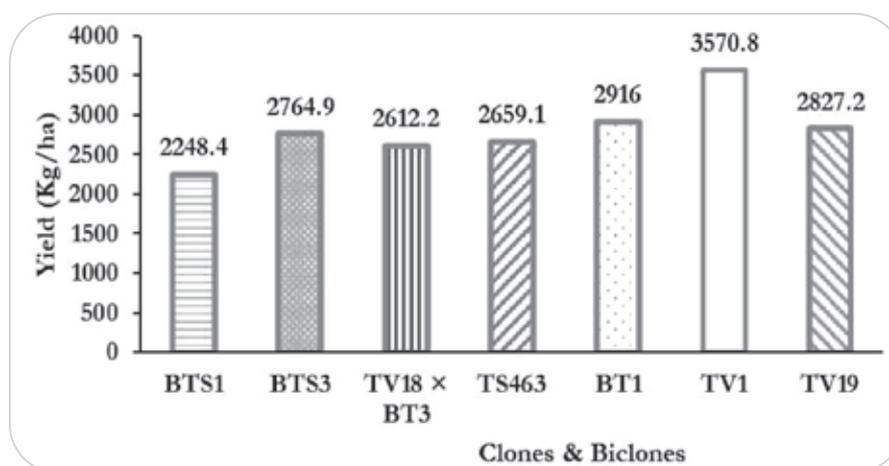


Fig. 17. Comparative yield of clones made tea (kg/ha)

Table 32. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.31	7.62	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	7.42	7.35	7.15	7.56	2.73	32.22	AA
TS463	7.59	7.36	7.42	7.32	2.76	32.45	AA
BT1	7.27	7.34	7.34	7.44	2.78	32.17	AA
TV1	7.54	7.34	7.56	7.64	2.90	32.98	AA
TV19	7.41	7.34	7.53	7.49	2.81	32.58	AA

(A: Average, AA: Above Average cup quality)

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.

### B3-12: Morphological characterization of BTRI released clones, some test clones and wild genotypes.

A total of 25 accessions (20 BTRI released clones, 4 test clones and 1 wild genotype) were planted in the nursery in October, 2017 to observe their rooting performance and to evaluate their rooting character. Details data will be published after completion of the experiment.

**B4: SHORT TERM/MEDIUM TERM EXPERIMENTS (NO. OF EXPERIMENTS-4)****B4-1. Developing a sustainable and cost effective protocol for manufacturing green tea and its derivatives (value added green tea).**

The experiment was carried out at BTRI Miniature Factory to study the five different types of green tea making procedures and suggest a sustainable green tea processing protocol from August 2016 to June 2017. Five treatments having each of three replications were given below:

T1=Hot water treatment + cooling & centrifuging + rolling + drying.

T2=Steaming + cooling & centrifuging + rolling + drying.

T3=Roasting/Panning + cooling & centrifuging + rolling + drying.

T4=Steaming + cooling & centrifuging + Hand rolling + manual oven drying.

T5=Slight Withering + Steaming + cooling & centrifuging + rolling + drying.

From the experiment it was concluded that, treatment T2 (Steaming + cooling and centrifuging + rolling + drying) was the best way for manufacturing green tea. Treatment T3 (Roasting/panning + cooling & centrifuging + rolling + drying) and T5 treatment (Slight Withering+ Steaming + cooling & centrifuging + rolling + drying) can be alternate way for producing green tea. For small growers treatment 4 (Steaming + cooling & centrifuging + Hand rolling + manual oven drying) will be more convenient to produce average quality green tea where 'Simple Withering Device' and 'Simple Drying Device' were being used. Because of slight withering treatment 5 produced green tea had got an extra AROMA.

**B4-2. Study on seasonal effect and different clonal effect on recovery percentages of green tea**

The experiment was carried out at BTRI Miniature Factory to study recovery percentages of green tea from March 2017 to November 2017. Monthly-wise recovery percentages of green tea was 19.19%. Detailed data will be published soon.

### Summary of activities of Botany Division

1. **No. of Experimental Visit: 38**
2. **Advisory Visit/Official Visit: 16**
3. **Correspondence: 8**
4. **Delivered lecture hours for postgraduate diploma/ certificate course at MTC: 08 hours**
5. **Workshop/Seminar: 13**
6. **Central Tea Tasting Session: 1**
7. **Valley Tea Tasting Session: 4**

Date	Place	Name of the Valley	Number of Participants	Number of Tea Estates	Total Group Tea Tasting Session
23.09.17	Juri Valley Club	Juri Valley Tea Tasting	28	17	4
12.10.17	Monu-Doiloi Valley Club	Monu-Doiloi Valley Tea Tasting	26	15	
13.10.17	Ootterbagh Tea Estate	Lungla Valley Tea Tasting	28	12	
26.10.17	Lakkatora Tea Estate	North-Sylhet Valley Tea Tasting	21	9	
Total			103	53	

#### 8. Group Tea Tasting Session: 4

Date	Place	Number of Participants	Number of Tea Estates	Total Group Tea Tasting Session
03.08.17	BTRI Tea Tasting Room	30	12	4
05.08.17	BTRI Tea Tasting Room	25	8	
06.08.17	BTRI Tea Tasting Room	30	11	
09.08.17	BTRI Tea Tasting Room	28	13	
Total		113	44	

9. **Received Sample Tea Tasting: 44**
10. **Quantity of Green tea produced: 603.55 Kg**
11. **Quantity of White tea produced: 8.97 kg**
12. **Quantity of planting material supplied:**

Rooted cutting (	Bi-clonal seeds
495	132

## AGRONOMY DIVISION

**Dr. Toufiq Ahmed**

Principal Scientific Officer  
Agronomy Division

### STAFF

After completion of PhD from China, Dr. Mohammad Masud Rana (Senior Scientific Officer) joined in the division on 1<sup>st</sup> August 2017. Mr. Arifur Rahman (Scientific Officer) resigned from the job on 26<sup>th</sup> April 2017 and S.M. Monoarul Islam joined as Scientific Officer on 4<sup>th</sup> December 2017. On 26<sup>th</sup> January 2017, Mr. Rani Debnath (Farm Supervisor) transferred from Bilascherra Experimental Farm to BTRI and took the charge of BTRI Farm. There was no other change in personnel position of the division.

### RESEARCH

During the reporting year, Agronomy Division carried out eight experiments under two research program areas such as, (i) standardization of cultural practices and (ii) development of soil fertility. Results of these experiments on the basis of collected data are briefly discussed below:

**Experiment 1: Effect of different pruning cycles on the yield of different mature clonal tea (BTRI Farm; Long term: 2010-2023)**

**Treatments:**

T<sub>1</sub> : LP-DS-MS

T<sub>2</sub> : LP-DS-MS-LS

T<sub>3</sub> : LP-LS -DS -MS

T<sub>4</sub> : LP-LS -DS -MS -DS-LS

T<sub>5</sub> : 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 90.

**Progress:** The plants were pruned according to the schedule of treatments. Yield data were collected at weekly interval. From the analysis result of yield data obtained in 2017, it is observed that significantly highest yield was obtained in the treatment T<sub>5</sub> and lowest in the treatment T<sub>2</sub> (Table 1), and these differences were due to the differences in given pruning operations. From the interaction effect, it was observed that highest yield (3756 kg/ha) was obtained in the treatment combination of T<sub>5</sub> × BT2 and the lowest in the combination of T<sub>2</sub> × BT11 (1596 kg/ha), but statistically the interaction was not significant (Fig. 1). From overall analysis (2010-2017) it is observed that longer pruning cycles providing higher yield of tea. The experiment will be continued another six years more. So, to make the final comments it is needed to wait until the field experiment is over.

**Table 1.** Made tea yield (kg/ha) of different treatments in 2017

Treatments	Yield (kg/ha)
T <sub>1</sub> (LP-DS-MS)	1830 <sup>c</sup>
T <sub>2</sub> (LP-DS-MS-LS)	1822 <sup>c</sup>
T <sub>3</sub> (LP-LS-DS-MS)	2215 <sup>b c</sup>
T <sub>4</sub> (LP-LS-DS-MS-DS-LS)	2616 <sup>b</sup>
T <sub>5</sub> (LP-DS-MS-LS-DS-MS-LS)	3397 <sup>a</sup>
LSD (0.01)	631.7
CV (%)	29

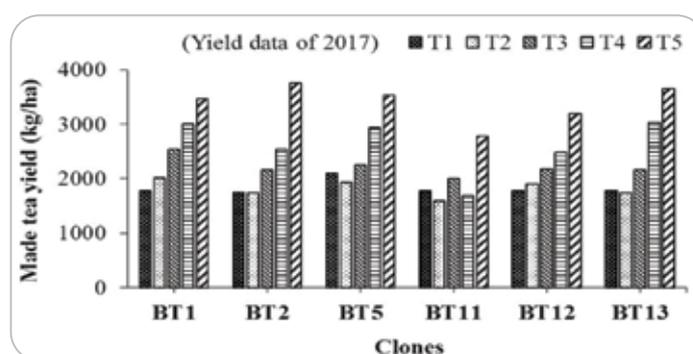


Figure 1. Interaction effect of different clones with different treatments in 2017

### Experiment 2: Response of different dosages of organic and inorganic fertilizers in pit on growth and development of clonal tea (BTRI Farm; Duration: 2014-2017)

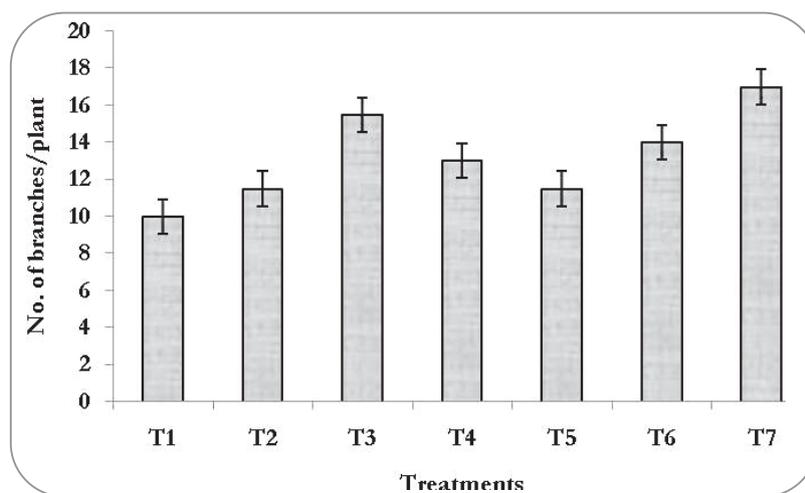
**Treatments:** 7; Total seven treatments were applied in following ways-

- T<sub>1</sub>: No fertilizer and manure is applied in pit
- T<sub>2</sub>: 1 kg decomposed cowdung was applied
- T<sub>3</sub>: 2 kg decomposed cowdung was applied
- T<sub>4</sub>: ½ kg decomposed oil cake was applied
- T<sub>5</sub>: 30 g TSP + 15 g MOP was applied
- T<sub>6</sub>: 1 kg decomposed cowdung + ½ kg decomposed oil cake was applied
- T<sub>7</sub>: 1.5 kg decomposed cowdung + 30 g TSP + 15 g MOP was applied

Having seven treatments, the experiment was laid out in a randomized block design with 4 replications. The planting material was BT17.

**Progress:** During the time of plantation in 2014, manures and fertilizers were applied in the pit according to the treatments. Normal practices were followed for intercultural operations. Different morphological characters of tea plant in each treatment were studied during first and second year after plantation (*i.e.* in 2015 during de-centering and in 2016 during the time of 1<sup>st</sup> frame formation pruning). Similarly, in 2017 at the age of 3 years of the plantation, different morphological parameters were recorded and analyzed during the time of skiff. Number of branches and fresh weight of the plants, both were significantly different for

different treatments. Maximum number of branches were observed in the plants of T<sub>7</sub> which was similar with the plants of T<sub>3</sub> but different with others and the lowest number of branches was observed in the plants of T<sub>1</sub> (Fig. 2). Similarly, for the fresh weight of plants, maximum weight (1.22 kg) was observed (found) in T<sub>7</sub> which was similar with T<sub>3</sub> but different with others and the minimum was in T<sub>1</sub> (0.71 kg).



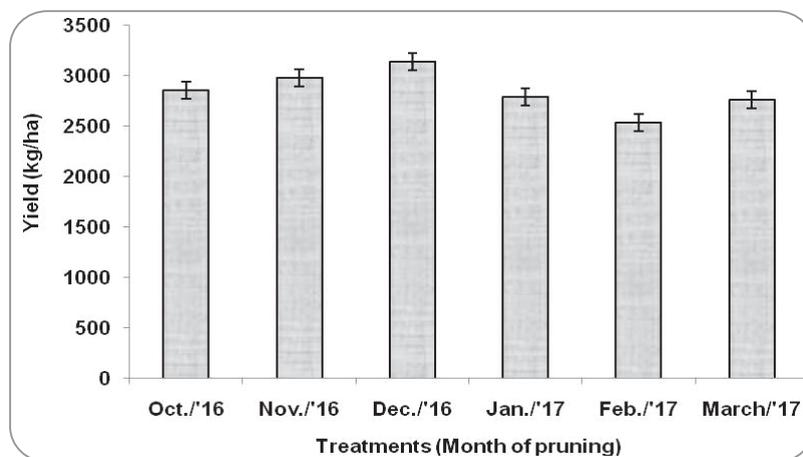
**Figure 2.** Variation of number of branches during the 3<sup>rd</sup> year pruning (just after the pruning)

### Experiment 3: Effect of different time of pruning on yield and crop distribution of mature clonal tea (BEF, Bilashcherra; Duration: 2015-2017)

#### Treatments:

- T<sub>1</sub>: Pruning in mid october
- T<sub>2</sub>: Pruning in mid november
- T<sub>3</sub>: Pruning in mid december (Control – Normal practice)
- T<sub>4</sub>: Pruning in mid january
- T<sub>5</sub>: Pruning in mid february
- T<sub>6</sub>: Pruning in mid march

**Progress:** The experiment was laid out in a Randomized Complete Block Design (RCBD) at the Bilashcherra Experimental Farm. Pruning operation was completed according to the schedule of treatments. Like the previous two years, in 2017, weekly harvested leaf yield was collected from each treatment and analyzed the data at the end of the cropping year. It was observed that the yield was not significantly different for treatments (Fig. 3). In 2017, maximum yield was observed in the treatment of December pruning but in 2016 it was in November pruning.



**Figure 3.** Variation of made tea yield due to the variation of pruning time

**Experiment 4: Effect of a plant growth regulator (Flora) on growth and yield of mature clonal tea (BTRI Farm; Duration: 2016-2017)**

**Treatments:**

T<sub>1</sub>: Control

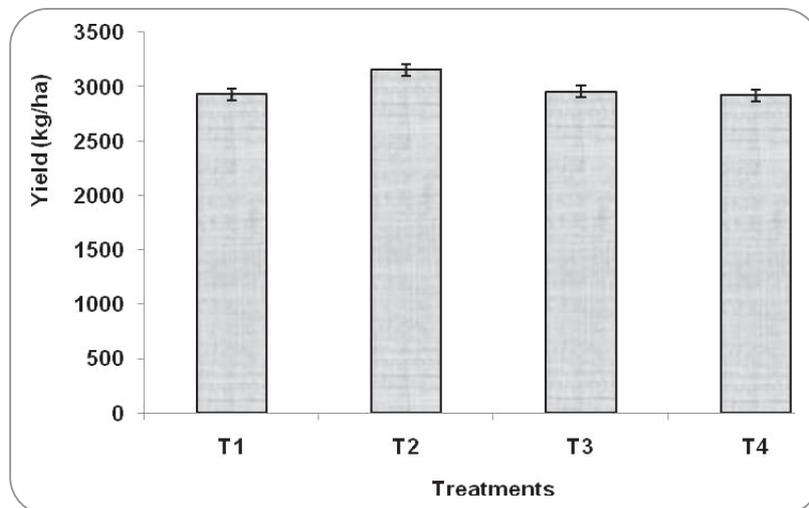
T<sub>2</sub>: Flora applied @ 0.4 L/ha

T<sub>3</sub>: Flora applied @ 0.8 L/ha (Company recommended dose)

T<sub>4</sub>: Flora applied @ 1.2 L/ha

The experiment was laid out in a randomized complete block design at the BTRI Farm. The plant growth regulator (Flora) was applied according to the treatments once in a month.

**Progress:** Harvested green leaf yield of every week were recorded from each plot throughout the plucking season. From the analysis, it was observed that the highest yield (3155 kg/ha) was obtained from the treatment T<sub>2</sub> that was followed by the treatment T<sub>3</sub> (2956 kg/ha) and the lowest yield (2921 kg/ha) was obtained from the treatment T<sub>4</sub> (Fig. 4). Statistically, the yield differences among treatments were not significant like the previous year. The experiment is completed.



**Figure 4.** Variation of made tea yield due to different treatments

**Experiment 5: Comparative study on yield performances of LSK and DSK tea area followed by light pruning (BTRI Farm; Duration: 2017)**

**Treatments:** 3 (Different types of pruning followed by LP);

T<sub>1</sub>: Light skiff (LSK)

T<sub>2</sub>: Medium skiff (MSK)

T<sub>3</sub>: Deep skiff (DSK)

The experiment was laid out in a randomized complete block design at BTRI Farm.

**Progress:** Pruning operation was completed according to the treatments. Harvested green leaf yield from each plot was collected weekly and at the end of the cropping season, the data were analyzed. It was observed that the yield was not significantly different for treatments. However, among the treatments maximum yield was observed in LSK (3015 kg made tea/ha) followed by MSK (2706 kg/ha) and DSK (2369 kg/ha) (Figure 5).

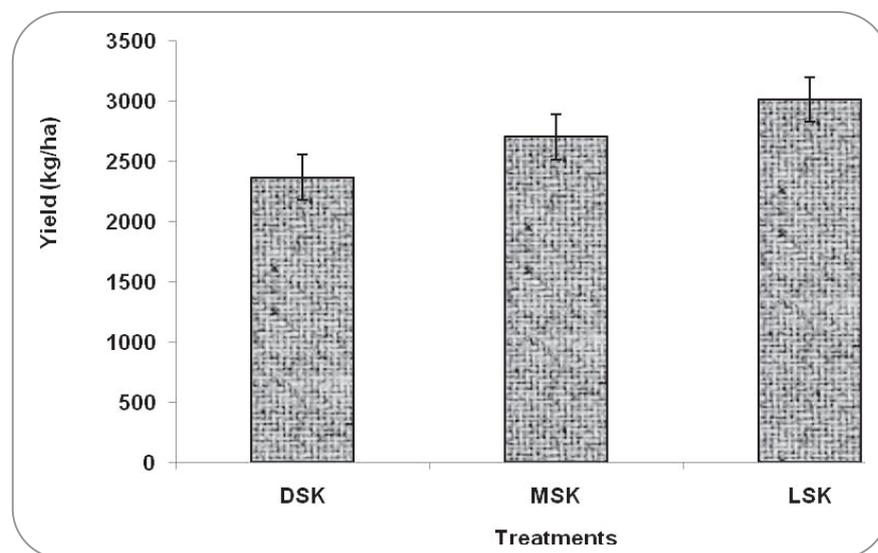


Figure 5. Variation of made tea yield due to different treatments

**Experiment 6: Comparative study of a plant growth regulator on tea in Sylhet and Chattogram region (BTRI Main Farm & BTRI Fatikchari sub-station; Duration: 2017)**

**Treatments:**

T<sub>1</sub>: Control

T<sub>2</sub>: Flora applied @ 0.4 L/ha

T<sub>3</sub>: Flora applied @ 0.8 L/ha (recommended dosage dose)

T<sub>4</sub>: Flora applied @ 1.2 L/ha

The experiment was set in a randomized complete block design at two different locations e.g. BTRI Main Farm, Srimongal and BTRI Sub-station Fatikchari, Chittagong. The plant growth regulator (Flora) was applied according to the treatments once in a month in both locations. At BTRI Main Farm, the part of the experiment was similar with experiment 4.

**Progress:** In both of the experimental locations, harvested green leaf yield of every week were recorded from each plot throughout the plucking season. At the end of the season, collected data from each location were analyzed separately. It was observed that treatments were not significantly different. Among the four treatments, it was observed that maximum yield was obtained in T<sub>4</sub> (3634 kg made tea/ha) in Chittagong region (Fig. 6). However, in Sylhet region it was in T<sub>2</sub> (3155 kg/ha) (Figure 4). The variation of yield may be due to the variation of locations, age of bushes and environment.

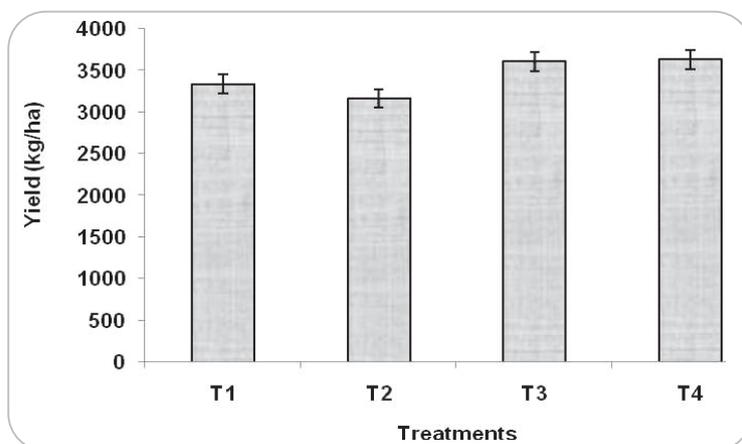


Figure 6. Variation of made tea yield due to different treatments

#### Experiment 7. Study on effectiveness of mechanical harvesting of tea in present plantation of Bangladesh

**Treatments:** It was just comparison of two types of plucking system e.g.

- Machine plucking (2 worker operated machine, model PFTT-60); and
- Hand plucking. Each treatment contained 180 bushes/plot.

**Progress:** After initiation of the experiment, data of the harvested green leaf was collected separately from each of the treatment throughout the year. Comparison of two plucking systems on the basis of different characteristics are summarized in Table 2.

Table 2. Comparison of two types of plucking system

Characteristics	Hand plucking	Machine plucking
Plucking interval	7-10 days	20-25 days
Total no. of plucking round (P.R) in a year	24-30	12-16
Average yield/plot/plucking round	About 9 kg	About 12 kg
Total G.L production (ha/year)	High (about 18000 kg)	Less (about 13000 kg)
Made tea yield (kg/ha/year)	3960	2860
Ratio between soft leaf & hard leaf	76 : 24	51 : 49
Cost for plucking (Tk/ha) [wage rate = 85 Tk/worker, Petrol price = 89 Tk/L]	61,835 (only for 727 pluckers)	39,320/- (142 workers+ depreciation cost for machine 5000Tk+ 250 L petrol)
Income (Tk/ha) [price of made tea=200Tk/kg]	7,92,000/-	5,72,000/-
Profit (Tk/ha)	7,30,165/-	5,32,687/-

### Experiment 8. Comparative study on yield and yield related parameters of different clones released from BTRI (BTRI Farm; Duration: 2017-2018)

**Treatments:** 4; BTRI released 4 mature tea clones were considered as treatments e.g. (a) BT2, (b) BT5, (c) BT6 and (d) BT8. Plantation year was 1995 and age of bushes about 22 years.

**Progress:** During the light pruning, number of effective branches per bush was counted. After analysis of data, it was observed that no. of branches per bush was significantly different for treatments. Maximum no. of branches per bush was in BT2 clone (52) and the lowest was in BT5 (30) which was identical with BT6 and BT8 (Fig. 7). During the cropping season, harvested green leaf yield from each treatment was collected. After analysis of collected data, it was observed that harvested green leaf yield was not significantly different for treatments. The experiment will be continued for another year to collect data on yield and yield related parameters.

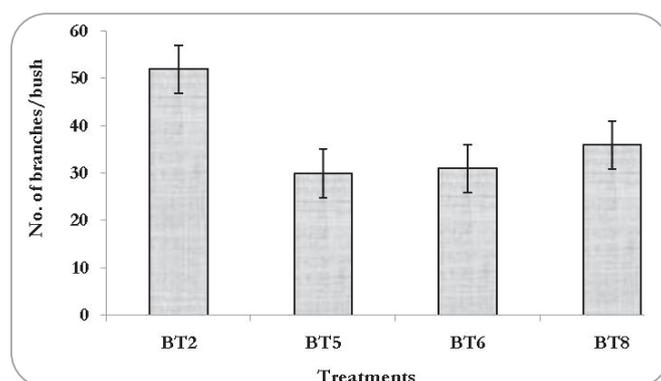


Figure 7. Variation of number of branches due to treatments

## OTHER ACTIVITIES

### Research Publications

During the reporting year, researchers of Agronomy division published scientific papers in different journals-

01. T. Ahmed, W.A.J.M. De Costa, and M.A. Wijeratne 2016. Effect of different plucking systems on yield and root starch reserve in two cultivars of tea [*Camellia sinensis* (L.)]. *Journal of environmental science and natural resources*. 9(2): 91-95. (Printed in 2017).
02. T. Ahmed, M. Ali, M.M. Rana and M.I. Hossen 2017. Effect of global warming and climate change on the tea plantation. *Tea Journal of Bangladesh*. (Accepted for publication in the volume of 46, 2017).
03. M.M. Rana, M. Ali, and S. Wei. (2016). Effect of explant type and plant growth regulators on seedling derived tea explants. *Tea journal of Bangladesh*. 19(1): 109-113. (Printed in 2017).

**Visit**

Scientific personal researchers of the division paid 170 visits to different Tea Estates for experimental, advisory services and other official purposes during the reporting year. Number of visits for the reporting year 2017 presented in the table below.

**Table 3.** No. of visit paid by the scientific personnel of the division during the reporting year

Reporting year	No. of experimental visits	No. of advisory visits	No. of other official tours
2017	123	24	23

**Workshop / Seminar**

Scientific personnel of Agronomy division arranged 19 workshops in different tea estates and BTRI to disseminate updated technologies among planters on plantation, pruning, tipping, plucking, drought management in tea etc.

**Annual Course**

Scientific personnel of the division delivered lectures on tea culture in the 52nd BTRI annual course.

**BTRI Main Farm**

Mr. Rani Debnath is the present Farm supervisor of BTRI Farm. 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 "

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**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 "

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**Total** : 6.46 ha

**Other uses**

Office, Laboratory, Guest house, Mosque, School,  
Factory, Club house, labour line, roads etc. : 17.22 ha

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**Grand total** : 34.90 ha

**Improved planting materials supplied**

Year of supply	No. of fresh cuttings	No. of rooted cuttings
2017	4,16,600	32,675

**Green leaf production and earning from other farm products**

Reporting year	Green leaf production in kg	Earning from other farm products in Taka
2017	75,195	33,145

**Green Leaf Supplied**

Reporting year	Central Factory BTRI	Mini Factory BTRI	Entomology division
2017	71,423 kg	3742.6 kg	30 kg

**Immature Bud Supplied**

Reporting year	Mini Factory BTRI
2017	42.4 kg

**Independence and Victory Day**

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

**Meteorological Data for the year 2017**

Month	No. rainy days	Rainfall (mm)	Evaporation (mm)	Temperature (°C)		Dew point (°C)	Sunshine hrs.	R.H. (%)
				Max.	Min.			
January	0	0	88.5	27.0	10.0	13.1	7.6	68.1
February	1	1	97.3	29.9	12.6	12.9	7.5	58.1
March	10	237	100.7	29.7	16.9	17.0	5.6	66.3
April	16	641	123.1	31.0	21.3	22.1	5.5	75.7
May	16	353	151.6	33.3	23.5	23.9	6.3	74.0
June	25	895	97.3	31.9	24.5	25.3	3.3	83.3
July	26	237	122.6	32.5	25.7	24.8	3.3	81.6
August	25	452	126.1	32.8	25.7	25.5	3.9	80.8
September	25	463	101.5	32.9	25.2	25.6	3.8	83.6
October	13	335	98.9	32.9	23.1	24.1	5.9	81.9
November	3	12	87.3	31.6	17.2	19.5	7.8	76.3
December	4	118	63.0	30.2	13.8	16.8	6.1	78.4
<b>Total/Average</b>	<b>164 (Total)</b>	<b>3744 (Total)</b>	<b>1257.9 (Total)</b>	<b>31.3</b>	<b>20.0</b>	<b>20.9</b>	<b>5.6</b>	<b>75.7</b>

## ENTOMOLOGY DIVISION

**Shovon Kumar Paul**  
Scientific Officer

### STAFF

Dr. Mohammad Shameem Al Mamun, Senior Scientific Officer was transferred to BTRI Substation, Panchagarh on 8 March, 2017. Mr. Abul Kalam Azad joined as Senior Farm Assistant on 4<sup>th</sup> July, 2017. The posts of Principal Scientific Officer and Senior Farm Assistant were lying vacant during the period under report. There was no other change in personnel position of the division.

### RESEARCH

Seven experiments under six programme areas were carried out during the year of 2017. The experiments were - Effect of some organic amendments for the control of plant parasitic nematodes in tea; Evaluation of some indigenous plant extracts against Thrips and Nematodes; Antagonistic potential of entomopathogens on plant parasitic nematodes in tea; Screening of pesticides against major insect pests in tea; Determination of judicious use of pesticides for a model tea estate; Determination of residue level of commonly used pesticides in tea; Comparative studies of bio-chemical change due to plant parasitic nematodes infestation in different tea clones. Another four experiments such as Evaluation of sex pheromone trap and sticky trap; Searching and identification of bio-control agents; Predation capacity of spider fauna; compatibility study among different pesticides in tea would not be possible to continue due to manpower shortage and unavailability of materials. Details of the experiments together with their findings are furnished below:

#### ENT 1. CULTURAL AND MECHANICAL CONTROL OF PESTS

##### ENT 1.1. Effect of organic amendments for the control of plant parasitic nematodes in tea (2016-2017)

**Progress:** The experiment was conducted at Nematology Field laboratory of BTRI with eight different organic materials such as mustard oil cake, sesame oil cake, rice husk, wheat bran, blackgram bran, poultry litter, vermicompost, tea waste compost have been selected for the study. Those materials have been mixed with 5 kg sandy loam soil @ 100 g of each organic material and kept in plastic pot with a diameter of 22 cm. The pot was then kept for 2 weeks and watered regularly for the decomposition of organic materials. Five (05) months old tea seedlings have been planted in those pots after 2 weeks. Before application of organic materials, no. of nematodes has been counted. The decomposed organic materials were added to pots at 4 months interval.

Data were collected on nematode population at monthly interval. The effectiveness of organic amendments in suppressing nematode population was calculated by using Henderson & Tilton formula. Results revealed that all the organic materials reduced nematode population over control (Fig. 1). The highest nematode reduction was found in vermicompost treated pots (Table 1).

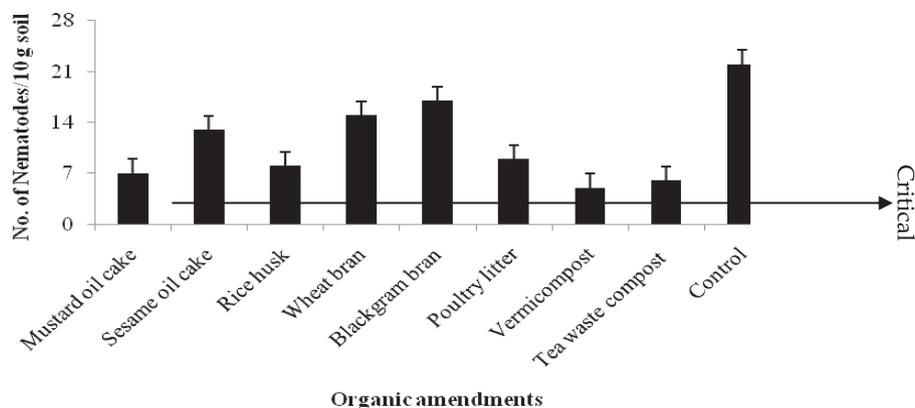


Fig. 1. Effect of some organic amendments on plant parasitic nematodes in tea

## ENT 2. STUDIES ON INDIGENOUS PLANT EXTRACTS

### ENT 2.1. Evaluation of indigenous plant extracts against Thrips and Nematodes (2016-2018)

#### *Screening of some plant extracts against Thrips*

An experiment was conducted to evaluate the toxicity of five indigenous plants such as Akonda (*Calotropis procera*), Castor bean (*Ricinus communis*), Garlic (*Alium sativum*), Nishinda (*Vitex negundo*) and Tobacco (*Nicotiana tabacum*) against thrips under both laboratory and field condition (Table 2). The extracts were prepared with water. The concentrations of the extracts were 5.0, 7.5 and 10% (w/v). Thrips infested shoots were collected from the experimental plot of BTRI main farm. Five infested shoots were kept in petri dish. The plant preparations were applied to the infested shoots with different concentration by hand sprayer. The petri dishes were arranged in CRD with 3 replications and kept in laboratory.

Data were collected at 24HAT, 48HAT and 72HAT. Thrips were counted under stereomicroscope. Mortality percentages were corrected by Abbot's Formula. In field condition, the above mentioned plant extracts were sprayed with three different concentrations. Two rounds of foliar spray were given at 15 days interval and post treatment observations were taken in four consecutive weeks. Effectiveness of the plant extracts were calculated by using Henderson and Tilton's Formula. All the plant extracts showed toxic effect on thrips under both laboratory and field condition.

**Table 1.** Effectiveness of different organic amendments against nematodes in tea

Treatments	Dose/ pot	Pre- treatment Observation	Effectiveness (%) of organic amendments against nematodes in tea												Overall mean (%)
			after 1 <sup>st</sup> application				after 2 <sup>nd</sup> application				after 3 <sup>rd</sup> application				
			1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month	4 <sup>th</sup> month	5 <sup>th</sup> month	6 <sup>th</sup> month	7 <sup>th</sup> month	8 <sup>th</sup> month	9 <sup>th</sup> month	10 <sup>th</sup> month	11 <sup>th</sup> month	12 <sup>th</sup> month	
Mustard oil cake	100 g	17	80.08	76.82	74.49	72.15	78.92	74.3	70.75	69.4	77.14	75.84	71.74	67.12	74.06bc
Sesame oil cake	100 g	21	81.43	76.94	72.61	69.51	79.27	73.11	70.84	66.17	78.66	72.82	68.73	65.63	72.98cd
Rice husk	100 g	13	78.67	75.28	71.76	67.73	80.84	76.64	71.68	68.35	79.26	74.81	70.35	68.79	73.68c
Wheat bran	100 g	11	77.01	74.94	69.2	64.56	80.73	76.9	71.78	65.26	79.92	75.22	69.3	64.32	72.43cd
Blackgram bran	100 g	15	71.69	69.33	65.63	63.5	76.26	71.82	66.27	63.22	74.17	69.97	65.65	62.92	68.37e
Poultry litter	100 g	19	76.41	73.16	71.24	65.62	78.83	75.61	72.43	69.58	80.08	76.03	71.63	66.47	73.09c
Vermicompost	100 g	16	82.23	79.56	76.42	74.31	83.36	78.85	75.22	72.69	84.62	79.24	77.88	73.99	78.20a
Tea waste compost	100 g	20	81.93	77.31	73.83	71.38	80.16	75.53	72.08	70.97	78.39	76.35	73.31	69.51	75.06b
Control	-	14	17	21	25	29	33	37	41	44	47	52	56	59	-

Mean of 3 replications. Figures with different letters are statistically different from each other by DMRT ( $p>0.05$ )

**Table 2.** Plants evaluated for insecticidal activities against thrips

Common name	Scientific name	Family	Plant parts used
Akonda	<i>Calotropis procera</i>	Apocynaceae	Leaves, flowers
Castor bean	<i>Ricinus communis</i>	Euphorbiaceae	Seeds
Garlic	<i>Allium sativum</i>	Amaryllidaceae	Cloves
Nishinda	<i>Vitex negundo</i>	Lamiaceae	Leaves
Tobacco	<i>Nicotiana tabacum</i>	Solanaceae	Leaves

Average mortality percentage of thrips at 24, 48 and 72 hours after treatment indicated that Garlic extract possessed the highest (79.80%) toxic effect whereas Akonda extract possessed the lowest (56.12%) toxic effect under laboratory condition at the highest (10%) concentration (Table. 3). Laboratory evaluation of plant extracts recorded to be 55.54-77.40% and 56.12-79.80% mortality of thrips at 7.5% and 10% concentration respectively. The maximum average mortality (68.13%) was observed at the highest concentration (10%) of plant extract and the mortality percentage was directly proportional to the level of concentration of plant extract. The order of the toxicity of plant extracts were Garlic>Tobacco>Castor bean>Nishinda>Akonda against thrips.

**Table 3.** Mean mortality percentage of thrips treated with different plant extracts under laboratory condition

Name of the plant	Dose (%)	Mortality rate (%)			Mean (%)
		24HAT	48HAT	72HAT	
Akonda	5.0	48.27	52.46	50.21	50.31j
	7.5	52.71	58.64	55.28	55.54h
	10.0	54.64	56.64	57.07	56.12h
Castor bean	5.0	53.65	60.55	64.57	59.59g
	7.5	65.14	68.87	64.45	66.15f
	10.0	71.35	67.58	69.74	69.56e
Garlic	5.0	76.29	74.58	73.64	74.84c
	7.5	75.16	80.56	76.47	77.40b
	10.0	78.47	79.35	81.57	79.80a
Nishinda	5.0	53.08	56.89	50.42	53.46i
	7.5	57.48	59.61	54.21	57.10h
	10.0	62.46	59.19	57.72	59.79h
Tobacco	5.0	70.35	66.58	68.54	68.49e
	7.5	72.28	67.23	70.35	69.95d
	10.0	76.43	74.19	75.49	75.37c
Probability level		NS			0.01

Mean of three observations; HAT= Hours after treatment; NS=Not Significant; Within column values followed by different letter(s) are significantly different by DMRT

Results revealed that the highest infestation reduction (73.45%) was found in Garlic treated plot and that of the lowest (44.68%) was found in Akonda treated plot under field condition (Fig. 2). The order of the toxicity of plant extracts were Garlic>Tobacco>Castor bean>Nishinda>Akonda against thrips.

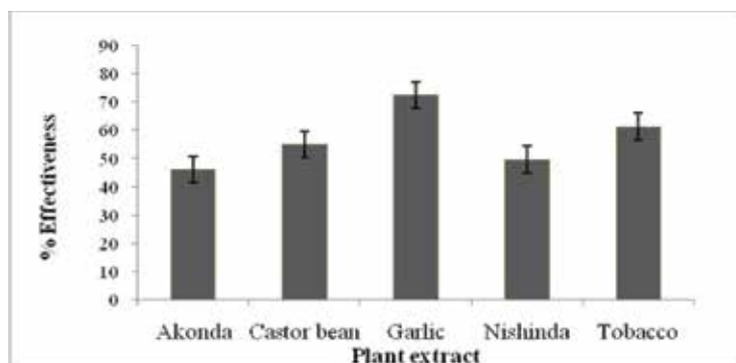


Fig.2. Effect of plant extracts on Thrips in field condition

#### Screening of some plant cakes against nematodes

A study was undertaken to evaluate the performances of some plant cakes i.e. Basok (*Adhatoda vasica*), Bhat (*Clerodendron infortunatum*), Akonda (*Calotropis procera*), Castor bean (*Ricinus communis*), Datura (*Datura metel*), Lantana (*Lantana camara*), Nishinda (*Vitex negundo*) and Tobacco (*Nicotiana tabacum*) against nematodes in tea.

The experiment was carried out in pot under Completely Randomized Design (CRD) with four replications at the Nematology Field Laboratory of BTRI. Soils were collected from nematode cultured plots of Entomology Division. Five kg of such soil was taken into 22 cm dia plastic pot. Thereafter the tested plant cakes @ 100g/pot were mixed thoroughly with soils. Five months old tea seedling was planted in each pot. All pots were kept moist by sprinkling tap water and when required. Untreated pot was considered as Control. Pretreatment was done by counting nematodes before application of different plant cakes.

The plant cakes were added to pots at 4 months interval. Nematode population was counted at monthly interval. The effectiveness of different plant cakes in suppressing nematode population was calculated by using Henderson & Tilton formula.

Result revealed that all the treatments had showed the toxic effect on nematodes and significantly reduced nematode population from the soil (Fig. 3). Among the plant cakes, datura cake showed the highest mortality of nematodes (75.99%) followed by tobacco (74.63%) and nishinda (72.14%) treated pot (Table 4).

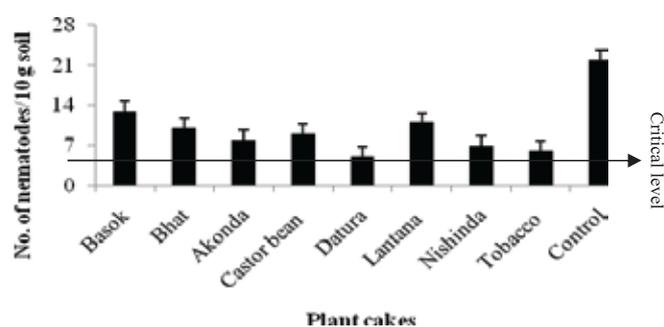


Fig. 3. Efficacy of some indigenous plant cakes on plant parasitic nematodes in tea

**Table 4.** Effectiveness of different plant cakes against nematodes in tea

Treatments	Dose/ pot	Pre- treatment	Effectiveness (%) of plant cakes against nematodes in tea												Overall mean (%)
			after 1 <sup>st</sup> application				after 2 <sup>nd</sup> application				after 3 <sup>rd</sup> application				
			1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month	4 <sup>th</sup> month	5 <sup>th</sup> month	6 <sup>th</sup> month	7 <sup>th</sup> month	8 <sup>th</sup> month	9 <sup>th</sup> month	10 <sup>th</sup> month	11 <sup>th</sup> month	12 <sup>th</sup> month	
Basok	100 g	13	74.24	66.59	61.44	57.47	76.72	71.31	65.67	58.47	75.94	68.11	62.71	55.16	66.15e
Bhat	100 g	11	75.37	70.79	65.93	62.98	78.83	72.56	67.87	64.92	77.28	74.08	69.37	62.43	70.20bc
Akonda	100 g	17	78.71	72.29	67.56	61.73	80.97	75.3	70.63	66.02	77.46	72.28	67.65	64.89	71.29b
Castor bean	100 g	19	76.07	71.97	66.25	61.64	78.44	75.33	71.51	65.46	77.74	72.83	67.2	63.11	70.63bc
Datura	100 g	23	83.48	78.13	76.57	71.84	80.35	76.08	72.7	69.65	81.53	77.39	75.42	68.76	75.99a
Lantana	100 g	15	74.12	69.77	62.6	59.65	77.28	73.55	69.28	63.05	75.91	69.56	65.19	58.73	68.22d
Nishinda	100 g	12	77.94	74.04	71.48	67.13	79.81	74.84	70.38	64.15	80.01	73.47	68.09	64.36	72.14b
Tobacco	100 g	18	79.77	75.87	71.91	69.41	81.17	77.19	74.13	70.54	80.41	75.5	71.88	67.77	74.63a
Control	-	9	11	15	19	22	26	29	32	36	41	45	48	52	-

*Mean of 3 replications. Figures with different letters are statistically different from each other by DMRT ( $p>0.05$ )*

### ENT 3. BIO-CONTROL OF PESTS

#### ENT 3.1. Antagonistic potential of entomopathogens on plant parasitic nematodes in tea (2016-2017)

**Progress:** Six commercial microbial pesticides (entomopathogens) i.e. *Beauveria bassiana*, *Metarhizium anisopliae*, *Paecilomyces lilacinus*, *Pseudomonas fluorescens*, *Trichoderma viridae* and *Verticillium lecanii* were collected from different companies (Table 5).

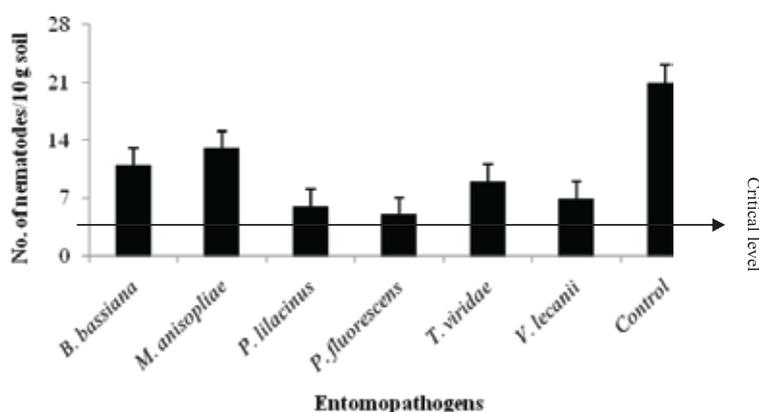
The above entomopathogens @ 10 g were mixed with well decomposed cow-dung and kept it for 7 days for increasing microbial action. Then 4 kg sandy loam soil was mixed with 1 kg cow-dung containing entomopathogens and kept it in a plastic pot 22 cm dia. Untreated pots were also prepared as control. Five months old tea seedling was planted in those pots and the pots were arranged in CRD with 4 replications. Other agronomical practices were done as and when necessary.

The entomopathogens were added to pots at 4 months interval. Nematode population was counted at monthly interval. The effectiveness of entomopathogens in suppressing nematode population was calculated by using Henderson & Tilton formula.

It was observed that all the entomopathogens reduced nematode population over control (Fig. 4). The highest (79.14%) nematode reduction was found in *P. fluorescens* treated pots and that of the lowest (69.01%) was *M. anisopliae* treated pots (Table 6).

**Table 5.** Entomopathogens evaluated against plant parasitic nematodes in tea

Technical Name	Commercial Name	Manufacturer/Supplier Name
<i>Beauveria bassiana</i>	Probiotic-1	Russell IPM
<i>Metarhizium anisopliae</i>	Probiotic-2	Russell IPM
<i>Paecilomyces lilacinus</i>	Nematox 1%WP	Haychem (BD) Ltd.
<i>Pseudomonas fluorescens</i>	Monaxe 0.5WP	Haychem (BD) Ltd.
<i>Trichoderma viridae</i>	Tricost 1%WP	Haychem (BD) Ltd.
<i>Verticillium lecanii</i>	Vertifire-L	International Panaacea Ltd.



**Fig. 4.** Effect of some entomopathogens on plant parasitic nematodes in tea

**Table 6.** Effectiveness of different entomopathogens against nematodes in tea

Treatments	Dose/ pot	Pre treatment	Effectiveness (%) of entomopathogens against nematodes in tea												Overall mean (%)
			after 1 <sup>st</sup> application				after 2 <sup>nd</sup> application				after 3 <sup>rd</sup> application				
			1 <sup>st</sup> month	2 <sup>nd</sup> month	3 <sup>rd</sup> month	4 <sup>th</sup> month	5 <sup>th</sup> month	6 <sup>th</sup> month	7 <sup>th</sup> month	8 <sup>th</sup> month	9 <sup>th</sup> month	10 <sup>th</sup> month	11 <sup>th</sup> month	12 <sup>th</sup> month	
<i>B. bassiana</i>	10 g	17	78.67	72.99	68.57	65.69	77.13	73.71	67.73	63.6	79.64	74.76	67.27	62.56	71.03d
<i>M. anisopliae</i>	10 g	22	77.12	70.38	66.84	63.85	75.68	71.02	66.22	61.21	78.05	72.01	65.37	60.42	69.01e
<i>P. lilacinus</i>	10 g	19	83.51	78.96	74.55	69.93	81.66	77.66	73.8	68.21	82.97	77.01	73.8	70.2	76.02b
<i>P. fluorescens</i>	10 g	14	84.17	80.64	78.92	76.85	85.76	81.58	77.87	73.08	83.86	79.11	75.41	72.42	79.14a
<i>T. viridae</i>	10 g	18	80.31	76.65	72.26	67.31	79.07	74.33	71.28	66.46	81.93	75.34	71.37	68.47	73.73c
<i>V. lecanii</i>	10 g	15	81.45	77.66	71.78	68.04	79.43	75.5	70.56	65.78	80.13	76.3	72.48	69.99	74.09c
Control	-	16	19	22	26	29	31	34	37	42	45	49	52	61	-

Mean of 3 replications. Figures with different letters are statistically different from each other by DMRT ( $p>0.05$ )

## ENT 4. SCREENING OF PESTICIDES

### ENT 4.1. Screening of pesticides against major insect pests in tea (1998-)

**Progress:** During 2017, fifty two (52) pesticides under different groups were tested against *Helopeltis*, Red spider mite, Termites, Aphids and Thrips in the field and the reports were sent to plant protection wing for their standardization (Fig. 5). The result revealed that all the tested pesticides was found satisfactory (>80% effectiveness).

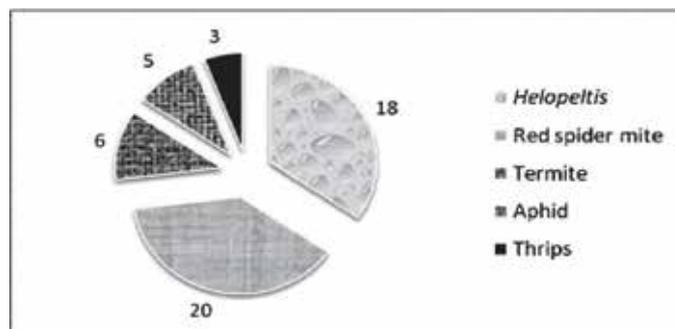


Fig. 5. Number of chemicals trial in the field against different insect pests of tea

### ENT 4.2. Determination of judicious use of pesticides for a model tea estate (2014-2017)

**Progress:** An experiment was initiated at BTRI to determine the judicious use of pesticides for a model tea estate. Standard plots were compared to the general practiced plots. Pesticide spray was given in standard plots by monitoring the insect pest infestation as well as observing the Economic Threshold Level (ETL) of different insects (Table 7). The weight of green leaves of each plot was taken in every plucking and insect pest infestation was also observed.

- Results revealed that the yield of both standard plot and general plot were increased significantly over control. But the different between yield of standard plot and general plot was found insignificant (Table 8).
- It was also found that the amount of spray volume was lower in standard plots compared to general practiced plots (Table 8). The round of pesticide spray against major insect pests has been determined (Table 9). It is a general guideline. The frequency and amount of pesticides depend on degree of infestation, climatic condition, variety, topography of land, seasonal abundance of individual pest species etc.
- The knowledge on biology and seasonal abundance of insect pests is helpful to use pesticides in effective way.
- Detection and marking of the initial pest-build up sites are needed to manage the pest through spot spraying. Such operation would reduce the pesticide load that results from routine, blanket applications.
- Spray should be given to the target site for effective management of pests (Table 7).

- Alternate spraying with contact and systemic insecticides of different chemical groups may be applied for minimizing the infestation severity which will also prevent pesticide resistance (Table 10).

Judicious use of pesticides encompasses the identification of pests, observing ETL, monitoring pest infestation, need based application etc. The correct choice of pesticides, dosage, timing and method of application is also very important for judicious use of pesticides. Judicious use of pesticide can reduce the frequency and amount of pesticide application in tea.

**Table 7.** ETL and target site of pesticide application

<b>Name of the Pest</b>	<b>ETL</b>	<b>Target site of pesticide application</b>
Tea Mosquito Bug	5% infestation	Tender shoots of upper canopy
Aphids	20% infestation	Top shoots & under surface of leaves
Thrips	3 Thrips per shoot	Tender shoots
Jassids	50 nymphs per 100 leaves	Top shoots & under surface of young leaves
Looper caterpillar	4-5 Lopper per plant	Whole bushes and trunk of the shade trees
Flushworm, Leaf Rollers	5 infested rolls per bush	Top shoots
Red Spider Mite	5 mites per leaf	Both surface of leaves, janam & fish leaves
Termites	10% infestation	Infested stem, trunk & soil around the collar zone
Nematodes	7.0 nematodes per 10 g soil	Nursery & young tea plantation

**Table 8.** No. of spray, average yield and increase of yield over control due to application of different insecticides

Plots	Insect infestation	No. of spray	Average yield (Kg/ha)	Increase of yield over control (%)
Standard plot	<i>Helopeltis</i>	7	1977.51a	47.39
	Red spider mite	5		
	Thrips	2		
	Looper caterpillar	3		
	Termite	1		
General plot	<i>Helopeltis</i>	10	2010.37a	49.84
	Red spider mite	7		
	Thrips	3		
	Looper caterpillar	4		
	Termite	2		
Control plot	<i>Helopeltis</i>	-	1341.72b	-
	Red spider mite	-		
	Aphids	-		
	Termite	-		
	Thrips	-		

Figures with different letters are statistically different from each other by DMRT ( $p>0.05$ )

**Table 9.** Comparison between Standard plot and General plot based on the number of spray per season

Plots	Insect infestation	No. of spray
Standard plot	<i>Helopeltis</i>	7-8
	Red spider mite	5-6
	Thrips	2-3
	Looper caterpillar	2-3
	Termite	1-2
General plot	<i>Helopeltis</i>	10-12
	Red spider mite	8-9
	Thrips	3-4
	Looper caterpillar	4-5
	Termite	2-3

**Table 10.** Tentative year round spraying schedule of different pesticide groups for controlling major insect pest in Tea

Insects	Off season	Early cropping season	Peak cropping season	Late cropping season
<i>Helopeltis</i>	-	Dimethoate/ Malathion	Thiamethoxam / Acetamiprid/ Thiacloprid	Cypermethrin/ Alpha-cypermethrin/ Deltamethrin/ Lambda cyhalothrin
Red spider mite	Sulphur/ Abom (As Prophylactic)	Fenpropathrin	Fenazaquin/ Hexithiazox	Propargite
Thrips	-	Chlorfenapyr	-	Chlorfenapyr
Looper caterpillar	-	-	Deltamethrin/ Cypermethrin	Dimethoate
Termite	Imidacloprid/ Fipronil	-	-	-

**ENT 5. PESTICIDE RESIDUE ANALYSIS****ENT 5.1. Determination of residue level of commonly used pesticides in tea (2017-2018)**

**Progress:** An experiment was initiated to know the residue level of pesticides at BTRI main farm. The following group of pesticides has been applied in experimental plots following BTRI recommended dose (Table 11) and the green leave samples were collected at 0, 3, 7, 10 and 14 days interval after pesticide application. The leaves samples were manufactured at Entomology laboratory of BTRI.

**Table 11.** Different group of pesticides applied in experimental plot

Chemical group	Technical name	Trade name	Name of insects	Dose/ha	Water volume
Pyrethroid	Deltamethrin	Decis 2.5EC	Tea mosquito bug	500 ml	500 lit
	Alpha Cypermethrin	Axis 10EC	Tea mosquito bug	500 ml	
	Lambda Cyhalothrin	Karate 2.5EC	Tea mosquito bug	500 ml	
	Fenpropathrin	Danitol 10EC	Red spider mite	1.0 lit	1000 lit
Quinazoline	Fenazaquin	Magister 10EC	Red spider mite	600 ml	
Neonicotinoid	Imidacloprid	Tiddo 200SL	Tea mosquito bug	250 ml	500 lit
	Thiamethoxam	Renova 25WG	Tea mosquito bug	100 g	

The determination of residue will be done by GC-ECD and HPLC-UVD with DB-5 Capillary and C18 Hypersil Column. Nitrogen gas (99.997% pure) will be used as carrier gas in GC. Hexane, Acetone and Acetonitrile will be used as extracting reagents and Florisil as Clean-up reagent.

## **ENT 6. BIO-CHEMICAL CHANGE OF PLANT THROUGH PEST INFESTATION**

### **ENT 6.1: Comparative studies of bio-chemical change due to plant parasitic nematodes infestation in different tea clones (2017)**

**Progress:** The experiment was conducted in the nursery area of BTRI with five tea clones viz. BT1, BT2, BT5, BT6 and TV1. Data were collected from experiment no. 6 (a) where the clones were arranged in paired plot design with healthy and infested plants. Three plants both healthy and infested from each clone were selected randomly. The plants were uprooted carefully, washed and chopped into approximately 1 cm pieces and thoroughly mixed. About 5 g root samples were taken for nematode extraction. The soil samples from the root zone of the tea plants were collected to a depth of 23 cm and about 5 cm from the base of the plants using a soil sampling auger. Each sample was a composite of 03 soil cores from each clones both healthy and infested plants. The composite samples were prepared by immediately mixed up of 3 individual subsamples of soil. A total of 10 composite samples were collected. They were transported in polybags and stored at 4°C within the same day to minimize changes in nematode populations.

Every time the soil sample was mixed thoroughly and 10 g soil was made for nematode extraction. Nematode extraction of both soil and root samples was carried out in Nematology laboratory of Entomology Division of BTRI following Baermann funnel method with some modification (Mian, 1998).

The biochemical components like chlorophyll, carotenoids, reducing sugar, proteins, steroids, indole acetic acid (IAA) of roots and leaves of both healthy and infected plants were analysed in Biochemistry laboratory of BTRI.

- Chlorophyll a was found to be low in infected leaves but the amount of chlorophyll b and carotenoids were found high in nematode infested plant leaves.
- The amount of reducing sugar reduces in the nematode affected plants.
- The protein content in roots did not differ much. But the nematode infested leaves contained much less protein content than the healthy leaves.
- The healthy leaves and roots contained more steroid than the nematode affected counter parts.
- The IAA content raised in nematode affected plant roots than healthy ones.

## **OTHER ACTIVITIES**

### **Advisory and Experimental visits**

A total of Twenty seven (27) advisory visits were paid to different tea estates to identify and render advice on specific pest problems and Forty six (46) advisory letters issued to different tea estates in respect of identification of various pests, their control measures and report on nematode analysis during the reporting year.

### **Analysis**

A total of Eighty five (85) soil samples were analyzed in the Laboratory for nematode count and reported to different tea estates. A total of 52 pesticides including insecticides, miticides, nematocides and termiticides were received from plant protection wing, Department of Agricultural Extension, Dhaka for field trial and reports were sent to plant protection wing for standardizations during the year 2017.

### **Tours/Visits**

A total of Nine (09) official visits were paid by the Scientists of the division to different organizations for Official purposes.

### **Courses on tea culture**

The Scientific personnel of the division delivered lectures on tea pest management at Annual Courses held at BTRI Main Station, Srimangal; BTRI Sub-Station, Fatikchari, Chittagong and BTRI Sub-Station, Panchagarh as well as in Post graduation diploma course, MTC, BTB. The resource persons gave comprehensive lectures and practical demonstration on tea pest spectrum, their control options, pesticides and its residue in made tea and spraying techniques.

### **Workshop/Seminar**

A total of Five (05) workshops were conducted at different tea estates under different valley circles on tea pest management during 2017.

**PLANT PATHOLOGY DIVISION****Mohammed Syeful Islam**

Senior Scientific Officer

Plant Pathology Division

**STAFF**

Dr. Mohammad Ali, Chief Scientific Officer, Department of Pest Management was promoted to Director, BTRI on 07/03/2017. The post of Chief Scientific Officer of the department becomes vacant from 07/03/2017. The posts of one Principal Scientific Officer and one Field Assistant of the division were remained vacant. There were no other changes in the staff position of this division during this period.

**RESEARCH**

There are eight experiments (ongoing 7 and new 1) were approved to conduct during 2017. Among these two experiments were completed earlier of the year and these are now under process for publication. Another one ongoing experiment was discontinued due to unavailability of input materials from providers. However the progresses of the experiments are as follows:

***PP 3: DISEASE MANAGEMENT*****PP 3.6: Study of microbial effects on made tea quality (BTRI: 2015- 2017).****Objectives**

1. To assess the changes in quality due to growth of microbes on black tea during storage.

**Progress**

Nine black tea and one Darjeeling green tea (mini pack) samples were collected from the market for microbial loads. The initial moisture content for each black tea sample was more than 7.8% and that was for Darjeeling green tea 5.48%. In controlled condition, *Aspergillus niger* and *Penicillium* spp. were found in all the samples (table 1). In opened environment, *Aspergillus* spp. was recorded in the black tea sample contained 11.89% moisture reaching from 4.9% after 20 days of plating. The *Aspergillus* spp was also recorded in drier mouth sample that contained 2.5% initial moisture reached to 8.3% after 42 days of plating (table 2). Theaflavins (TF), Thearubigins (TR), Total Liquor Color (TLC), Highly Polymerized Substances (HPS) and Color Index (CI) of five black tea samples were measured in both pre- and post-fungal growth stage (table 3). The experiment was completed earlier of the year. Now it is under process for publication.

**Table 1.** Microbial contamination with black tea and Darjeeling green tea samples at different moisture level.

Sample	Company/ Brand	% moisture	Name of fungi
1	Meghna Tea Co. Ltd.	7.91	<i>Aspergillusniger, Penicilliums</i> pp.
2	Danish Tea	7.86	<i>A. niger, A. flavus, Penicilliums</i> pp.
3	IspahaniMirzapore	8.06	<i>A. niger, Penicilliums</i> pp.
4	Star ship (Special tea)	8.25	<i>A.niger, A. flavus, Penicilliums</i> pp.
5	Seylon tea (Gold)	8.97	<i>A. niger, Penicilliums</i> pp.
6	Sylhet Gold tea	9.12	<i>A. niger, Penicilliums</i> pp.
7	Pusti tea (Tender sample)	7.95	<i>A. niger, A. flavus, Penicilliums</i> pp.
8	Pusti tea (Market sample)	8.56	<i>A. niger, A. flavus, Penicilliums</i> pp.
9	Darjeeling green tea	5.48	<i>A. niger, Penicilliums</i> pp.
10	Drier mouth sample (BTRI)	2.5	Not found

**Table 2.** Moisture absorption and fungal growth on black tea in open environment (2016)

Sample no.	Initial moisture (%)	Final moisture (%)	Days required to fungal growth	Name of fungi
1	4.9	11.89	20	<i>A. flavus &amp; A. niger</i>
2	2.5 (DM)	8.3	42	<i>Aspergillus</i> spp.

**Table 3.** Changes in Biochemical parameters for black tea samples at pre- and post-fungal growth stage.

Sample no.	Pre-fungal growth stage					Post-fungal growth stage				
	TF	TR	TLC	HPS	CI	TF	TR	TLC	HPS	CI
1	0.250	3.111	1.74	3.015	4.084	0.017	1.514	4.92	1.514	0.118
2	0.267	2.933	1.94	4.038	3.836	0.026	0.805	5.02	0.805	0.163
3	0.311	3.752	1.67	3.956	4.029	0.009	1.037	3.55	1.037	0.064
4	0.155	3.465	1.70	7.299	1.442	0.026	0.860	3.84	0.860	0.259
5	0.259	3.533	2.76	7.845	2.274	0.036	1.300	4.35	0.505	0.596

Note: TF, TR, TLC HPS are expressed in percentage.

**PP 3.7: Effects of diseases on the change of tea quality (BTRI: 2015-2017)****Objectives**

1. To find out the changes in quality of made tea due to different disease infestation.

**Progress**

There is a significant reduction in quality of tea in terms of Chlorophyll-a, Chlorophyll-b and Carotenoids by 76.98, 82.78 and 50%, respectively in red rust infected tea by *Cephalosporium parasiticum* (table 1). The experiment was completed earlier of the year. Now it is under process for publication.

**Table 1.** Chlorophylls and Carotenoids contents in fresh and red rust infected tea leaves.

Items	Chlorophyll-a (mg/g)	Chlorophyll-b (mg/g)	Carotenoids (mg/g)
Fresh leaves	4.43	1.80	1.02
Infected leaves	1.02	0.31	0.51
% Reduced	76.98	82.78	50

In infected tea leaves, a reduced per cent of Thearubigin (TR), highly polymerized substances (HPS) and total liquor color (TLC) were observed by 34.35, 18.52 and 3.417%, respectively. No change was found in case of Theaflavin (TF) in both fresh and infected leaves but Color Index (CI) was found to be increased in infected leaves by 35.32% (table 2). Caffeine Content decreased by 15.97% and P<sup>H</sup> value was found almost same for fresh and infected leaves (table 3).

**Table 2.** TF, TR, HPS levels and color changes in fresh and red rust infected tea leaves.

Items	TF%	TR%	HPS%	TLC%	Color Index
Fresh Leaves	0.29	3.90	2.43	1.76	4.70
Infected leaves	0.29	2.56	1.98	1.70	6.36
% Reduced	00	34.35	18.52	3.41	(-) 35.32

**Table 3.** Caffeine level in fresh and red rust infected tea leaves.

Items	Amount of Caffeine (mg/ L) at specific absorbance		P <sup>H</sup> of brewed tea		Color of brewed tea	
	Absorbance at 260 nm	Amount of Caffeine	Before boiling	After boiling	Before boiling	After boiling
Fresh Leaves	1.81	47.45	4.84	4.81	Reddish	Light red brownish
Infected leaves	1.52	39.87	4.93	4.80	Yellowish	Deep red brownish
% Reduced	-	15.97	-	-	-	-

### PP 3.8: Management of tea diseases with Plant Growth Promoting Rhizospheric microbes (PGPR) (BTRI/ BEF: 2016- 2020)

#### Objectives

1. To isolate potential Rhizospheric microbes from tea soil.
2. To evaluate Rhizospheric microbes for controlling different tea diseases both in field and laboratory condition.
3. To evaluate Rhizospheric microbes for growth and development of tea plants.

**Progress:** There are four microbes like *Bacillus*, *Pseudomonas*, *Streptomyces*, *Trichoderma* were recorded. These microbes and one collected biofertilizer enhance plant growth identically ( $P= 0.05$ ) in nursery regarding increasing number of leaves, plant height and stem girth (Table1). The microbes have a positive impact on the rate of increase in number of leaves, height of plants and girth of plants by 33, 43 and 3% respectively with encouraging relations (Figure 1,2, 3 and 4). In case of disease severity, the lowest severity (21.00) was found with *Trichoderma* followed by *Bacillus*, *Pseudomonas* and *Streptomyces* with identical values (Table2). *Trichoderma* and *Bacillus* cause 16 and 14% reduction of disease severity while both *Pseudomonas* and *Streptomyces* cause 10%. All the microbes have a great impact in reducing disease severity by 19% with optimistic relations (Figure 4). Radial colony growth (mm) of *C. theae* was also in similar trends. Collected biofertilizer showed comparatively lower response in reducing disease severity. The experiments will be continued.

**Table 1.** Showing the plant growth parameter against different growth promoting microbes in nursery

Treatments	No. of leaves	Height of plant (cm)	Girth of stem (mm)
Control	16.67 b	46.67 b	1.53 b
<i>Bacillus</i>	19.67 a	54.80 a	1.87 a
<i>Pseudomonas</i>	19.67 a	55.37 a	1.80 a
<i>Streptomyces</i>	20.33 a	55.43 a	1.93 a
<i>Trichoderma</i>	19.67 a	55.37 a	1.63 b
Biofertilizer	19.33 a	54.90 a	1.53 b

Same letter (s) followed by values in column is/ are not statistically different from each other.

**Table 2.** In-vitro radial colony growth (mm) of *Corticium theae* after different periods (hour) of incubation and In-vivo disease severity against different growth promoting microbes.

Treatments	Radial colony growth (mm) after different periods (hour) of incubation					Disease severity (PDI)
	48	72	96	108	120	
Control	51.33 a	68.67 a	81.33 a	89.67 a	90.00 a	25.00 a
<i>Bacillus</i>	42.67 d	60.67 c	72.67 c	83.33 b	89.67 ab	21.50 cd
<i>Pseudomonas</i>	42.67 d	61.67 c	69.67 d	81.33 c	88.67 abc	22.50 bc
<i>Streptomyces</i>	43.67 c	61.67 c	68.67 e	79.67 d	87.67 c	22.50 bc
<i>Trichoderma</i>	27.67 e	42.67 d	56.67 f	67.33 e	72.67 d	21.00 d
Biofertilizer	44.67 b	67.67 b	77.67 b	83.67 b	88.33 bc	23.00 b

Same letter (s) followed by values in column is/ are not statistically different from each other.

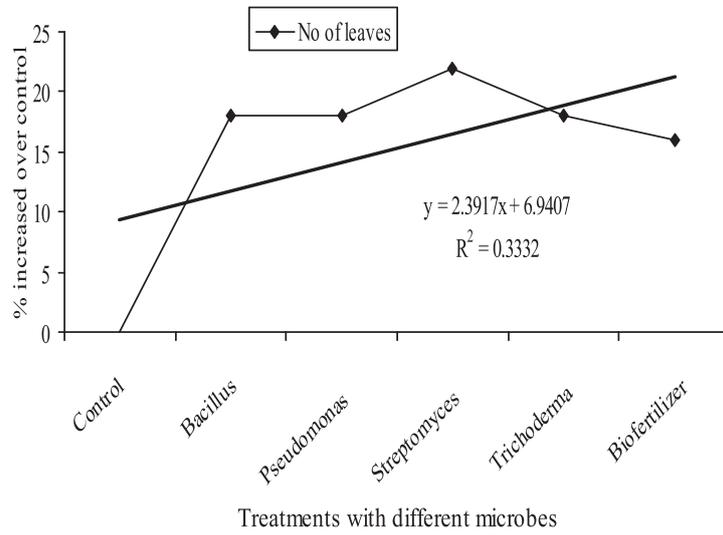


Fig. 1: Rate of increased in number of leaves over the control

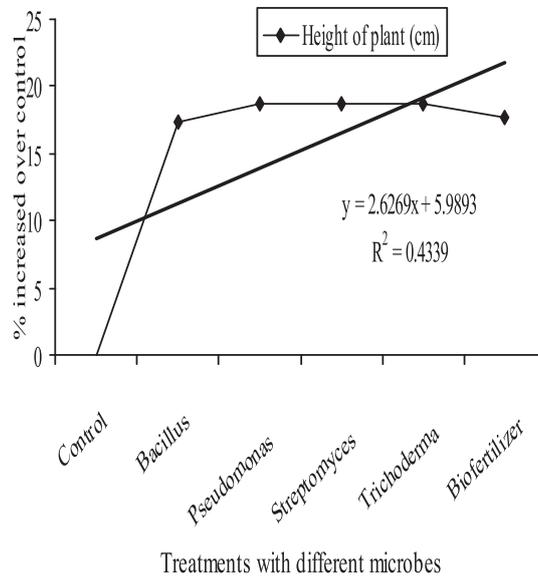


Fig. 2: Rate of increased in height of plants over the control

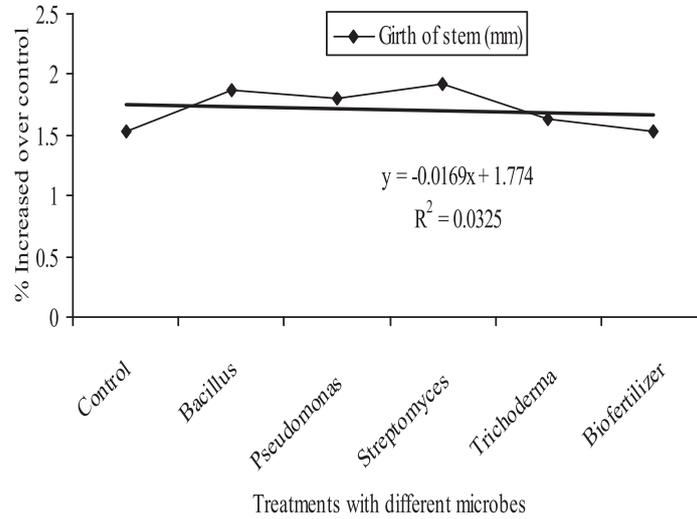


Fig. 3: Rate of increased in girth of stem over the control

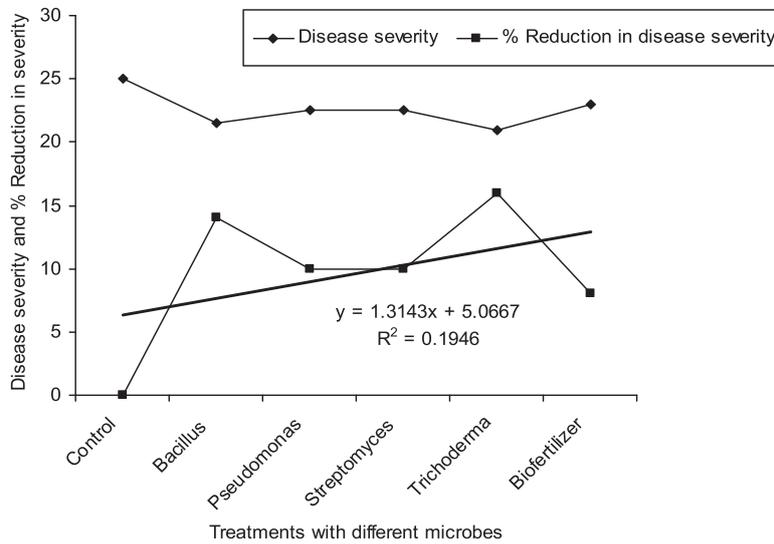


Fig. 4: Rate of reduced in disease severity over the control

**PP 3.9: Studies on the overwintering process of the pathogen and capability of transmission for infecting Black rot disease (BTRI/ BEF: 2016- 2017).**

**Objectives**

1. To identify the suitable persisting place and determine the density of overwintered pathogens of the disease during dormant season.
2. To find out the mode of transmission and trend of disease development in the next cropping seasons.
3. To find out a suitable control option against the overwintered pathogens.

**Progress**

The highest number of viable and vigorous pathogenic propagules (> 20%) was found in plant debris in all diluted concentrations followed by pruning litters and surface soils (Table1). Only cleaning the plant debris can reduce 22.27% disease severity over the control whereas pruning litters and soil fragments showed similar reduction of disease severity (9.20-11.86) shown in table2. From the result, it can be concluded that the pathogen can able to survive vigorously with plant debris in dormant period followed by pruning litters and soil fragments.

Subsequently, after pruning operations in infected plantation cleaning of pruning litters, cleaning of infected plant debris & soil drenching 2- 3 times application of a systemic fungicides like Carbendazim 50 WP @ 750gm/ ha mixed in 1000 L of water in May to July at 15 days interval gave highest production of tea (1,947.68 kg/ha) and low disease severity (3.86) as well (Table2). **The experiment is completed.**

**Table 1.** Presence of *Corticium theae* in different sources of infection during dormant period

Sources of infection	Direct method	Dilution method		
		10 <sup>-3</sup>	10 <sup>-4</sup>	10 <sup>-5</sup>
Pruning litters	+++	+++	+++	++
Plant debris	+++	+++	+++	+++
Soil	+++	+++	++	++

**Table 2.** Showing the Effect of different groups of fungicides on the severity of Black rot disease and yield of tea.

Treatments	Made tea (Kg/ha)	Disease Severity (PDI)	% changes in severity
T <sub>1</sub> = Control (No cleaning & sanitation)	1,549.32 j	8.26 a	00
T <sub>2</sub> = Cleaning of only pruning litters	1,837.90 h	7.28 b	11.86
T <sub>3</sub> = Cleaning of only infected plant debris	1,853.10 g	6.42 c	22.27
T <sub>4</sub> = Only soil drenching	1,760.96 i	7.50 b	9.20
T <sub>5</sub> = Cleaning of pruning litters + Cleaning of infected plant debris + soil drenching	1,894.12 c	4.86 d	41.16
T <sub>6</sub> = Cleaning of only pruning litters + soil drenching	1,864.68 e	4.72 d	42.85

T <sub>7</sub> = Cleaning of only infected plant debris + soil drenching	1,859.46 f	5.88 c	28.81
T <sub>8</sub> = Cleaning of pruning litres + Cleaning of infected plant debris	1,878.00 d	4.68 d	43.34
T <sub>9</sub> = Cleaning of pruning litres + Cleaning of infected plant debris + soil drenching + Carbendazim	1,947.68 a	3.86 e	53.26
T <sub>10</sub> = Cleaning of pruning litres + Cleaning of infected plant debris + Carbendazim	1,917.30 b	4.46 de	46.00

**PP 4.0: Advent and Economic Importance of Epiphytic Red Rust of Tea: Assessment, Causes and Remedies (2017-2018)**

**Objectives**

- To determine the associated causes (both biotic and abiotic) of the disease.
- To assess the economic importance of the disease.
- To find out the remedial measures of the disease.

**Progress**

Assessment of the disease was in discreet ways due to uneven occurrence of the disease in tea fields these are not presentable. The experiment will be continued.

**PP 3.3: Screening of new fungicides and herbicides against different diseases and weeds in tea (BTRI/ BEF/ TE (s): Short term).**

**Progress**

A total of thirteen fungicides and nine herbicides of different groups were tested against respective pests. Tested chemicals were found > 80% effective against the respective pests. Reports were sent to PTASC for further necessary action.

**PP 4: WEEDS MANAGEMENT**

**PP 4.6: Weed management in tea with BecAno 500 SC (BTRI/ BEF/ TEs: 2014-2018)**

**Progress**

This experiment has been discontinued. The provider of the Chemical could not supply BecAno 500 SC (Indaziflam). The experiment was continued for three years (2014-2016). So, the progress of the experiment for 2016 is incorporated. An experiment was carried out at BTRI Farm with 10 treatments following RCBD. The treatments T<sub>0</sub> = Control, T<sub>1</sub> = Paraquat 20 SL @ 2.8 L, T<sub>2</sub> = Glyphosate 41 SL @ 3.5L, T<sub>3</sub> = BecAno 500 SC @ 150 ml/ha, T<sub>4</sub> = Paraquat 20% +BecAno 500 SC, T<sub>5</sub> = Glyphosate 41 SL+ BecAno 500 SC, T<sub>6</sub> = First application Paraquat 20% SL and 30 days later BecAno 500 SC, T<sub>7</sub> = First application Glyphosate 41 SL and 30 days later BecAno 500 SC, T<sub>8</sub> = First application BecAno 500 SC and 30 days later Paraquat 20% SL, T<sub>9</sub> = First application BecAno 500 SC

and 30 days later Glyphosate 41 SL. The treatments were applied in the plots containing sufficient moisture. Data are being collected in terms of per cent weed germination (monocot and dicot) at monthly interval. Till the month of June no weed germination was observed in the plots treated by T<sub>5</sub>= Glyphosate 41 SL+ BecAno 500 SC. The experiment is completed.

**Table 1.** Effect of different herbicides on weed control (2016)

Treatments		Dose ha <sup>-1</sup> diluted in 400 L water	Weed control (%)
T <sub>0</sub>	Control	-	0 b
T <sub>1</sub>	Paraquat 20SL	2.8 L	95 a
T <sub>2</sub>	Glyphosate 41 SL	3.5 L	95 a
T <sub>3</sub>	BecAno 500 SC	150 ml	90 a
T <sub>4</sub>	T <sub>1</sub> + T <sub>3</sub>	2.8 L + 150 ml	95 a
T <sub>5</sub>	T <sub>2</sub> + T <sub>3</sub>	3.5 L + 150 ml	100 a
T <sub>6</sub>	T <sub>1</sub> then T <sub>3</sub>	2.8 L then 150 ml	90 a
T <sub>7</sub>	T <sub>2</sub> then T <sub>3</sub>	3.5 L then 150 ml	95 a
T <sub>8</sub>	T <sub>3</sub> then T <sub>1</sub>	150 ml then 2.8 L	90 a
T <sub>9</sub>	T <sub>3</sub> then T <sub>2</sub>	150 ml then 3.5 L	90 a

**PP 5: ARBUSCULAR MYCORRHIZAL FUNGI IN TEA**

**PP 5.3: Inoculum Production of AM Fungi for Tea Cultivation (BTRI: 2015-2018).**

**Experiment: Identification of VAM and determination of their potentiality in tea cultivation (2017-2018).**

**Progress**

- 20 plant species were investigated for mycorrhizal colonization, among them 8 plant species are found responsive. Responsive plant species to AM colonization are presented in following table

**Table 1.** Number of AM positive segment and % colonization of AM species in different Responsive plant species

SL No.	Responsive plant species to AM colonization	Number of AM positive segment	Total number of scored segments	% colonization of AM species
1	<i>Leucas aspera</i> (Setodron)	12	20	60
2	Marigold	7		35
3	<i>Albizzia lebbek</i>	6		30
4	<i>Derris robusta</i>	3		15
5	Guatemala	4		20
6	<i>Albizzia odoritissima</i>	3		15
7	<i>Mimosa invisa</i>	3		15
8	<i>Indigofera</i> spp.	2		10

***Non-responsive plant species (12 nos.) to AM colonization***

1. Lemon grass, Citronella, Nishi, Bogamedeloa, Paharineem, Bagrakot, Sisso, Acassia, Shaknotey, Durba grass, Tripatra and Carpet grass
2. Microscopic images of colonization of AM species have already been taken, and identification of AM species is going on.
3. 6000 cuttings of all 20 released clones (BT1 to BT20, each of 300) have been planted in primary beds.
4. 300 plants of the most responsive *Leucas aspera* (Setodron) plant species have been planted in a separate bed in the nursery.
5. Nutrient status of soils of primary bed has been measured with the help of Soil Science Division.

**Table:** Nutrient status of soils of primary bed

Particulars	Critical Values	Status in test soils
Soil texture	Sandy loam-Loam	Sandy Clay
Soil pH	4.5-5.5	4.8
Organic Carbon	1%	0.75%
Total Nitrogen	0.1%	0.082%
Available Phosphorus	10 ppm	7.42 ppm
Available Potassium	80 ppm	27.90 ppm
Available calcium	90 ppm	383.20 ppm
Available Magnesium	25 ppm	65.12 ppm

6. Colonization potentiality of AM species will be observed after harvesting of AM from *Leucas aspera* plants and further inoculation with all 20 test clones in secondary beds.
7. Treatments: T<sub>1</sub>= Control, T<sub>2</sub>= Nursery mixture, T<sub>3</sub>= T<sub>2</sub> + *Gigaspora*, T<sub>4</sub>= T<sub>2</sub>+ *Scutellospora*, T<sub>5</sub>= T<sub>2</sub> + *Gloma*, T<sub>6</sub>= Only *Gigaspora*, T<sub>7</sub>= Only *Scutellospora*, T<sub>8</sub>= Only *Gloma*

**OTHER DIVISIONAL ACTIVITIES**

Scientists of the division paid 28 advisory visits to different tea estates for analyzing and solving the problems related to tea production and quality. 31 correspondences were accomplished followed by advisory visits, sample analysis and other officials. Moreover they also delivered about 12 hours comprehensive lectures in MTC modules organized by PDU. Four workshops on tea disease and weed management were carried out in different tea valleys. Three scientific papers were also published in journals during the period under report.

**STATISTICS & ECONOMICS DIVISION**

**Dr. Shefali Boonerjee**  
Senior Scientific Officer

**STAFF**

The posts of Principal Scientific Officer (PSO), and Statistical Assistant were lying vacant during the period under report. There was no other change in personnel position of the division.

**RESEARCH**

There were three experiments running in this division namely (Economic Efficiency of tea production, Evaluation of technology and Economic Efficiency of tea factories). The present situation of these experiments is summarized below.

**SE 1: ECONOMIC EFFICIENCY OF TEA PRODUCTION**

SE 1.1. Economics of optimum fertilizer dose for some selective clones at BTRI farm. The data of this expt. were revived, arranged and analyzed. The experiment was conducted to find out optimum economic fertilizer doses for some selected clones of BTRI. In this experiment a total of 4 clones namely BT2, BT5, BT6 and BT8 were taken to study the performance in four different fertilizer doses. There were 4 treatments e.g. T1 (N : P : K = 0:0:0 kg/ha), T2 (N : P : K = 164 : 32 : 100 kg/ha), T3 (N : P : K = 186 : 36 : 125 kg/ha) and T4 (N : P : K = 204 : 41 : 150 kg/ha) with 4 replications were examined for study the economic performance of the clones. It was observed that BT2 and BT6 obtained the highest yield from T2 where BT5 obtained partially higher yield from T3 and BT8 responded better in T2. The partial budget analysis was done to find out the most viable economic doses for different clones. Finally it was revealed that T2 partially obtained the higher marginal rate of return for all the clones.

**SE 2: EVALUATION OF TECHNOLOGIES**

SE 2.1. Adoption of BTRI matured technologies and its extension to Bangladesh tea industry.

The study conducted to examine the overall feature of implementation and its efficiency of the BTRI technologies to the tea estates. BTRI has innovated a number of technologies since last 55 years and made a great impact on tea improvement providing these technologies. Bangladesh tea has increased its productivity remarkably from the last few decades but it is still now behind in terms of yield and quality than the other leading tea growing countries in the world. The yield trend is less than that of other tea producing countries like India, Kenya, Sri-Lanka etc. The important reason of such low production is assumed due to improper utilization of scientific technologies like inferior planting material, lack of authentic control measures of pest and disease management, absence of proper agronomic practices, soil fertility and pH control etc. BTRI has so far released 21 outstanding clones and many other successful technologies which are effectively been used in the tea industry. But there is no information about the percentage of application of the

technologies and its efficiency in implementation. So the current data regarding the disseminated technologies to the estate required to up-to-date. This database will be helpful to find out the adoption efficiency in the field and to find out the limitations of dissemination of the BTRI technologies.

In the present experiment, the adoption percentages of both BT and TV clones in the tea estates of different valleys are tried to explore. The calculated data on clonal plantation areas of the tea estates are presented in the Table 1.

**Table 1.** Valley wise clone plantation in the different tea estate

Valley	Total tea area (ha)	Seedling area (%)	Clone area (%)	BT clones (%)	TV clone (%)	Av. yield of BT area (kg/ha)	Av. yield of TV area (kg/ha)
Balisera	14537.91	56.41	35.63	21.82	78.39	1801.5	1836.37
Monu-Doloi	7410.07	51.99	41.24	48.78	46.26	1706.75	2403.00
Lungla	8025.3	55.85	40.81	51.28	44.77	1592.78	1715.83
Juri	7634.26	48.49	44.86	47.69	50.57	1765.67	1582.5
Luskerpur	8348.23	51.90	48.17	68.31	31.10	1591.2	1527.2
North Sylhet	4632.51	73.98	24.29	51.79	48.20	994.2	960.6
Chittagong	5326.97	43.70	60.18	74.62	28.35	1684.67	1646.43
Total	55915.25	54.34	41.64	45.05	40.20	1590.97	1667.42

During this study, it was recorded that, among the 164, a total of 88 tea states were responded initially. They have sent their information through the questionnaire. These data were tabulated by arranging them according to valley wise and ownership/company wise. The necessary information of 57 gardens was collected from the monitoring reports of Project Development Unit (PDU), BTB. The collected data of total 144 gardens were partially summarized according to valley wise adoption of clonal plantation. About 41.64% land of total tea area of the 7 valleys is occupied by clone plantation with the average production of 1607.48 kg/ha. The use of BT and TV clones are 45.05% and 40.20% with the average production of 1591 and 1667 kg/ha respectively. Among the valleys, the highest clone plantation was found in Chittagong valley (60.18%) followed by Luskerpur (48.17%), Juri (44.86%), Monu-Doloi (41.24%), Lungla (40.81%), Balisera (35.63%) and North Sylhet (24.29%). The highest (74.62%) BT clones are adopted by Chittagong valley and the lowest (21.82%) by Balisera valley. Among the tea estates under different managements, the

gardens of NTC occupied by 50.48 % of land with clones of which about 62% is BT clones. BTB managed gardens have 57% BT clones out of their 41% clone area. The New Sylhet Tea Co. cultivated about 65% BT clones of 85% clonal plantation of total tea area exist in their lone tea estate. Duncun Brothers, Finlay and Deundi Tea Co. have 33.64%, 35.3% and 46.40% clone area of which 30.22%, 8.35% and 60.55% are covered by BT clones respectively.

**Table 2.** Management wise clone plantation

Name of the Company/Management	No. of TE	Seedling area (%)	Clone area (%)	BT clone area %	TV clone area %	Av. yield of BT clones (kg/h)	Av. yield of TV clones (kg/h)
Finlay	7	63.76	35.3	8.35	72.2	1500	1900
NTC	11	47.43	50.48	61.95	32.9	1416	1417
BTB	3	56	41.41	57	42.81	1386	1291
Duncun Brothers Ltd.	16	61.22	33.64	30.22	41.93	1695	1950
Deundi Tea Co.	4	53.6	46.40	60.55	40	1533	1500
The New Sylhet Co.	1	14.9	85.09	65.55	26.75	1800	1700

## **SE. 1.2 ECONOMIC EFFICIENCY OF SOME SELECTED BOUGHT LEAF FACTORIES AT PANCHAGARH (2017-2020).**

The experiment was undertaken to assess the economic efficiency and to find out constrains of production of the selected bought leaf factories at Panchagarh. The socio-economic condition of workers was also targeted to study.

### **OTHER ACTIVITIES**

#### **Annual Returns of BTB and BCS**

Annual returns of BTRI farms including Bilashcherra Experimental farm on land use, tea seeds, plants and tea waste (BTB return No. 2) and also on employment and employment cost (BTB return No. 4) were prepared for the year of 1017 and sent to BTB. Annual statistical return of manpower and labor welfare (BCS form No. 2) and on tea garden land (BCS return No. 3) of BTRI farms for 2017 also had sent to BCS office, Dhaka.

#### **Annual Courses**

The Senior Scientific Officer delivered lectures on “Tea statistics and Economics” in the 53<sup>rd</sup> Annual course on Tea Culture organized by BTRI for the convened staff of tea estates of greater Sylhet held at the institute during 2017.

**TEA STATISTICS****Table 1.** Month wise production, export and export earning of Bangladesh tea during 2017

Month	Production 2017 (mkg)	Export Quantity (mkg)	Export Earning (mtk)	Import (mkg)
January	0.157	0.685	85.994	0.581
February	0.016	0.463	52.053	0.001
March	1.152	0.356	40.672	-
April	4.382	0.296	41.098	1.000
May	5.934	0.098	14.297	1.406
June	8.584	0.130	18.616	0.342
July	11.206	0.168	18.882	0.121
August	10.648	0.095	20.653	0.24105
September	9.784	0.016	07.956	0.08206
October	11.464	0.049	19.734	0.154
November	9.075	0.103	31.463	0.255
December	6.547	0.109	25.870	0.020
Total	78.95	2.568	377.288	4.2031

Source: BTB Monthly Statistical Bulletin, 2017.

**Table 2.** Export Earnings by countries to destination during 2017

Shipped to country	Quantity (mkg)	Earning (mtk)
Pakistan	2.16	264.776
U.A.E.	0.276	65.733
K.S.A.	0.068	26.869
U.S.A	0.013	5.235
Kuwait	0.039	9.734
Japan	0.00043	0.034
Total	2.568	372.381

Source: BTB Monthly Statistical Bulletin, 2017.

**BILASHCHERRA EXPERIMENTAL FARM**  
BTRI, SREEMANGAL

**STAFF**

Mr. Roni Debnath,,Farm Supervisor was transferred to BTRI Farm on 25 January 2017. There was no other change in the staff position during the reporting year.

**FARM**

**Table 1.** Land Distribution

Sl. No.	Description	Area (ha)
	Under Tea	110.64
	I. Plucking Area	
	1. Immature Tea (under 5 years)	6.00
	2. Tea bushes 5 to 10 years	4.18
(a)	3. Tea bushes 11 to 40 years	33.36
	4. Tea bushes 41 to 60 years	60.10
	II. Seed Bari	6.00
	II. Seed Nursery	0.50
	III. Clone Nursery	0.50
	Under Subsidiary Crops	19.76
(b)	I. Fruit Tree	5.15
	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	68.36
	<b>Total Area of the Farm</b>	<b>228.36</b>

**Table 2.** Crop Production

Description	Quantity
a. Green Leaf	8,88,241 (kg)
b. Made Tea	1,99,588 (kg)
c. Average Production	2044 (kg/ha)

**Table 3.** Green leaf Production of the Farm in the Year 2017

Name of the Month	Month-wise crop production in 2017 (kg)
January	-
February	-
March	8,186
April	59,600
May	15,737
June	1,38,948
July	1,33,114
August	73,148
September	1,93,678
October	1,15,282
November	99,983
December	50,565
<b>Total</b>	<b>8,88,241 kg</b>

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

Bi-Clonal Seed production(kg)	Institutional use (kg)	Sales of Bi-Clonal Seed (kg)	Sale amount (Tk)	Sales of Different Fruit (Tk)
259	25	234		28,000.00

### Extension and Development

1.51 ha of land was newly planted in 2017. It has a nursery with the average capacity of 20,000 plants. Water supply, labor houses, roads and bridges were regularly maintained. Four thousand tea saplings were infilled in different sections in the year 2016. Experiments of different divisions had been facilitated at the period.

### 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-STATION**  
**Fatickcherri, Chattogram**

**Ashim Kumar Saha**  
Senior Scientific Officer

**STAFF**

Mr. Ashim Kumar Saha, SSO (Soil Science) was transferred to Fatickchari substation from Bangladesh Tea Research Institute, Sreemongal and took over the charge of Officer-in-charge of the substation on 12 March, 2017. There was no other change in the personnel position of the sub-station during the period under report.

**PRODUCTION**

68,510 kgs green leaves were produced during the year 2017. Harvested green leaves were sent to Kaiyacherra-Dolu Tea Estate for manufacturing.

**DISTRIBUTION OF IMPROVED PLANTING MATERIALS**

Year	Items	Tea Estate		CHT Project	Banshkhali	Total (No./kg)
		No.	Quantity (No./kg)			
2017	Fresh Cuttings	9	21,19,600	4,98,000		26,17,600
	Biclonal Seed	8	263	-	-	263

Besides the above mentioned items, Jackfruits & Cane were sold at worth of 8,000/=Tk during the year.

**INFILLING AND EXTENSION PROGRAMME**

About 8 acre area was brought under tea cultivation extension program during the reporting year.

**DEVELOPMENT**

A flag stand was built in front of the office premises. SSO bungalow & SO bungalow of sub-station were repaired during 2017. A nursery having capacity of five lakh tea saplings was being developed during the reporting year and it will be continued to the next year. About 5,000 different fruit, flower and forestry plant species were planted during the reporting year.

**SEMINARS AND WORKSHOPS**

A course of two days duration on tea culture and workshops on different topics such as pruning, plucking, diseases and pest management etc. were organized time to time at the sub-station for the tea planters of Chattogram Valley.

**MISCELLANEOUS**

The Independence Day as well as the Victory Day were celebrated with due solemnity during the reported year. On both the occasions sweets and prizes for sports were distributed among the labors and their children of the sub-station.

**KALITI SUB-STATION****Kulaura, Moulvibazar****STAFF**

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

**PRODUCTION**

Green leaves produced during 2017 and total number of fresh cuttings distributed to different tea estates is given below:

Year	Production of green leaf (Kg)	Sale price @ 27.00 (Tk)	Fresh cutting supplied (nos.)	Sale price @ 0.30 (Tk)	Roted cutting supplied (nos.)	Sale price @ 7.00 (Tk)
2017	27271	7,36,317	168000	50,400	1100	7,700

**BTRI SUB-STATION****Bandarban****STAFF**

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

**Research Work**

There was a total no of small grower under registration 221, No of small grower under tea cultivation 40, total land under tea cultivation 302 Acre in the year 2017. Provided technical support all over the year to small holding tea growers. Co-ordinated sales of green leaves all over the year and arranged day long annual course in the reporting year.

**Works under the Project**

1. Given newly registration small tea grower 87 N0s.
2. Tea sapling raised 6 lac.
3. Land lease for tea sapling production 1 lac.
4. 22 small tea grower visited Sreemangal, Moulvibazar for receive adequate knowledge tea cultivation under motivational activities.
5. Training of different topics such as tea plantation, land preparation, pruning, plucking, disease and pest management, Total no. of farmer 175 under 7 batches.
6. Necessary repairing of the office building has been done in the reporting year.
7. Proper maintenance of mother bush plot around the year.

**BTRI SUB-STATION  
Panchagarh**

**Dr. Mohammad Shameem Al Mamun**  
Senior Scientific Officer

**STAFF**

Dr. Mohammad Shameem Al Mamun, Senior Scientific Officer (Entomology) took over the charge of BTRI substation, Panchagarh on 13 March 2017. Mr. Mohammad Saiful Kadir, Account Assistant and Mr. Md. Yasin Arafat, Stenotypist cum Computer Operator were transferred from BTRI, Sreemangal to BTRI Sub-Station, Panchagarh on 1 November 2017. There was no other change in the personnel position of the substation during the period under report.

**Research Project**

A sub-project entitled “Integrated Pest Management (IPM) Approaches to Major Pests of Tea for Sustainable Tea Production” under Competitive Research Grant (CRG) of NATP Phase 2 of PIU, BARC funded by USAID & GoB was implemented at BTRI Substation, Panchagarh since May 2017. The objective of the project is to minimize the load of synthetic pesticides through a sustainable management practice along with consumers’ safety by adopting IPM practices. The experiments on different control options of IPM such as cultural control viz., plucking, pruning cycle, field sanitation, Mechanical viz., solar light trap, yellow sticky trap and indigenous plant extracts against major pests of tea were carried out at BTRI Substation and different farmers’ field at Panchagarh during the study period. A pest management laboratory with sophisticated equipments and an IPM field laboratory was established at the substation under this project. The project will be completed in September 2018.

**Development Project**

A development project entitled “Extension of Small Holding Tea Cultivation in Northern Bangladesh” under Bangladesh Tea Board; Ministry of Commerce funded by Overseas Development Assistance (ODA) Revolving Fund was implemented at BTRI Substation, Panchagarh since September 2015. The objective of the project is to extend tea cultivation in 500 hectares of land (300 ha. in Panchagarh, 150 ha. in Thakurgaon, 25 ha. in Dinajpur & 25 ha. in Nilfamari) by organizing and motivating the farmers in the project areas and to supply the planting materials (Fresh cuttings) & 10 lacs tea saplings of appropriate clone/ variety at the cheapest rate to the tea growers of that locality each year. About 60 hectare of lands was extended and 269 small tea growers were registered under this project. One Consultant and one Field Assistant were recruited under this project during the period under report. About 1.0 lac tea saplings have been distributed to the registered small grower at the subsidized rate. 5.11 Acre of land was acquired for the development of VP nursery, demonstration & experimental plot adjacent to BTRI Substation under this project. The project will be completed in June 2021.

**VP Nursery**

A well organized HYV VP nursery with the capacity of 1,40,000 saplings were maintained and 19,600 saplings were distributed to the registered small growers @ Tk. 4.5/saplings and earned Tk. 88,200/= during 2017. A nursery house was established for farm operation during 2017.

**Advisory visit**

A total of One hundred forty six (146) advisory visits were paid to different tea gardens and small tea growers' gardens in northern Bangladesh and rendered advice on tea cultivation in scientific way during 2017. Four (4) advisory letters issued to different tea gardens in Panchagarh. Twenty (20) samples of tea plants/plant parts were received from different small tea growers in respect of identification of various pests, diseases, other nutrient deficiencies, and their remedies during the reporting year.

**Official visit**

A total of Ten (10) official visits were paid to different organizations including BARC, Bangladesh Tea Board, Chattogram and Ministry of Commerce, Dhaka.

**Monitoring visit**

Two (2) monitoring visits were paid to Korotoa Tea Garden and Sallylan Tea Garden and collected information on development activities of the garden in a prescribed format during 2017.

**Training/Workshop**

A total of Five (5) training workshops were conducted by BTRI for small tea growers at garden level on different aspects of tea culture during 2017 and Twelve (12) motivation workshops were conducted for small tea growers under Northern Bangladesh Project during 2017.

### Other activities of the divisions during 2017

Sl.	Item	Soil Science	Bio chemistry	Botany	Agronomy	Entomology	Plant Pathology	St. & Eco.	Technology
01	No. of experiments	04	-	31	08	07	07	03	-
02	No. of experimental visits	31	-	38	123	03	51	-	-
03	No. of advisory visits	23	-	16	24	27	28	-	-
04	No. of advisory correspondence	226	-	08	07	46	31	-	-
05	No. of official visits	20	-	04	23	09	-	-	-
06	No. of soil, fertilizer & dolomite samples analyzed	2657	-	-	-	-	-	-	-
07	No. of nursery soil, water & cowdung samples analyzed for nematodes	-	-	-	-	85	-	-	-
08	No. of pesticide residue analysis (commercial)	-	-	-	-	-	-	-	-
09	No. of pesticide residue analysis (Experimental)	-	-	-	-	-	-	-	-
10	Physical test of pesticides in Lab.	-	-	-	-	-	-	-	-
11	No. of pesticides tested in tea fields	-	-	-	-	52	22	-	-
12	No. of circulars/pamphlets/leaflets issued to T. E.	-	-	02	-	02	-	-	-
13	No. of workshop/seminar conducted	01	-	74	19	05	04	-	-
14	MTC module conducted (Hours/year)	30 hrs.	-	08 hrs.	12 hrs.	13 hrs.	12 hrs.	-	20 hrs.
15	Attended national seminar, conference, symposium & workshop	01	-	05	02	01	02	-	-
16	Attended international seminar, conference & symposium	-	-	-	-	-	-	-	-
17	Attended Training/Course	01	-	-	-	-	-	-	-
18	No. of research paper published	01	01	01	03	01	03	-	-
19	No. of Fresh cutting supplied	-	-	-	4,16,600	-	-	-	-
20	No. of Rotted cutting supplied	-	-	425	32,250	-	-	-	-
21	Biclonal seed supply to T. E.	-	-	132 Kg	-	-	-	-	-
22	Tea tasting	-	-	09	-	-	-	-	-