

# ANNUAL REPORT 2020



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

An organ of

**BANGLADESH TEA BOARD**

171-172, Baizid Bostami Road

Nasirabad, Chattogram

[www.btri.gov.bd](http://www.btri.gov.bd)

## ANNUAL REPORT 2020

Published by	Director Bangladesh Tea Research Institute Srimangal-3210, Moulvibazar
Publisher's name	Dr. Mohammad Ali
Published year	2020
Compiled by	Dr. Md. Ismail Hossain Chief Scientific Officer (Crop Production Dept.)
Cover and Design	Md. Riyadh Arefin Scientific Officer (Botany Division)
Printing press	<b>Obri Printing Artisan</b> <b>Station Road, Srimangal-3210, Moulvibazar</b>

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Taka 250.00 per copy (Home)

US \$ 15.00 per copy (Abroad)

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## DIRECTOR'S REPORT STAFF

The report of the technical staff shows the position as on 31 December 2020

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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

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Scientific Officer : Kani Fatema Tuz Zohora  
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B.S. (Hons), M.S. (DU)  
Scientific Officer : Farhana Jahan Chowdhury  
B.S. (Hons), M.S. (CU)  
Scientific Officer : Vacant

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Principal Scientific Officer : Vacant  
(Dr. Mohammad Masud Rana, Senior Scientific  
Officer of Agronomy division was given the charge  
of the division as an additional duty)  
Senior Scientific Officer : Vacant  
Scientific Officer : Vacant

#### 2. DEPARTMENT OF CROP PRODUCTION

Chief Scientific Officer : Dr. Md. Ismail Hossain  
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M.S in Crop Botany & Ph.D. (BAU)

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B.Sc.Ag. (Hons), M.S. (BSMRAU)  
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Senior Farm Assistant : Md. Majibur Rahman  
B.Sc. (CU), TPM (India)

**B. AGRONOMY DIVISION**

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Senior Scientific Officer	:	Dr. Mohammad Masud Rana B.Sc.Ag. (Hons) M.S. (BAU), Ph.D. (China)
Senior Scientific Officer	:	Vacant
Scientific Officer (Transferred to Bandarban CHT Project)	:	Md. Imran Hossen B.Sc.Ag. (Hons), M.S. (SAU)
Scientific Officer	:	Sultan Md. Monwarul Islam B.Sc.Ag. (Hons), M.S. (BAU)
Farm Supervisor	:	Roni Debnath M.Sc.Ag. (Hons), M.S. (SAU)
Farm Assistant	:	Md. Shamim Hossain Dip.-in-Agric. (ABKC)

**3. DEPARTMENT OF PEST MANAGEMENT**

Chief Scientific Officer	:	Vacant
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**A. ENTOMOLOGY DIVISION**

Principal Scientific Officer	:	Vacant
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Scientific Officer	:	Md. Jahangir Alam B.Sc.Ag.(Hons), M.S. (BAU)
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**B. PLANT PATHOLOGY DIVISION**

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Scientific Officer	:	Raihan Mujib Himel B.Sc.Ag. (Hons.), M.S. (BSMRAU)

**TECHNOLOGY DIVISION**

Senior Scientific Officer	:	Vacant
Scientific Officer (Deputation in Bandarban)	:	Dulal Chandra Dey B.Sc. Engg. Mech. (BUET)
Senior Tea Maker (Deputation in Bandarban)	:	Md. Amir Ali B.Sc. (RU)
Assistant Engineer (Civil)	:	Md. Naion Hossain B.Sc. Engg. Civil (DUET)

**STATISTICS & ECONOMICS DIVISION**

Principal Scientific Officer	:	Vacant
Senior Scientific Officer	:	Dr. Shefali Boonerjee B.Sc. (Hons), M.Sc. (RU) Ph.D. (DU)

**BTRI SUB-STATION, FATIKCHARI, CHATTOGRAM**

Scientific Officer & Officer in-charge	:	Md. Moshir Rahman Akonda B.Sc.Ag. (Hons), M.S. (BAU)
Senior Farm Assistant	:	Ajit Chandra Chowdhury B.A. (NU)

**BTRI SUB-STATION, KALITI, KULAURA**

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Dip.-in-Agric. (Rangpur)

**BILASHCHERRA EXPERIMENTAL FARM**

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Dip.- in-Agric. (Mymensingh)

Field Assistant : Zobayer Ahamed  
Dip.- in-Agric. (Rangpur)

Field Assistant : Md. Sabbir Mahedi Joy  
Dip.- in-Agric. (Rangpur)

## RESEARCH

This report reflects the research and other activities of the institute for the year 2020 starts from 1<sup>st</sup> January to 31<sup>st</sup> December.

During the year under report, a total of 61 experiments on different aspects of tea culture were in progress in different disciplines research divisions. The main features are briefly enumerated below:

Soil Science Division carried out researches on two major fields in respect of fertilizer efficiency and improvement of soil properties. 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, performance of bio-char as a soil amendment and its effect on tea soil properties was started during the reporting year. Research on present status of toxic heavy metals (Pb, Cd, Cr, Ni) in tea soils, green leaves & made tea and determination of critical values of nutrients in tea soil and plant leaf in Sylhet, Chattogram and Panchagarh region were also initiated during the reported 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 3232 advisory soil, paid soil, fertilizer, compost and others samples were analyzed during 2020.

Biochemistry division carried out researches on tea product diversification and standardization of green tea processing technique using a modern green tea processing unit under Bangladesh condition. Product diversification of tea holds immense possibilities for the future and is an important area of research. This type of research would contribute to the domestic economy by innovating new products as well as creating new employment opportunities. Green tea is being popular in our country for its known health benefits; and due to its increasing demands, new factories are being established day by day. Research on green tea processing technique would enable our domestic manufacturers to produce quality green tea. The experimental findings obtained so far were highlighted and discussed in the current report.

Plant improvement received top priority as usual amongst the research activities of Botany Division. Several new germplasm were collected and screened for desired characters under plant improvement research. Certain amount of test clones were under different stages of long term yield and quality trials. Hybridization between clones and agrotypes, collection and preservation of germplasm of tea from home and exotic sources were continued. Several tea tasting sessions were organised for the tea planters to improve the quality of tea.

Agronomy Division carried out research activities on various cultural practices e.g. Planting, pruning, tipping, plucking and related agro-techniques in tea field and effect of different type of composts on growth and development of tea plant. 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 adopt with the mechanization of tea. Experiments on mechanization of tea was going on to adopt this technology.

The Research of Entomology Division includes cultural and mechanical control of insect pests, bio-control of insect pests, and screening of pesticides, host plant resistance and 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, Use of Plant Growth Promoting Rhizospheric (PGPR) Microbes in controlling different tea diseases, Identification of potential source of infection of tea disease for disease development were the new areas of research of the division.

Statistics and Economics division engaged on the economic efficiency of the test clones of BTRI and adoption of BTRI Innovated Technologies and its Extension to Bangladesh Tea Industry. 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 2020. A total of 15,36,200 fresh cuttings, 50929 rooted cuttings and 1519 kg bi-clonal seeds were distributed to different tea estates in the year 2020. Technology disseminations through seminars, workshops and advisory visits were continued in the Main station and Sub-stations during the year.

#### TEA TASTING SESSIONS

As a regular annual feature and group exercise, five valley tea tasting sessions were conducted for the tea planters to improve further the manufacturing of quality tea from the tea factories.

#### VISITS

Scientific personnel of the institute and sub-stations paid a total of 264 experimental and 95 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

'BTRI Annual Report 2019' and 'Tea Journal of Bangladesh, Volume 47 (1&2)' were published in 2020.

#### 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.

#### LIBRARY

BTRI Library contained 4,936 books and 9,150 Journals, Annual Report, Pamphlets, Circulars, Newsletter, Proceedings and Research highlights, etc.

**(Dr. Mohammad Ali)**

Director, BTRI.

## SOIL SCIENCE DIVISION

**Ashim Kumar Saha**  
Senior Scientific Officer  
**STAFF**

One (01) Principle scientific officer and one (01) scientific officer post lying vacant during the period. There was no other change in the personnel position of the division during the period under report.

### RESEARCH

A total of eight experiments were conducted during the year 2020 by Soil Science Division. Progress of the experiments is given below.

#### SS 1: EFFECT OF VERMICOMPOST ON SOIL PROPERTIES, GROWTH AND YIELD OF MATURE TEA (2016-2020)

The long-term 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 2020. There are eight treatments in a Randomized Block Design with three replications. The unit plot size was 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 (1.5 tons/ha) + 100% Recommended fertilizer dose
T <sub>3</sub> = 80% Recommended fertilizer dose	T <sub>7</sub> = Vermicompost (3.0 tons/ha) + 80% Recommended fertilizer dose
T <sub>4</sub> = 60% Recommended fertilizer dose	T <sub>8</sub> = Vermicompost (6.0 tons/ha) + 60% Recommended fertilizer dose

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

**Table 1.** Fertility status of the initial soil of the experimental field

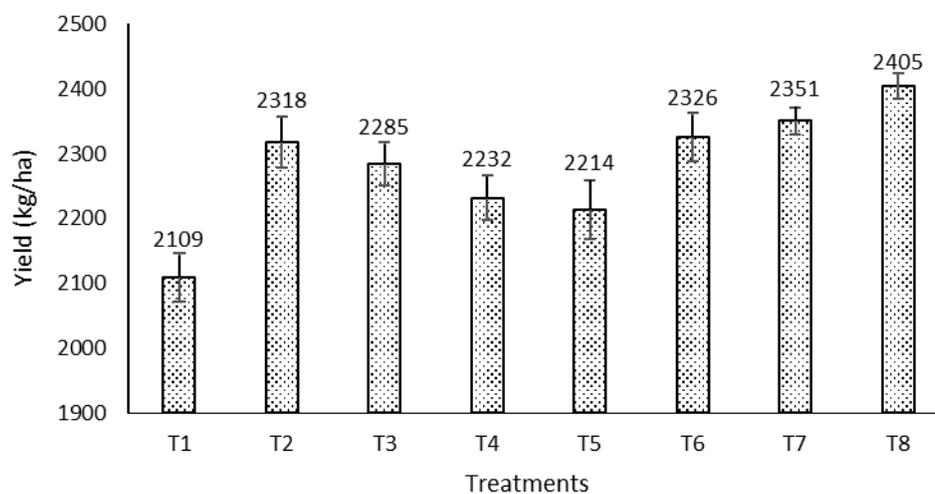
Location	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
BEF	SCL	4.5	1.01	0.120	5.49	48.31	49.26	9.52
Critical value	SL – L	4.5-5.5	1.0	0.1	10	80	90	25

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

**Table 2.** Soil analytical results at the end of the year 2020

Treatment	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCI	5.0	1.18	0.120	83.91	57.11
T <sub>2</sub>	SCI	4.7	1.57	0.159	95.99	90.32
T <sub>3</sub>	SCI	4.9	1.27	0.129	59.22	40.19
T <sub>4</sub>	SCI	5.0	1.60	0.161	70.94	57.73
T <sub>5</sub>	SCI	4.6	1.60	0.162	57.65	79.04
T <sub>6</sub>	SCI	5.1	1.63	0.165	73.74	58.99
T <sub>7</sub>	SCI	5.2	1.47	0.149	74.80	65.26
T <sub>8</sub>	SCI	5.0	1.42	0.144	86.27	42.07

The result shows that, in every treatment increased yield was recorded over the control. The highest made tea yield (2405 kg/ha) was recorded in treatment T<sub>8</sub>. The rate of increase over the control was 14.02% in the case of treatment T<sub>8</sub>. The increase of yield due to different treatment was statistically significant at 1% level ( $F= 33.11$ ). This experiment was ended in the year 2020.

**Fig 1.** Effect of vermicompost on the yield of tea (BEF, 2020)

**SS 2: STATUS OF MICRONUTRIENTS (B, Zn, Mn, Fe & Cu) IN SOME SELECTED TEA SOILS OF BANGLADESH (2017-2022)**

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 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.

**Location:** BTRI, BEF and different tea gardens of Sylhet, Chattogram and Panchagarh.

**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. 651 soil samples from 47 tea estates has been collected and analysis is going on.

**SS 3: STUDIES ON PHYSICAL PROPERTIES OF SOME SELECTED TEA SOILS OF BANGLADESH AND THEIR INFLUENCE ON CHEMICAL PROPERTIES AND YIELD OF TEA (2017-2022)**

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-yr-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 to assess the long-term impact of growing tea on soil physical properties and how it correlates with crop yield.

**Methodology:**

This research is 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 are 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

**Progress, 2020:**

30 soil samples were collected from different Tea Estates of Bangladesh during the month of July to February. Soil texture, structure, color, moisture percentage, bulk density and some chemical properties are determined, which is shown below. More soil samples from different tea estate will be collected to estimate the Physical Properties. Soil Analysis is going on.

**Table 3.** Soil analytical results at the end of the year 2020

Area/ Tea Estate	Texture	Structure	Color	Moisture %	Bulk Density %	pH	O.C %	Total N %	Av. P ppm	Av. K ppm
BTRI	SCL	Sub Angular Blocky	Greenish Gray	17.16	1.85	5.04	0.95	0.099	12.07	77.89
Bilashcherra Experimental Farm	SCL	Sub Angular Blocky	Gray-Greenish Gray	22.73	1.89	5.4	1.27	0.126	22.77	65.56
Monipur T.E	SCL	Sub Angular Blocky	Light Brownish Gray	17.61	1.76	4.5	1.39	0.140	11.61	65.28
Luskerpore T.E	SCL	Sub Angular Blocky	Greenish Gray	5.23	1.75	4.6	0.70	0.074	8.66	145.81
Oodaleah T.E	SCL	Sub Angular Blocky	Gray-Light Olive Gray	15.22	1.74	4.6	1.41	0.141	8.74	135.31
BTRI Sub Station, Fatickcherry	CL	Sub Angular Blocky	Light Brown-Gray	12.64	1.72	4.5	1.25	0.078	8.68	61.08
Kality Sub Station	SCL	Sub Angular Blocky	Light Brown	8.53	1.78	4.9	1.14	0.115	12.00	66.24
Rashidabad T.E	SCL	Sub Angular Blocky	Light Reddish brown	5.53	2.07	4.5	1.04	0.106	23.14	61.08
Bahadurpur T.E	SCL	Sub Angular Blocky	Grey	5.52	2.08	4.8	1.11	0.115	32.15	62.48
Gazipore T.E	SCL	Granular	Pale Yellow	5.51	1.89	4.7	1.62	0.164	28.17	129.71
Etah T.E	SL	Granular	Light Brown	2.44	1.55	4.5	1.67	0.170	8.17	42.87

**SS 4: PRESENT STATUS OF TOXIC HEAVY METALS (Pb, Cd, Hg, Cr) IN TEA SOILS, GREEN LEAVES AND MADE TEA IN BANGLADESH (2018-2022)**

Tea is rich in many trace inorganic elements. In addition to many essential elements required for human health, some toxic elements may also be present in tea leaves. This could be due to polluted soil, application of pesticides, fertilizers of industrial activities. There is often little information available about the safety of tea leaves and finished products with respect to heavy metal contamination. Due to the significant amount of tea consumed, it is important to know the toxic metal contents.

**Location:** BTRI, Bilashcherra Experimental Farm and different tea gardens of Sylhet, Chattogram and Panchagarh.

**Progress:** 42 soil, 18 green leaves and 03 made tea (black) Golden Broken Orange Pekoe (GBOP), Pekoe Fannings (PF) and Orange Fannings (OF) grade samples and 01 made tea (green) were collected from Bilashcherra Experimental Farm and tea factory of Bangladesh Tea Research Institute (BTRI), Srimangal.

43 soil, 23 green leaves and 09 made tea (black) Golden Broken Orange Pekoe (GBOP), Pekoe Fannings (PF)/Orange Fannings (OF) and Churamoni Dust (CD)/Red Dust (RD) grade samples were collected from 03 tea gardens of Chattogram district. 61 soil, 53 green leaves and 15 made tea (black) samples such as Golden Broken Orange Pekoe (GBOP), Pekoe Fannings (PF) and Churamoni Dust (CD) grade samples were collected from 05 tea gardens of Moulvibazar district and 01 tea garden of Sylhet district. 03 made tea (green) samples such as Hyson, Young Hyson and Fine Young Hyson grade samples were collected from Jagcherra tea estate. A part of the physical, chemical and biochemical analysis of the collected soil, leaf and made tea samples such as moisture, soil textural class, pH, organic matter, total nitrogen, available phosphorus, potassium, calcium, magnesium, sulphur, boron, iron, manganese, zinc, copper, lead, cadmium, chromium, nickel as well as protein, caffeine, total polyphenol and theaflavin and thearubigin content of made tea samples has been completed.

**SS 5: PERFORMANCE OF BIO-CHAR AS A SOIL AMENDMENT AND IT'S EFFECT ON TEA SOIL PROPERTIES (2018-2020)**

Bio char is the porous carbonaceous solid produced by thermochemical conversion of organic materials in an oxygen depleted atmosphere which has physicochemical properties suitable for the safe and long-term storage of carbon in the environment and, potentially, soil improvement. A good portion of the carbon so produced will remain in soils for hundreds and, possibly, thousands of years. Hence, biochar can be an important component of a global response to carbon abatement, though the challenges of achieving such a large-scale utilization of biochar would be considered. Some possible reasons which help to account for the impacts of biochar on soils are: 1) increase in pH of acid soils, 2) increase in water retention, especially sandy and silty soils, 3) provision of nutrients in the ash contained within the biochar, 4) enhancement of the cation exchange capacity (CEC) of the soil, so increasing nutrient use efficiency, 5) enhancement of microbial communities including bacteria, mycorrhizae and fungal hyphae and 6) benefits to soil physical properties. The long term experiment has been undertaken to observe the effect of bio-char on soil properties,

growth and yield of mature tea at BTRI Farm. The experiment was laid out in RBD having four treatments and three replications. The experiment was laid out in the year 2018 and continued up to 2020. Each plot size was 28.43 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 are as follows:**

T <sub>1</sub> = Control (Recommended fertilizer dose)	T <sub>3</sub> = 1.5 t/ha Bio-char + Recommended fertilizer dose
T <sub>2</sub> = 1.0 t/ha Bio-char + Recommended fertilizer dose	T <sub>4</sub> = 2.0 t/ha Bio-char + Recommended fertilizer dose

**Table 4.** Fertility status of the initial soil of the experimental field

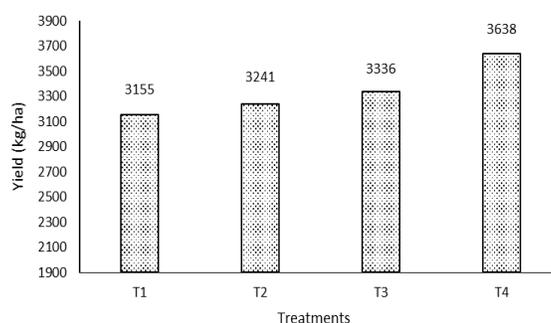
Location	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm	Av. Ca ppm	Av. Mg ppm
BTRI	SCL	4.88	1.25	0.127	29.72	71.43	BTRI	SCL
Critical value	SL – L	4.5-5.5	1.0	0.1	10	80	90	25

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

**Table 5.** Soil analytical results at end of the year of 2020

Treatment	Texture	pH	O.C %	Total N %	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCI	5.1	1.23	0.128	46.26	50.38
T <sub>2</sub>	SCI	5.2	1.3	0.133	59.31	52.16
T <sub>3</sub>	SCI	5.2	1.37	0.14	57.54	50.53
T <sub>4</sub>	SCI	5	1.27	0.127	65.36	52.47

The result shows that, in every treatment increased yield was recorded over the control. The highest made tea yield (3638 kg/ha) was recorded in treatment T<sub>4</sub> (Fig. 2). The rate of increase over the control was 15.31% in the case of treatment T<sub>4</sub>. The increase of yield due to different treatment was statistically significant at 5% level (F=7.326).



**Fig 2.** Effect of bio-char on the yield of tea (BTRI, 2020)

**SS 6: DETERMINATION OF CRITICAL VALUES OF NUTRIENTS IN TEA SOIL AND PLANT LEAF IN SYLHET, CHATTOGRAM AND PANCHAGARH REGION (2018-2021).**

Critical values of nutrients in tea soil and plant leaf are very important for proper fertilizer management. Critical values of some nutrients in tea soils of Bangladesh were optimized earlier. But soil fertility status is changing day by day. So, now it's a crucial time to estimate critical values of essential elements in tea soil as well as tea plant leaves on the basis of present scenario of tea soils of Bangladesh.

**Location:** Different tea gardens of Sylhet, Chattogram and Panchagarh.

**Progress:** Compilation of the last five years soil analytical data of different valley circles as a primary work of the research has been completed. Soil samples were collected from 17 tea estates during 2020. The physical and chemical properties of all the collected soil samples were analyzed using standard method.

**Table 6.** Soil analytical results at the year of 2020

Name of Tea Estate	Depth (cm)	Texture	pH	Org. C (%)	Total N (%)	Avail. P (ppm)	Avail. K (ppm)
Amrail T.E.	0-23	SL-SCL	4.49	1.07	0.11	6.55	103.41
Amtali T.E.	0-23	SCL	4.10	1.01	0.10	31.39	76.35
Baliser T.E.	0-23	SL-SCL	4.71	0.94	0.10	17.96	45.27
Daragaon T.E.	0-23	CL-SCL	4.16	0.99	0.10	45.87	87.94
Dauracherra T.E.	0-23	SCL	4.64	0.61	0.06	1.67	53.12
Deanston T.E.	0-23	SL-SCL	3.89	0.86	0.09	16.89	80.83
Dinarpur T.E.	0-23	SL-SCL	4.78	1.04	0.10	46.86	95.00
Horincherra T.E.	0-23	SCL	3.89	0.93	0.10	278.53	125.11
Hooglicherra T.E.	0-23	SCL	3.87	0.79	0.08	12.27	97.63
Moulvi T.E.	0-23	CL-SCL	3.98	0.72	0.08	30.37	55.02
Mazdehee T.E.	0-23	SL-SCL	4.61	0.87	0.09	22.40	42.82
Mirzapore T.E.	0-23	SCL	4.51	0.84	0.09	46.13	55.65
Nurjahan T.E.	0-23	SL-SCL	4.70	1.06	0.12	50.25	120.69
Premnagar T.E.	0-23	SL-SCL	4.53	1.32	0.11	6.57	62.96
Rasidpur T.E.	0-23	SL-SCL	4.18	0.90	0.09	145.58	87.87
Rajghat T.E.	0-23	SL-SCL	4.33	1.21	0.12	12.13	109.88
Saif T.E.	0-23	SL-SCL	4.56	1.36	0.14	10.87	83.69

**SS 7: COMPARATIVE STUDY OF CONSERVATION AND CONVENTIONAL AGRICULTURE PRACTICE IN SMALL HOLDING TEA CULTIVATION IN RESPONSE TO CLIMATE CHANGE (2020-2025)**

**Objectives:**

1. To efficient use of external and natural resources.
2. To economic profitable and viable for small holders.
3. To provide efficient and sustainable Eco farming systems to compliments the livestock, social structure etc.
4. To reduce the mortality rate of new plantation in dry season.
5. To minimize soil erosion with nutrient.
6. To reduce Land slide

**Methods and Materials:**

1. Land Preparation would be different in separate area i.e. follow Conservation agriculture management system and another would be Conventional agriculture management system.
2. Planting New two acres area in Bilashcherra Experimental Farm one will plant by Conservation agriculture management system and another would be Conventional agriculture Management System.
3. Comparative data Collection will start from 2nd year in the new planting area of two i.e. Mortality of sapling, Growth and yield of tea plant, soil properties, etc.

**Expected Outcome:**

1. To integrate in systems perspectives to facilitate resilience under changing climate scenarios and international markets.
2. The process will save our natural resources for future especially water, energy, and soil health and bio-diversity with assurance of food security.
3. To protect air and water pollution through soil erosion, residue burning, injudicious use of agro-chemicals which creating the human health problems.
4. By adopting Conservation Agriculture based Sustainable Intensification (CASI) to remove the social and cultural disparities and provide better prosperities by boosting the economic growth of the community by region and nation.
5. To get maximum alive tea plant and minimize the high vacancy.

**Progress 2020:**

1. In conventional Method about 500 young teas were planted in Bilashcherra Experimental Farm. (Section: Near Coffee Tillah)
2. In conservation method Field was prepared. Plantation work is running.

**Table 7.** Fertility status of the initial soil of the experimental field

Treatment	Sample No.	Texture	pH	O.C	Total N%	Av.P ppm	Av.K ppm
Conventional Method	1	SCL	4.4	1.57	0.159	13.81	41.72
	2	SCL	4.5	1.90	0.192	10.16	117.09
Conservation Method	1	SCL	4.9	1.95	0.196	7.83	183.37
	2	SCL	4.8	1.83	0.185	85.69	158.67

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

### **SS 8: EFFECT OF DIFFERENT MULCHING MATERIALS ON SOIL PROPERTIES, EARTHWORM POPULATION AND GROWTH OF YOUNG TEA. (2020-2022)**

A mid-term experiment was conducted both at Bilashcherra Experimental Farm and Luskerpore Tea Estate to improve the condition of soil moisture, increase the Carbon content of soil and to determine the effect of mulching materials on soil properties, the earthworm population and growth of young tea. Usual cultural practice and pest control measure were taken as when needed. Growth data, was recorded every month. Nutrient status of collected soil samples are determined by using standard methodology. Earthworm population and yield data (tipping data) are collecting. There are 9 treatments with 3 replications in a Randomized Block Design. The unit plot size was 1.5 m<sup>2</sup> with 6 plants (Young tea) per plot.

**The treatment combinations are presented below.**

T <sub>1</sub> = Control	T <sub>6</sub> = Straw 20 tons/ha
T <sub>2</sub> = Boga Medla (5 cm layer) 3.75tons/ha	T <sub>7</sub> = Banana Tree 20tons/ha
T <sub>3</sub> = Water hyacinth 5cm layer	T <sub>8</sub> = Pruning litter 10ton/ha
T <sub>4</sub> = Guatemala Grass 2.5ton/ha	T <sub>9</sub> = Weeds (5 cm layer) 20 tons/ha
T <sub>5</sub> = Citronella Grass 2.5ton/ha	

**Progress, 2020:****Table 8.** Initial Soil Status of the experimental field (Bilashcherra Experimental Farm)

Treatment	Soil Texture	Soil Structure	Color	Bulk Density gm/cm <sup>3</sup>	Moisture %	pH	O.C	Total N%	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCL	Sub angular blocky	Grey	1.88	28.75	4.6	0.71	0.074	6.33	48.97
T <sub>2</sub>	SCL					4.7	0.58	0.062	8.85	47.72
T <sub>3</sub>	SCL					4.7	0.99	0.103	22.63	90.32
T <sub>4</sub>	SCL					4.8	1.18	0.120	7.60	49.01
T <sub>5</sub>	SCL					4.8	1.37	0.140	16.28	38.32
T <sub>6</sub>	SCL					4.8	0.99	0.102	24.35	80.36
T <sub>7</sub>	SCL					4.9	1.11	0.115	14.92	93.45
T <sub>8</sub>	SCL					4.6	1.06	0.110	7.55	40.82
T <sub>9</sub>	SCL					5.0	1.24	0.128	6.82	102.85

**Table 9.** Initial Soil Status of the experimental field (Luskerpore Tea Estate)

Treatment	Soil Texture	Soil Structure	Color	Bulk Density gm/cm <sup>3</sup>	Moisture %	pH	O.C	Total N%	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCL	Sub angular blocky	Greenish Grey	1.70	7.15	4.1	1.04	0.108	2.73	32.53
T <sub>2</sub>	SCL					4.2	0.95	0.10	4.06	33.31
T <sub>3</sub>	SCL					4.2	0.90	0.095	5.13	49.65
T <sub>4</sub>	SCL					4.4	0.92	0.098	9.19	38.01
T <sub>5</sub>	SCL					4.1	0.95	0.10	5.43	47.83
T <sub>6</sub>	SCL					4.2	1.09	0.120	2.50	54.14
T <sub>7</sub>	SCL					4.4	1.10	0.114	5.18	31.21
T <sub>8</sub>	SCL					4.2	1.03	0.108	5.64	33.06
T <sub>9</sub>	SCL					4.3	0.90	0.098	15.51	39.09

**Table 10.** Soil analytical results after mulching application at the end of year 2020 (Bilashcherra Experimental Farm)

Treatment	Texture	Moisture %	pH	O.C %	Total N %	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCI	20.32	4.6	1.65	0.168	9.27	61.21
T <sub>2</sub>	SCI	22.18	4.8	1.70	0.175	38.33	65.54
T <sub>3</sub>	SCI	24.56	4.8	1.62	0.168	20.38	118.39
T <sub>4</sub>	SCI	22.14	4.9	1.38	0.142	10.97	95.86
T <sub>5</sub>	SCI	18.59	4.8	1.52	0.154	12.37	50.38
T <sub>6</sub>	SCI	21.36	5.0	1.66	0.168	19.46	110.16
T <sub>7</sub>	SCI	25.12	4.9	1.38	0.142	15.99	102.36
T <sub>8</sub>	SCI	20.38	4.8	1.41	0.146	15.18	39.55
T <sub>9</sub>	SCI	21.59	5.2	1.39	0.142	9.05	147.41

**Table 11.** Soil analytical results after mulching application at the end of year 2020 (Luskerpore Tea Estate)

Treatment	Texture	Moisture %	pH	O.C %	Total N %	Av. P ppm	Av. K ppm
T <sub>1</sub>	SCI	6.32	4.7	1.13	0.118	34.00	104.73
T <sub>2</sub>	SCI	7	5.2	1.77	0.180	18.18	132.92
T <sub>3</sub>	SCI	7.86	5.3	1.61	0.165	8.15	136.67
T <sub>4</sub>	SCI	6.96	5.2	1.34	0.138	41.64	127.91
T <sub>5</sub>	SCI	6.25	5.1	1.40	0.145	12.34	139.19
T <sub>6</sub>	SCI	7.00	5.2	1.13	0.118	10.88	124.75
T <sub>7</sub>	SCI	8.23	5.4	1.21	0.125	7.21	85.31
T <sub>8</sub>	SCI	7.58	5.1	1.47	0.152	12.09	77.79
T <sub>9</sub>	SCI	8.69	5.2	1.45	0.150	12.70	126.03

The result shows that, soil moisture percentage is retained after mulching application. In BEF, treatment T<sub>7</sub> keep highest moisture where in Luskerpore T.E, treatment T<sub>8</sub> hold highest moisture percentage. Organic Carbon is increased over Initial Soil Status for both BEF and Luskerpore Tea Estate. The graphs show that all the parameters of plant growth (such as Plant height, Branch number, Leaf Number and Girth) are gradually increased over initial growth. This experiment will continue 2021.

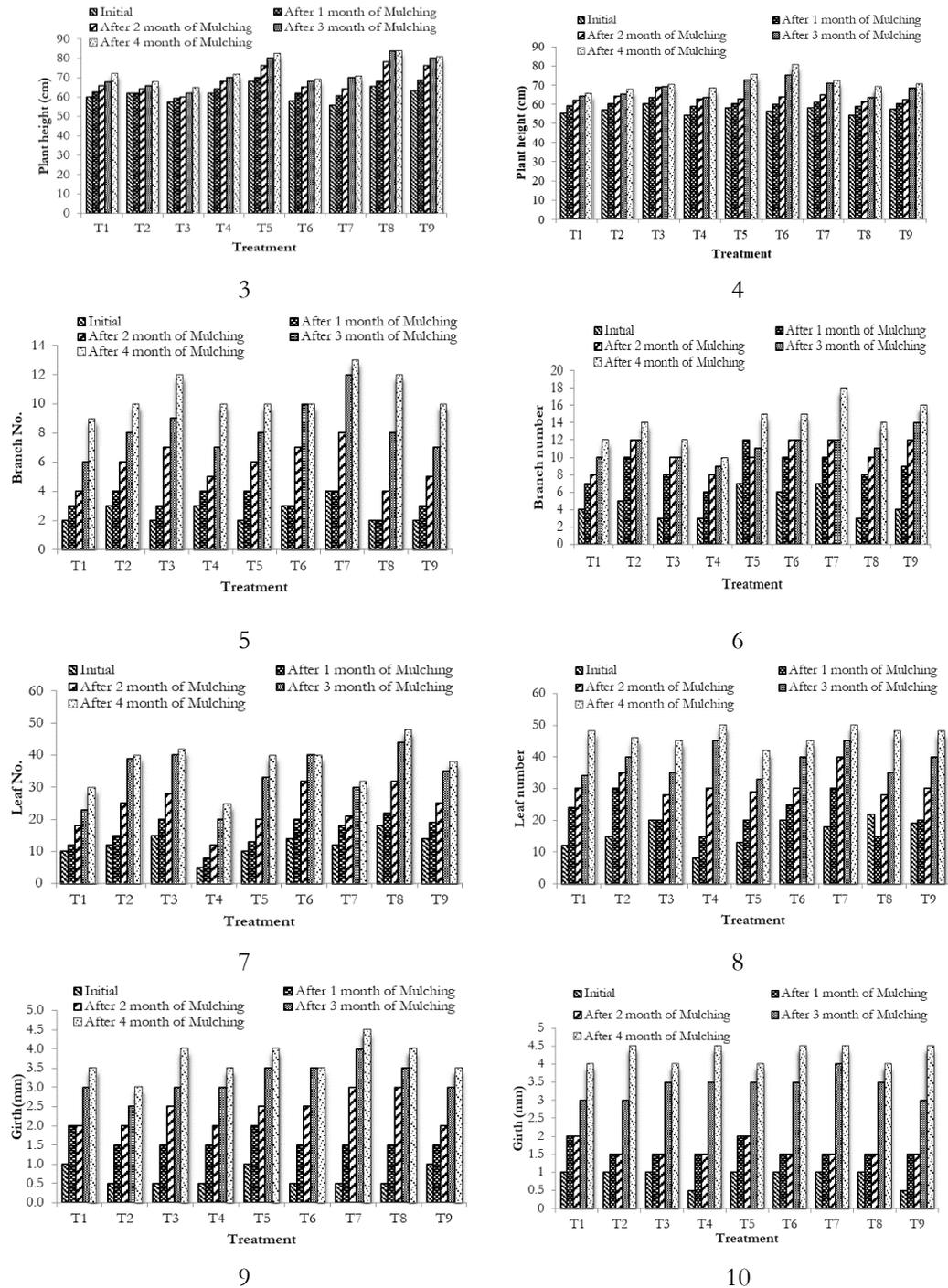


Fig 3-10. Growth Data Analysis of BEF (3, 5, 7, 9) and Luskerpore T.E (4, 6, 8, 10)

### 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 3183 soil samples (56 advisory and 3127 paid) and 49 other samples from 107 tea estates were analyzed for different purposes, the breakup of which is presented in table 12.

**Table 12.** Number of samples analyzed

Year	Advisory Soil	Soil	Fertilizer	Lime/Dolomite	Water	Compost	Total (Fertilizers & others)	Total (Soils & others)
2020	56	3127	43	00	00	06	49	3232

**Table 13.** List of Tea Estates from where soil and other samples were received or collected and analyzed during the year 2020

Affifanagar	Chandpur Belgaon	Haldavalley	Kodala	Madhupur	Rajghat
Allynugger	Chatlapore	Hatimara	Kurmah	Marina	Rampore
Ameenabad	Chundicherra	Hingajea	Kalikabari	Mathiura	Rasheedabad
Amo	Clevedon	Hooglicherra	Kazi and Kazi	Monipur	Rasidpur
Amrail	Clonal	Horrincherra	Kurma	Moomincherra	Rungicherra
Amtali	Daragaon	Hossainabad	Lackatoorah	Nahar	Ruthna
Bahadurpur	Dauracherra	Hajinagar	Lalchand	Nalua	Sabari
Balisera	Deanston	Jafflong	Lallakhal	Neptune	Sagurnal
Baraoora	Dinarpur	Jagadishpur	Langliyacherra	Noyapara	Saif
Bawany	Doloi	Jagcherra	Lungla	Nurjahan	Sathgaon
Bidyabeel	Deundi	Jhemai	Luskerpore	Oodaleah	Shumshernugger
Boban	Dildarpur	Junglebari	M R Khan	Patrakhola	Silloah
Brindabon	Etah	Kaiyacherra Dalu	Madabpore	Paharika	Sreebari
Bilashcherra	Fatehbagh	Kaliti	Mazdehee	Parkul	Srigobindpur
Chadpore	Fayzabad	Karimpore	Mertinga	Pathariya	Star
Chaklapunji	Ghazipore	Karnafuli	Mirzapore	Phulbari	Udnacherra
Champarai	Green Field	Kashipore	M Ahmed	Phulcherra	Zareen
Chandbagh	Habibnagar	Khan	Madanmohanpur	Pooteacherra	

## OTHER ACTIVITIES

### Advisory correspondence

A total of 203 advisory letters to different tea estates on soil, fertilizers, dolomite, compost and other soil related aspects were sent during the year 2020.

**Tours**

During the year under report officers of the division paid a total 63 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 2020. Scientists of this division also delivered lectures as resource speakers at the Management Training centre (MTC) for Post Graduate Diploma Course organized by Project Development Unit (PDU) of Bangladesh Tea Board.

**BIOCHEMISTRY DIVISION**

**Dr. Mohammad Masud Rana**  
**Senior Scientific Officer**

**STAFF**

Dr. Mohammad Masud Rana, Senior Scientific Officer of Agronomy division was given the charge of biochemistry division on 23.08.2020 as an additional duty. The posts of Principal Scientific Officer, Senior Scientific Officer and Scientific Officer of the division were lying vacant during the period under report.

**RESEARCH**

A total of two experiments were conducted during the year 2020 by Biochemistry division. Both the experiments were new and started during the period August-September 2020. The progress of the experiments are summarized below.

**Experiment 1: Assessing biochemical and sensory changes of tea during standardization of a modern green tea production unit for manufacturing quality green tea (BTRI; Short term: 2020-2021)**

Green tea is processed using different techniques but three basic steps are common which are fixation, rolling and drying. In Chinese style, a slight amount of indoor withering is allowed before steaming or pan firing the green leaves for removing the moisture from the leaves. This also allows to develop some flavor compounds in tea. Withering period may vary depending on the physical condition of the leaves and could be from an hour to several hours. Withering may reduce about 20-30% of the moisture of the leaves. The rolling process begins shortly after the steaming or pan firing has finished. Leaves are rolled in a rolling machine for about 10-60 minutes with differing pressure. During rolling process, the fibers are softened, allowing the tea flavor components to be released. Rolling is followed by drying. Drying process is carried out in a wooden or metal drum in which leaves are swiveled for nearly 15-30 minutes at 100-105°C hot air. During this process, the leaves progressively lose moisture to keep final moisture content of the green tea between 3-6%.

A modern green tea factory has just launched at Bangladesh Tea Research Institute. The processing steps in this factory are Withering → Fixation → 1<sup>st</sup> Re-humidification → Rolling → Roll Drying (1<sup>st</sup> Drying) → 2<sup>nd</sup> Re-humidification → Final Drying. Variable temperatures and durations can be used in these steps. So, there is a great scope to standardize the processing technique using this green tea production unit. Therefore, the present study has been carried out to standardize the green tea processing technique using the modern green tea production unit for quality product.

**Objectives of the study:**

- To standardize the green tea production technique using the modern green tea production unit.
- To identify the major chemical constituents present in the final product.

**Treatments:**

Four sets of treatments were included in this study. The treatments of this study are as follows-

## a) Withering periods-

W1 : 1 hour

W2 : 2 hours

W3 : 3 hours

## b) Fixation temperatures (averages of three zones)-

F1 : 250 °C

F2 : 260 °C

F3 : 270 °C

## c) Rolling periods-

R1 : 45 minutes

R2 : 50 minutes

R3 : 55 minutes

d) Roll drying (1<sup>st</sup> drying) temperatures (averages of three zones)-

D1 : 200 °C

D2 : 210 °C

D3 : 220 °C

## e) Final drying temperatures-

D1 : 100 °C

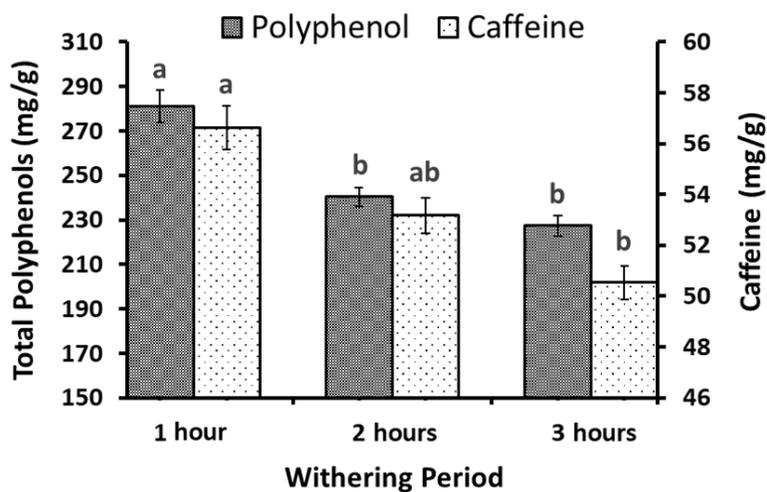
D2 : 110 °C

D3 : 120 °C

**Progress:** The experiment was initiated in August 2020. This experiment is little different than the other experiments in nature having complex sets of treatments and limited amount of raw materials. Hence, only one set of treatments were employed during manufacturing of green tea at BTRI green tea factory in a single processing day. Green leaves (single leaf & a bud + two leaves & a bud) were supplied from the Bilashcherra Experimental Farm and BTRI Farm for the manufacturing of green tea. Different treatments were employed one by one and the respective product green tea samples were collected and preserved in the refrigerator for further analysis. Chemical analysis of the samples were done in the biochemistry lab following standard protocols (according to ISO and others). Total phenolic contents (total polyphenols) were measured as gallic acid equivalent (GAE). Findings from the analysis results are summarized below.

***Effects of different withering periods***

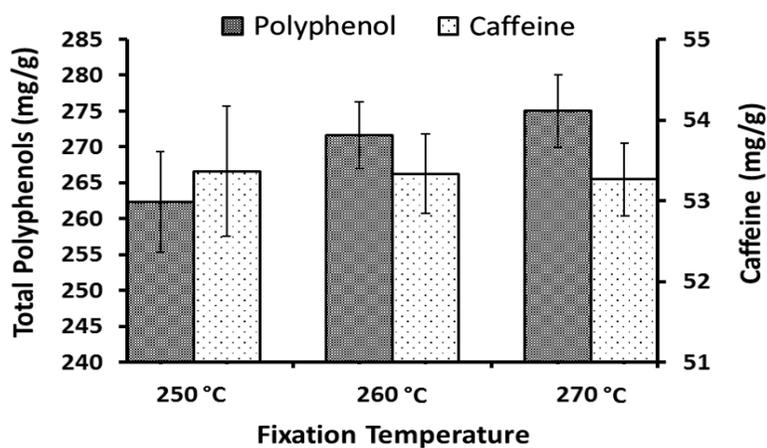
It was observed that total polyphenols and caffeine contents were significantly highest when withering was done for one hour (Figure 1). When withering periods were extended, the total polyphenols and caffeine contents were gradually decreased significantly. From this finding, it can be suggested that when other factors are constant, one hour withering is enough and better to produce quality green tea than 2-3 hours withering.



**Figure 1.** Effects of different withering periods on the total polyphenols and caffeine contents of the product green tea

#### *Effects of different fixation temperatures*

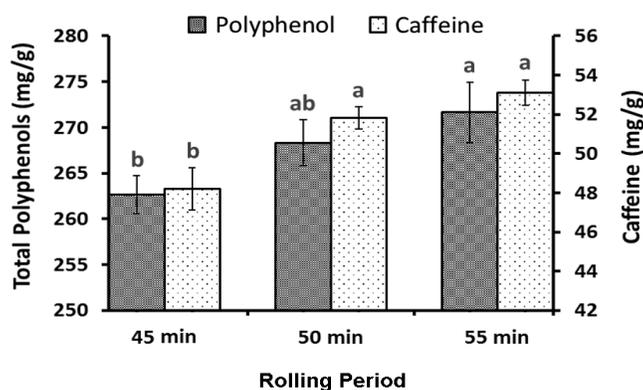
Three different fixation temperatures were tested to find out the optimum one. It was noticed that when the fixation temperatures were increased from 250 to 270 °C, the total polyphenols contents were increased gradually, though not significantly (Figure 2). Caffeine contents did not vary due to different fixation temperatures. This result indicated that within tolerable limit (so that the leaves do not burn), higher fixation temperature favored quality green tea production.



**Figure 2.** Effects of different fixation temperatures on the total polyphenols and caffeine contents of the product green tea

### ***Effects of different rolling durations***

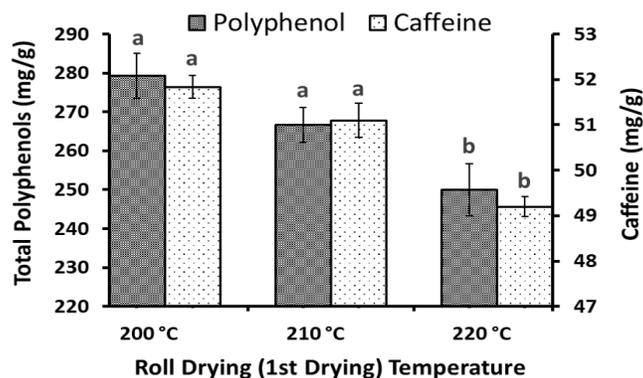
Rolling found an important factor significantly affecting the green tea quality. The total polyphenols and caffeine contents were significantly increased when rolling durations were increased from 45 to 55 minutes (Figure 3). The highest total polyphenols and caffeine contents were noted with 55 minutes rolling, when other factors are constant. So, there is a further scope to try for a 60-65 minutes rolling duration to observe its effect on the green tea quality.



**Figure 3.** Effects of different rolling durations on the total polyphenols and caffeine contents of the product green tea

### ***Effects of different roll drying (1<sup>st</sup> drying) temperatures***

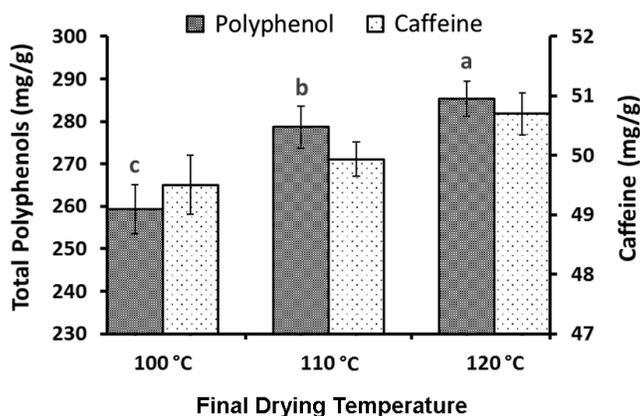
Roll drying (1<sup>st</sup> drying) temperature showed significant effect on green tea quality. It was observed that roll drying temperature is negatively correlated with the green tea quality. When the roll drying temperature increased from 200 to 220 °C, the total polyphenols and caffeine contents were decreased (Figure 4). Compared to 200 °C, the decrease was not significant at 210 °C but was significant at 220 °C. Therefore, it can be said that roll drying temperature should not exceed 210 °C.



**Figure 4.** Effects of different roll drying (1<sup>st</sup> drying) temperatures on the total polyphenols and caffeine contents of the product green tea

### ***Effects of different final drying temperatures***

Three different final drying temperatures were tested to observe their effect on the green tea quality. It was observed that within the tested range, increased drying temperature had the positive effect on the green tea quality. When final drying temperature increased from 100 to 120 °C, the total polyphenols and caffeine contents were increased (Figure 5). The increase was significant for total polyphenols, but insignificant for caffeine. From the finding it can be said that irrespective to other factors, final drying temperature can be maintained at 120 °C for better quality green tea.



**Figure 5.** Effects of different final drying temperatures on the total polyphenols and caffeine contents of the product green tea

### **Experiment 2: Development of different value added products using the tea flavor (BTRI, Short term: 2020-2021)**

Tea contains a range of soluble substances such as catechins, caffeine, theanine, chlorophyll, organic acids, and vitamins. Catechins account for a large amount (about 30% of its dry weight) compared to other soluble substances. Tea polyphenols, particularly catechins which are antioxidants and their antioxidative properties were found to be stronger than those of vitamins C, vitamin E, and  $\beta$ -carotene. However, to achieve health benefits only drinking tea may not provide a sufficient level of catechins. Therefore, the use of catechins in foods is an alternative way to supplement catechin consumption. Furthermore, Catechins improve flavor and colour of foods; hence, addition of catechins can also prolong the shelf life of foods. In addition, green tea is also well known for its anti-aging and skin protecting effects. Green tea leaves are rich in amino acids and minerals that can be used for nourishing, moisturize and brighten the skin. Product diversification of tea holds immense possibilities for the future and is an important area of research. This type of research would contribute to the domestic economy by creating new employment opportunities as well as innovating new products. The various diversified products could be develop are: (a) tea flavored Ice cream, Cake, Cookies, Candy, Chocolate, Biscuits, Chewing gum etc., (b) various cosmetics like facial, face mask, face powder etc., (c) other products like L-theanine tablet, tea seed oil, toothpaste etc. Therefore, the present study has been undertaken to invent different

diversified products using the tea flavor and develop standard protocols for their manufacture.

#### Objectives of the study

- To invent different diversified products using the tea flavor.
- Develop standard protocols for the production of diversified products.

**Progress:** The experiment was initiated in September 2020. First, tea extracts were collected from the Black and Green teas. Then these extracts were used during the production process of different products to add value and also to develop new products. Black and Green tea powders and liquors were also directly used to develop new products. Green tea soap, green tea instant facial, tea flavored candy, tea flavored cookies, and green tea pickles has been developed so far. Currently, research is underway on how to improve the quality of these developed products and also to invent new products. The experiment will be continued.



Green tea soap



Green tea instant facial  
(Paste type)



Green tea instant facial  
(Powder type)



Tea flavored candy



Tea flavored cookies



Green tea pickles

**Figure 6.** Developed different diversified products using the tea and tea flavor

**BOTANY DIVISION**  
**Dr. Md. Ismail Hossain**  
 Chief Scientific Officer

**STAFF**

Mr. Md. Rayhan-Ur-Rahaman, Scientific Officer was transferred to BTRI main station from BTRI Fatickcharri substation on 16 August 2020. The post of one Scientific Officer, one Senior Scientific Officer and one Field Assistant were vacant. There were no other changes in personnel position of the division during the period under report.

**RESEARCH**

Forty experiments in four programme areas namely –

**Prog. Area-1:** Preliminary selection of vegetative clones,

**Prog. Area-2:** Long term yield and quality trial of provisionally selected clones,

**Prog. Area-3:** Tea breeding & establishment of germplasm bank and

**Prog. Area-4:** Short term/mid term experiments were carried out by the division.

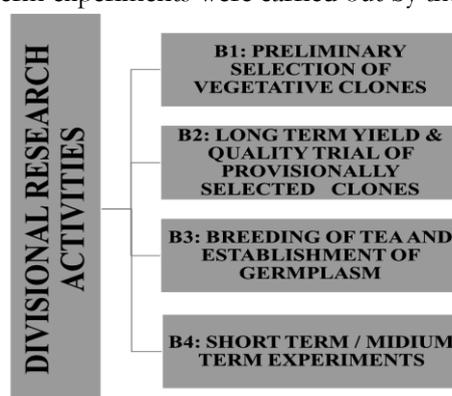


Fig 1. Divisional Activities of Botany Division (2020)

Results are briefly described below:

**B1: PRELIMINARY SELECTION OF VEGETATIVE CLONES (NO. OF EXPERIMENTS-3)**

**B1-27-7: Selection of Vegetative Clones at Shumshernugger T. E., Section Main Div. Sec. No. 9 (1993-2021)**

27 new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 3,562 cuttings from 24 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 (1993-2021)**

Fifty two new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 4,234 cuttings from previously selected 36 bushes of section no. 1 of Amo Tea Estate were collected and planted in the nursery.

**B1-31: Selection of Vegetative Clones at Baraoorah T. E., Section No. 8 (2007-2021)**

12 new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 2,394 cuttings from 12 bushes of section no. 1 of Baraoorah Tea Estate were collected and planted in the nursery.

**Progress:**

- Preliminary selection of desirable mother bushes is continued at Shumshernugger, Amo and Baraoorah Tea Estates.
- A total of 27, 52 and 12 mother plants from variable seedling population of Amo, Shumshernugger and Baraoorah tea estates respectively have been selected.
- 11 plants are also selected from BTRI C2 area.
- Collection of cutting is going on from the selected plants for rooting trial in nursery in order to find out their rooting ability.

**B2: LONG TERM YIELD & QUALITY TRIAL OF PROVISIONALLY SELECTED CLONES (NO. OF EXPERIMENTS-24)****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, 1996-2022).**

The experimental plants were medium skiffed at 78 cm. Recommended doses of fertilizer & usual cultural practices were applied. There were 28 plucking rounds in 2020. The yield data were analyzed and presented in Table-1.

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

Clone	A/8/01	A/17/22	A/22/27	A/22/40	BT1
Treatment mean	943.9	902.2	891.7	960.4	928.8

Treatment difference: Significant (LSD value at 5% level of significance= 32.9)

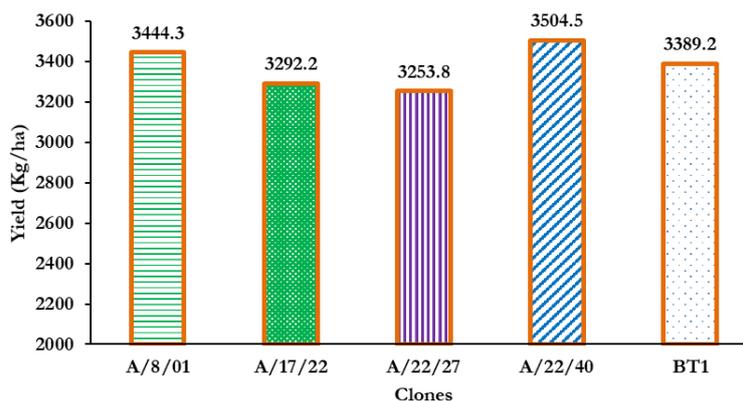


Fig. 2. Comparative yield of clones made tea (kg/ha)

The analytical results reveal that yield difference was highly significant (5% level of significance) in 2020. Test clones A/8/01 and A/22/40 were comparable in terms of yield while A/17/22 and A/22/27 performed lower yield than the control BT1. The estimated made tea production in kg/ha is presented in Fig. 2. 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	7.64	7.67	7.35	7.45	2.56	32.67	AA
A/17/22	7.66	7.47	7.36	7.44	2.68	32.61	AA
A/22/27	7.51	7.54	7.39	7.33	2.47	32.24	AA
A/22/40	7.48	7.62	7.56	7.31	2.78	32.75	AA
BT1	7.45	7.65	7.38	7.36	2.85	32.69	AA

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

All the test clones comparable with the control BT1 in case of quality.

**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, 1997-2022).**

The plants of this trial were deep skiffed at 74 cm in 2020. There were 28 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-3 and the estimated made tea production in kg/ha presented in Fig. 3.

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

Clones	CHA/J1/10	Sh/B/6/59	Sh/B/6/62	A/8/24	BT2
Treatment mean	946.45	980.95	957.37	1029.25	881.59

Level of significance: Significant (LSD value at 5% level of significance= 141.61)

The analytical results reveal that yield difference was highly significant (5% level of significance) in 2020. All the test clones were comparable in terms of yield while control BT2 performed lower yield than the test clones. 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.

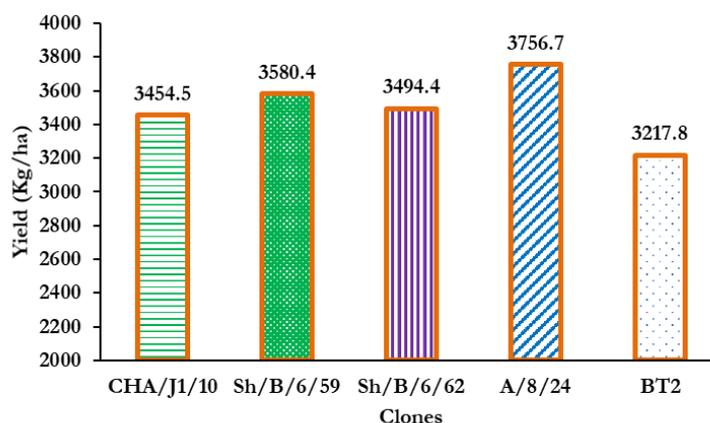


Fig. 3. Comparative yield of clones made tea (kg/ha)

Table 4. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
CHA/J1/10	7.57	7.44	7.51	7.51	2.79	32.82	AA
Sh/B/6/59	7.37	7.41	7.36	7.38	2.73	32.25	AA
Sh/B/6/62	7.42	7.36	7.55	7.66	2.77	32.76	AA
A/8/24	7.43	7.36	7.32	7.42	2.68	32.21	AA
BT2	7.48	7.38	7.43	7.44	2.86	32.59	AA

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

All the test clones have got comparable cup quality with test clone BT2, excepting the test clone's unique flavoury character.

**B2-39: Yield and Quality Trial of Four Test clones Selected from Shumshernugger T.E.; Test clones Sh/B/6/36, Sh/B/6/38, Sh/B/6/55 and Sh/B/6/67 against Standard BT1 (BTRI, 1998-2022).**

The plants of this trial were light pruned at 64 cm in 2020. There were 22 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-5. The estimated made tea production in kg/ha is presented in Fig. 4.

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

Clone	Sh/B/6/36	Sh/B/6/38	Sh/B/6/55	Sh/B/6/67	BT1
Treatment mean	577.88	773.56	714.63	754.37	606.95

Treatment difference- Significant (LSD value at 5% level of significance= 131.11)

The analytical results reveal that yield difference was highly significant (5% level of significance) in 2020. All the test clones Sh/B/6/38, Sh/B/6/55 and Sh/B/6/67 showed significantly higher yield against control BT1, while Sh/B/6/36 showed lower yield against control. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 6.

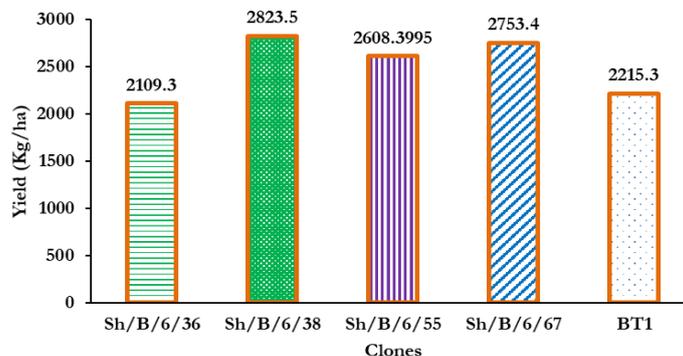


Fig. 4. Comparative yield of clones made tea (kg/ha)

Table 6. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/B/6/36	7.33	7.42	7.76	7.32	2.66	32.49	AA
Sh/B/6/38	7.27	7.51	7.48	7.46	2.76	32.48	AA
Sh/B/6/55	7.34	7.44	7.53	7.26	2.81	32.38	AA
Sh/B/6/67	7.55	7.53	7.39	7.49	2.79	32.75	AA
BT1	7.41	7.43	7.52	7.41	2.88	32.65	AA

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

All the Test clones were comparable in cup with the control BT1.

#### 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, 2000-2022).

The plants of this trial were medium skiffed at 78 cm in 2020. There were 22 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-7.

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

Clone	MZ/39	E/4	D/13	B2T1	BR2/97	SDL/1	BT2
Treatment mean	1035.5	1000.3	790.42	872.78	853.93	979.74	996.11

Treatment difference- Significant (LSD value at 5% level of significance= 43.58)

The analytical results reveal that yield difference was highly significant (at 5% level of significance) in 2020. Test clones MZ/39 and E/4 were significantly higher in terms of yield with the control BT2 while the test clone D/13, B2T1, BR2/97 and SDL/1 performed lower yield than the control. 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. 5.

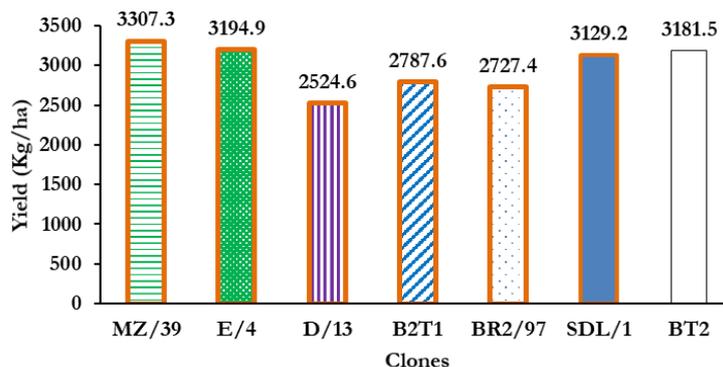


Fig. 5. Comparative yield of clones made tea (kg/ha)

Table 8. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
MZ/39	7.49	7.44	7.61	7.53	2.74	32.81	AA
E/4	7.62	7.55	7.49	7.39	2.75	32.8	AA
D/13	7.47	7.52	7.44	7.43	2.78	32.64	AA
B2T1	7.42	7.36	7.42	7.46	2.75	32.41	AA
BR2/97	7.51	7.39	7.44	7.52	2.82	32.68	AA
SDL/1	7.38	7.42	7.53	7.66	2.77	32.76	AA
BT2	7.49	7.61	7.53	7.41	2.69	32.73	AA

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

All the Test clones were comparable in cup with the control BT2. However, the unique flavoury 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, 2000-2022).**

The plants of this trial were medium skiffed at 78 cm in 2020. There were 27 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. 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	1138.99	1124.77	1105.94	1146.69	1108.64

Treatment difference- Insignificant

The analytical results reveal that yield difference was insignificant during the cropping year. The analytical results revealed that all test clones except A/8/66 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 10.

Table 10. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/37	7.36	7.51	7.53	7.35	2.79	32.54	AA
A/8/55	7.29	7.44	7.52	7.44	2.66	32.35	AA
A/8/62	7.38	7.39	7.59	7.34	2.78	32.48	AA
A/8/66	7.53	7.53	7.45	7.56	2.81	32.88	AA
BT2	7.52	7.65	7.51	7.55	2.72	32.95	AA

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

All the test clones were comparable in terms of cup quality. The flavoury character of BT2 was not considered in the case of assessing cup quality. The estimated made tea production in kg/ha is presented in Fig. 6.

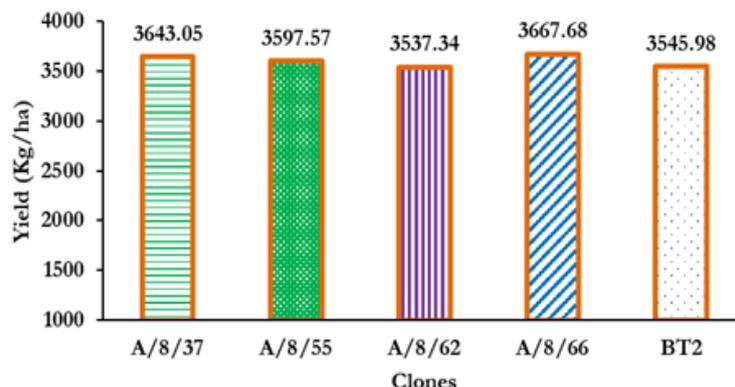


Fig. 6. Comparative yield of clones made tea (kg/ha)

**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 deep skiffed at 76 cm in 2020. There were 26 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-11

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

Clone	A/17/16	Ph/9/1	Ph/9/9	Sh/B/6/46	BT1
Treatment mean	1051.68	995.62	1013.94	1049.51	1010.37

Level of significance: Insignificant.

The analytical results revealed that all test clones except Ph/9/1 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 12.

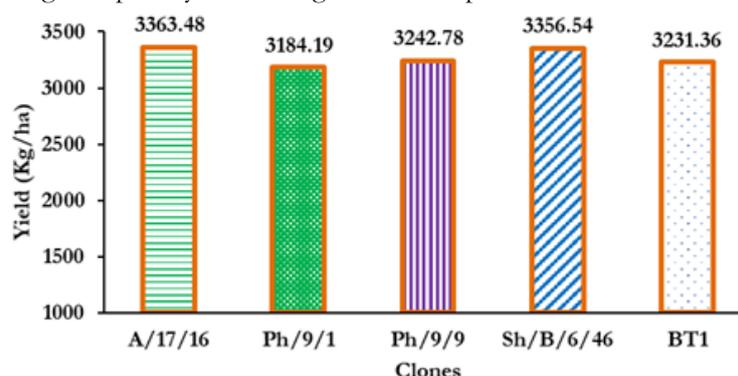


Fig. 7. Comparative yield of clones made tea (kg/ha)

Table 12. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/17/16	7.52	7.31	7.43	7.43	2.78	32.47	AA
Ph/9/1	7.33	7.45	7.39	7.44	2.66	32.27	AA
Ph/9/9	7.43	7.48	7.57	7.45	2.71	32.64	AA
Sh/B/6/46	7.48	7.44	7.48	7.45	2.66	32.51	AA
BT1	7.34	7.38	7.47	7.41	2.77	32.37	AA

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

All the test clones were comparable in cup with the control.

#### 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 deep skiffed at 76 cm in 2020. There were 25 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-13. The estimated made tea production in kg/ha is presented in Fig. 8.

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

Clone	Ph/9/4	Ph/9/25	Ph/9/40	BS/67	BT5
Treatment mean	913.68	940.51	986.11	935.81	923.46

Treatment difference- Significant (LSD value at 5% level of significance= 59.13)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The yield performance of test clone Ph/9/25, Ph/9/40 and BS/67 were higher than the control BT5. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 14.

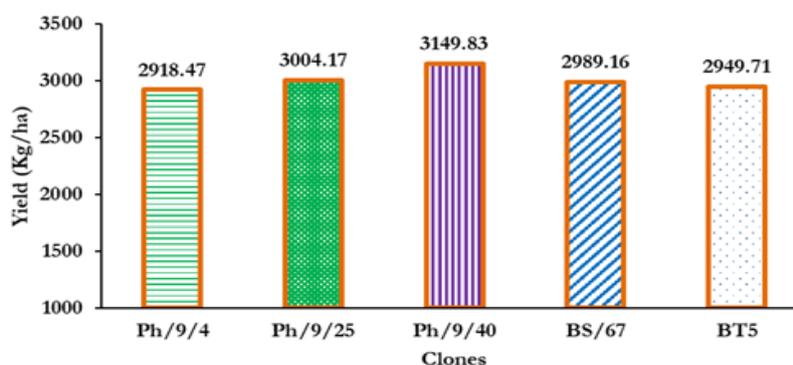


Fig. 8. Comparative yield of clones made tea (kg/ha)

Table 14. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/4	7.36	7.53	7.39	7.51	2.67	32.46	AA
Ph/9/25	7.32	7.38	7.42	7.49	2.66	32.27	AA
Ph/9/40	7.31	7.33	7.35	7.47	2.72	32.18	AA
BS/67	7.51	7.57	7.55	7.44	2.69	32.76	AA
BT5	7.49	7.53	7.55	7.44	2.71	32.72	AA

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

All the test clones were comparable in terms of cup quality with the control BT5.

**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, 2003-2020).**

The plants of this trial were light skiffed at 78 cm in 2020. There were 28 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-15.

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

Clone	A/8B/1	Ph/9B/1	Ph/9/11	BT1
Treatment mean	1137.96	1213.99	1249.24	1013.37

Treatment difference- Significant (LSD value at 5% level of significance= 144.28)

The analytical results revealed that all test clones are significantly produce higher yield against control. 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 16.

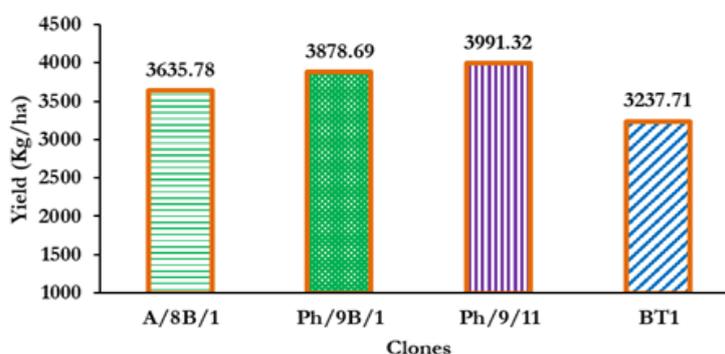


Fig. 9. Comparative yield of clones made tea (kg/ha)

Table 16. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8B/1	7.44	7.62	7.44	7.44	2.59	32.53	AA
Ph/9B/1	7.41	7.44	7.52	7.53	2.82	32.72	AA
Ph/9/11	7.57	7.51	7.46	7.33	2.77	32.64	AA
BT1	7.57	7.62	7.44	7.39	2.79	32.81	AA

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

All the Test clones were comparable in terms of cup quality with the control BT1.

**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 deep skiffed at 76 cm in 2020. There were 28 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-17.

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

Clone	Ph/9/68A	Sh/D/11/18	A/8/61	SC/12/28	BT2
Treatment mean	836.94	1182.68	934.38	1205.38	686.89

Treatment difference- Significant (LSD value at 5% level of significance= 128.13)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The yield performances of all the test clones were higher than the control BT2. The estimated made tea

production in kg/ha is presented in Fig. 10. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 18.

Table 18. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/61	7.44	7.32	7.42	7.39	2.84	32.41	AA
Ph/9/68A	7.48	7.38	7.64	7.28	2.61	32.39	AA
Sh/D/11/18	7.22	7.41	7.66	7.27	2.82	32.38	AA
SC/12/28	7.49	7.41	7.55	7.52	4.51	34.48	E
BT2	7.28	7.46	7.68	7.72	2.71	32.85	AA

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

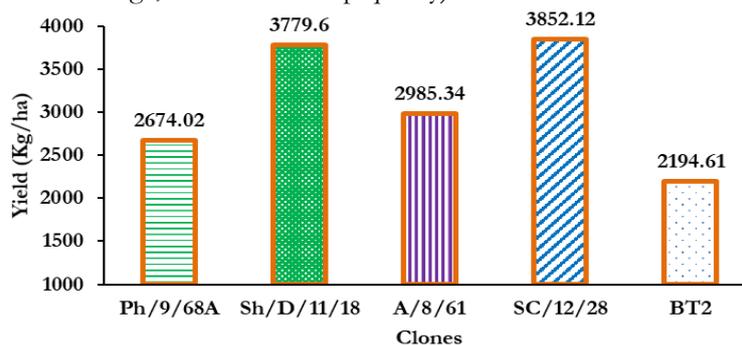


Fig. 10. Comparative yield of clones made tea (kg/ha)

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

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

The plants of this trial were deep skiffed at 76 cm in 2020. There were 26 plucking rounds in the reporting year. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-19.

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

Clone	D1/18	D/6	D/10	D/12	BT5
Treatment mean	935.25	925.15	838.17	904.95	787.06

Treatment difference- Significant (LSD value at 5% level of significance=119.61)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The yield performance of all test clones were higher than the control BT5. The estimated made tea production in kg/ha is presented in Fig. 11.

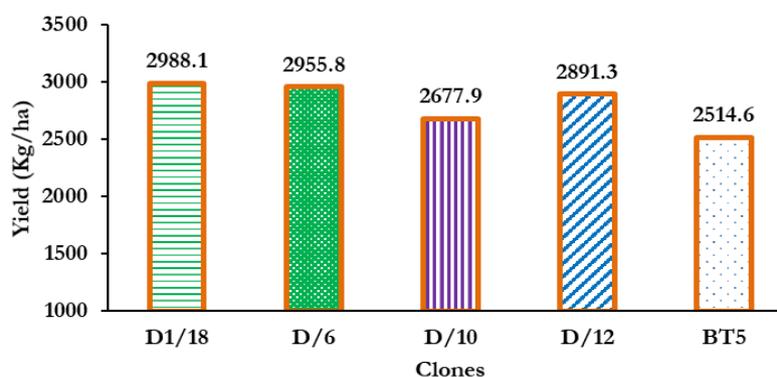


Fig. 11. Comparative yield of clones made tea (kg/ha)

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	7.63	7.46	7.55	7.41	2.87	32.92	AA
D/6	7.46	7.51	7.56	7.73	2.88	33.14	AA
D/10	7.21	7.56	7.42	7.52	2.94	32.65	AA
D/12	7.39	7.66	7.46	7.42	2.75	32.68	AA
BT5	7.29	7.71	7.35	7.61	2.92	32.88	AA

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

Test clones were comparable with the control BT5.

### 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 light pruned at 56 cm in 2020. There were 20 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-21.

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

Clone	Ph/9/92	BS/3	Ph/9/108	G/61/8	BT15
Treatment mean	802.5	795.23	740.25	761.15	670.55

Treatment difference- Significant (LSD value at 5% level of significance= 51.95)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The yield performances of all the test clones were higher than the control BT5. 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 22.

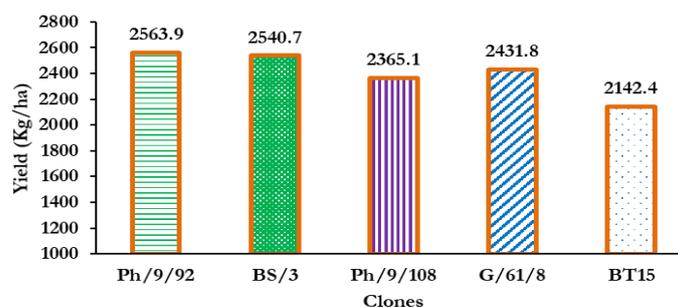


Fig. 12. Comparative yield of clones made tea (kg/ha)

Table 22. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/92	7.56	7.45	7.69	7.53	2.79	33.02	AA
BS/3	7.36	7.51	7.18	7.33	2.66	32.04	AA
Ph/9/108	7.51	7.71	7.48	7.62	2.85	33.17	AA
G/61/5	7.54	7.56	7.63	7.83	2.85	33.41	AA
BT15	7.71	7.82	7.79	7.31	3.58	34.21	E

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

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

**B2-48: Yield and Quality Trial of Four Test clones Selected from Shumshernugger and Amo T. E; Test clones – A/8/124, Sh/10/2, A/8/125 and A/11/38 against Standard BT2 (BTRI, 2009-2026).**

The plants of this trial were medium skiffed at 71 cm in 2020. There were 27 plucking rounds in the reporting year. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-23.

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

Clone	A/8/124	Sh/10/2	A/8/125	A/11/38	BT2
Treatment mean	1025.5	975.76	1047.05	989.93	747.08

Treatment difference- Significant (LSD value at 5% level of significance= 81.28)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The yield performance of all test clones were higher than the control BT2. 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 24.

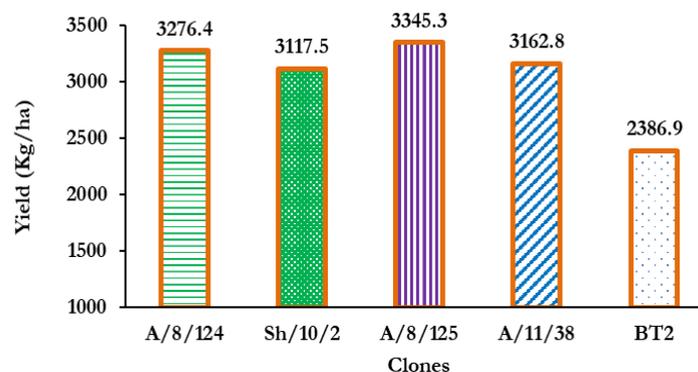


Fig. 13. Comparative yield of clones made tea (kg/ha)

Table 24. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/124	7.49	7.54	7.43	7.39	2.87	32.72	AA
Sh/10/2	7.39	7.42	7.59	7.42	2.81	32.63	AA
A/8/125	7.76	7.53	7.69	7.53	2.68	33.19	AA
A/11/38	7.39	7.53	7.31	7.53	2.88	32.64	AA
BT2	7.59	7.61	7.44	7.61	2.68	32.93	AA

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

All the test clones were similar to the control BT2 in respect of cup quality. However, the flavour 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. E.; Test clones – A/8/128, BS/91/6, against Standard BT2 (BTRI, 2011-2028).**

The plants were medium skiffed at 71 cm in 2020 and there were 24 plucking round during the cropping period. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-25.

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

Clone	Sh/D/13/4	BS/91/6	Sh/10/5	A/8/128	BT2
Treatment mean	1080.6	1055.2	950.2	1020.5	774.8

Treatment difference- Significant (LSD value at 5% level of significance= 192.27)

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. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 26.

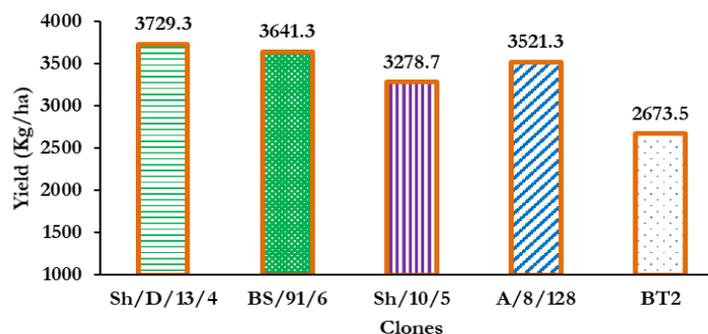


Fig. 14. Comparative yield of clones made tea (kg/ha)

Table 26. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/D/13/4	7.52	7.26	7.54	7.38	2.81	32.51	AA
BS/91/6	7.53	7.38	7.33	7.44	2.88	32.56	AA
Sh/10/5	7.44	7.62	7.39	7.55	2.81	32.81	AA
A/8/128	7.53	7.52	7.44	7.54	2.72	32.75	AA
BT2	7.36	7.51	7.39	7.47	2.81	32.54	AA

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

All the test clones were similar to the control BT2 in respect of cup quality. However, the flavour 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 plants were skiffed pruned at 70 cm in 2020 and there were 22 plucking round during the cropping period. Recommended doses of fertilizer & usual cultural practices were applied. 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	747.83	763.65	634.94	602.06	581.61

Treatment difference- Significant (LSD value at 5% level of significance= 64.82)

The analytical results revealed that all the test clones gave significantly higher yield than the control. The estimated made tea production in kg/ha is presented in Fig. 15. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 28.

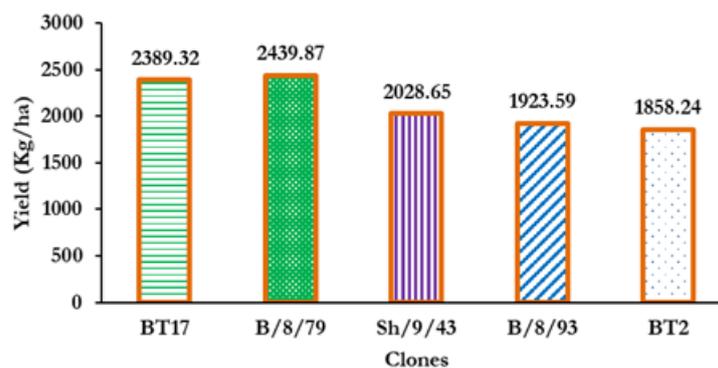


Fig. 15. Comparative yield of clones made tea (kg/ha)

Table 28. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT17	7.26	7.42	7.47	7.42	2.71	32.28	AA
B/8/79	7.41	7.21	7.53	7.46	2.81	32.42	AA
Sh/9/43	7.48	7.38	7.64	7.28	2.61	32.39	AA
B/8/93	7.59	7.54	7.26	7.42	2.34	32.15	AA
BT2	7.56	7.51	7.18	7.53	2.66	32.44	AA

(A: Average, AA: Above Average, E: Excellent 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.

#### B2-51: 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 plants were light pruned at 55 cm in 2020 and there were 22 plucking round during the cropping period. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table 29.

Table 29. Yield of green leaves

Clone	BTS1	A/8/194	Sh/9/65	BT17	BT2
Treatment mean	590.71	715.4	697.6	640.7	512.5

Treatment difference- Insignificant

The analytical results revealed that all the test clones gave higher yield than the control. The estimated made tea production in kg/ha is presented in Fig. 16. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 30.

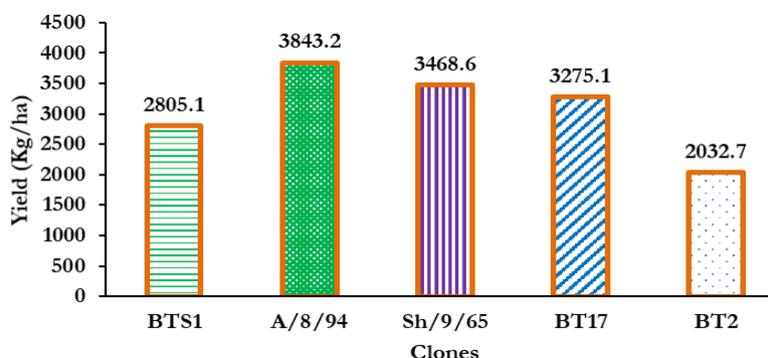


Fig. 16. Comparative yield of clones made tea (kg/ha)

Table 30. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.26	7.42	7.47	7.42	2.71	32.28	AA
A/8/194	7.41	7.21	7.53	7.46	2.81	32.42	AA
Sh/9/65	7.48	7.38	7.64	7.28	2.61	32.39	AA
BT17	7.33	7.32	7.46	7.42	2.66	32.19	AA
BT2	7.45	7.65	7.38	7.36	2.85	32.69	AA

(A: Average, AA: Above Average, E: Excellent 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.

**B2-52: Yield and Quality Trial of Four Test Clones Selected from Amo T.E., Baraoorah T.E., and Shumshernugger T.E.; Test Clones–B/8/97, B/8/101, Sh/9/71 and A/8/217 against Standard BT2 (BTRI, 2017-2034).**

The trial was initiated in May 2017 at BTRI farm under Latin Square Design with 105cm x 60cm spacing. The plants were skiffed pruned at 20 inches in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table 31. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 31. Yield of green leaves

Clone	B/8/97	Sh/9/71	A/8/217	B/8/101	BT2
Treatment mean	422.59	404.81	431.34	375.53	327.82

Treatment difference- Significant (LSD at 5%=55.45)

The estimated made tea production in kg/ha is presented in Fig. 17. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 32.

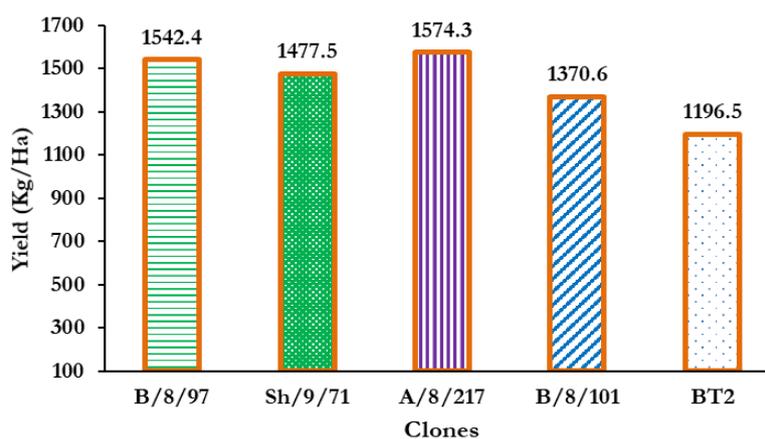


Fig. 17. Comparative yield of clones made tea (kg/ha)

Table 32. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.11	7.71	7.31	7.15	3.2	32.48	AA
Sh/9/71	7.22	7.35	7.42	7.33	2.83	32.15	AA
A/8/217	7.35	7.43	7.40	7.33	2.56	32.07	AA
B/8/101	7.32	7.61	7.52	7.43	2.91	32.79	AA
BT2	7.22	7.69	7.54	7.33	3.23	33.01	AA

(A: Average, AA: Above Average, E: Excellent 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.

**B2-53: Yield and Quality Trial of Four Test Clones Selected from Amo T.E., Baraoorah T.E., and Shumshernugger T.E.; Test Clones–B/8/131, B/8/144, Sh/9/85 and A/8/254 against Standard BT2 (BTRI, 2017-2034).**

The trial was initiated in May 2017 at BTRI farm under Latin Square Design with 105cm x 60cm spacing. The plants were skiffed pruned at 50 cm in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table 33. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 33. Yield of green leaves

Clone	B/8/131	B/8/144	Sh/9/85	A/8/254	BT2
Treatment mean	411.64	400.90	382.08	426.85	344.05

Treatment difference- Significant (LSD at 5%=42.81)

The estimated made tea production in kg/ha is presented in Fig. 18. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 34.

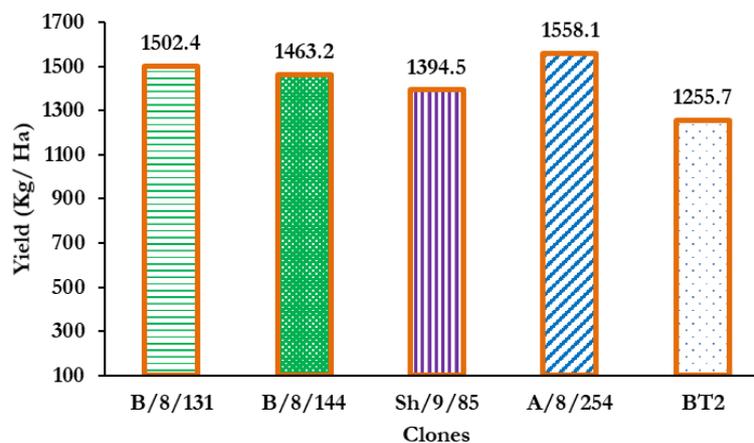


Fig. 18. Comparative yield of clones made tea (kg/ha)

Table 34. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/131	7.31	7.75	7.33	7.42	2.95	32.76	AA
B/8/144	7.26	7.71	7.44	7.53	2.85	32.79	AA
Sh/9/85	7.29	7.55	7.61	7.33	2.93	32.71	AA
A/8/254	7.36	7.44	7.31	7.24	2.96	32.31	AA
BT2	7.35	7.46	7.38	7.52	2.86	32.57	AA

(A: Average, AA: Above Average, E: Excellent 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.

**B2-54: Yield and Quality Trial of Four Test Clones Selected from Rajghat T.E. (Biddyabil Division), Amrail T.E., and Madhabpur T.E.; Test Clones–P/RJG/8/80, P/AML/14/98, P/RJG/11/106 and P/MDP/13/70 against Standard BT2 (BTRI, 2019-2036).**

A long term experiment was initiated at Bilashcherra Farm in 2019 under Latin Square Design with 105cm x 60cm spacing of plants. Normal cultural practices and timely operations were carried out. Growth of the plants was satisfactory. This experiment was initiated under NATP-2 sub project titled as “**Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based Agroforestry system to mitigate the climate change**”.

The yield data were analyzed and presented in Table 35. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 35. Yield of green leaves

Clone	P/RJG/8/80	P/AML/14/98	P/RJG/11/106	P/MDP/13/70	BT2
Treatment mean	390.1	405.2	385.2	413.1	355.5

Treatment difference- Significant (LSD at 5%=22.94)

The estimated made tea production in kg/ha is presented in Fig. 19. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 36.

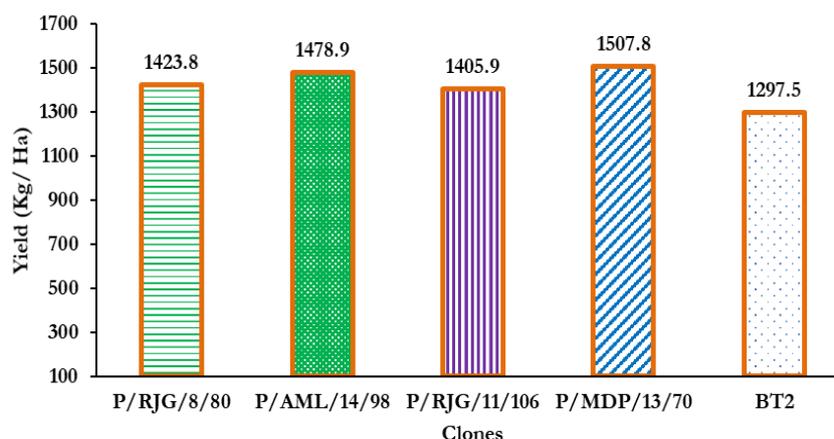


Fig. 19. Comparative yield of clones made tea (kg/ha)

Table 36. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/RJG/8/80	7.44	7.35	7.27	7.38	2.85	32.29	AA
P/AML/14/98	7.31	7.51	7.43	7.61	2.88	32.74	AA
P/RJG/11/106	7.31	7.44	7.56	7.39	2.98	32.68	AA
P/MDP/13/70	7.41	7.53	7.33	7.46	2.85	32.58	AA
BT2	7.44	7.61	7.59	7.38	3.09	33.11	AA

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

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

**B2-55: Yield and Quality Trial of Four Test Clones Selected from Rajghat T.E. (Biddyabil Division), Kurmah T.E., and Champarai T.E.; Test Clones– P/RJG/6/57, P/KRM/11/46, P/RJG/6/48 and P/CHM/18/79 against Standard BT2 (BTRI, 2019-2032).**

A long term experiment was initiated at Bilashcherra Farm in 2019 under Latin Square Design with 105cm x 60cm spacing of plants. This experiment was initiated under NATP-2 sub project titled as “Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based Agroforestry system to mitigate the climate change”.

The yield data were analyzed and presented in Table 37. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 37. Yield of green leaves

Clone	P/RJG/6/57	P/KRM/11/46	P/RJG/6/48	P/CHM/18/79	BT2
Treatment mean	405.28	382.95	398.84	379.83	361.67

Treatment difference- Significant (LSD at 5%=29.72)

The estimated made tea production in kg/ha is presented in Fig. 20. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 38.

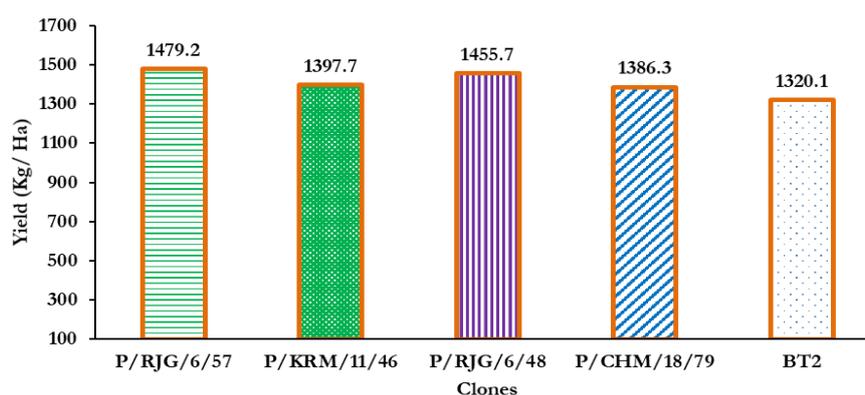


Fig. 20. Comparative yield of clones made tea (kg/ha)

Table 38. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/RJG/6/57	7.33	7.53	7.49	7.61	3.11	33.07	AA
P/KRM/11/46	7.51	7.36	7.28	7.46	3.21	32.82	AA
P/RJG/6/48	7.51	7.42	7.22	7.41	2.97	32.53	AA
P/CHM/18/79	7.44	7.54	7.42	7.29	3.15	32.84	AA
BT2	7.25	7.43	7.35	7.33	3.12	32.48	AA

(A: Average, AA: Above Average, E: Excellent 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

### B2-56: Long term Yield and Quality Trial of Four Test Clones (Multi-location trail) at Amo Tea Estate against Standard BT2 (2019-2032).

The yield data were analyzed and presented in Table 39. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 39. Yield of green leaves

Clone	A/8/217	A/8/194	Sh/9/65	B/8/93	BT2
Treatment mean	381.56	398.91	372.82	389.25	369.95

Treatment difference- Non-Significant

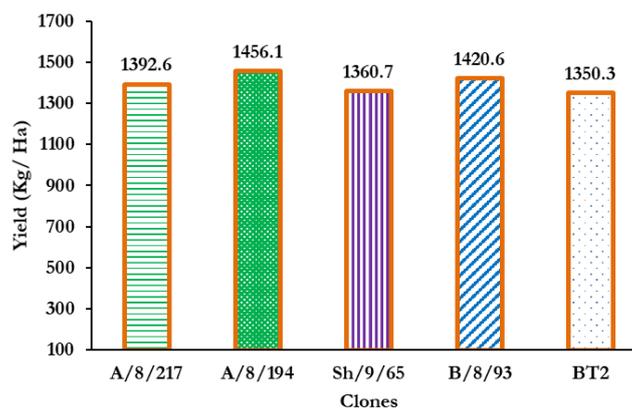


Fig. 21. Comparative yield of clones made tea (kg/ha)

The estimated made tea production in kg/ha is presented in Fig. 21. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 40.

Table 40. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/217	7.36	7.51	7.39	7.26	3.14	32.66	AA
A/8/194	7.26	7.38	7.33	7.55	2.89	32.41	AA
Sh/9/65	7.29	7.38	7.41	7.35	3.11	32.54	AA
B/8/93	7.33	7.25	7.44	7.31	3.13	32.46	AA
BT2	7.46	7.22	7.44	7.51	2.99	32.62	AA

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

**B2-57: Long term Yield and Quality Trial of Four Test Clones (Multi-location trail) at Hafiz Tea Estate against Standard BT2 (2019-2032).**

The yield data were analyzed and presented in Table 41. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 41. Yield of green leaves

Clone	B/8/97	Sh/9/71	B/8/79	Sh/9/43	BT2
Treatment mean	375.15	395.78	388.47	380.83	367.91

Treatment difference- Non-Significant

The estimated made tea production in kg/ha is presented in Fig. 22. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 42.

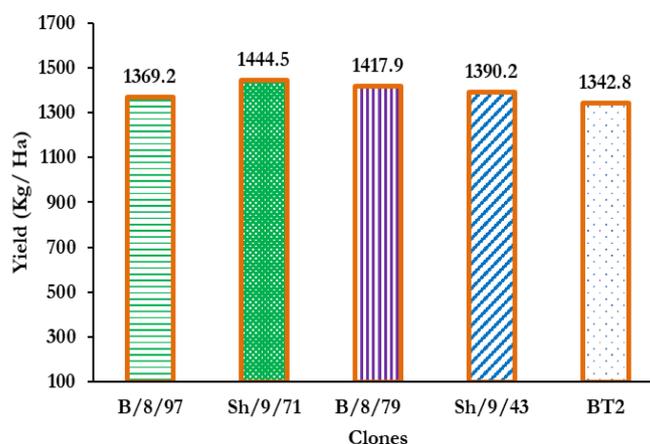


Fig. 22. Comparative yield of clones made tea (kg/ha)

Table 42. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.36	7.61	7.53	7.26	3.16	32.92	AA
Sh/9/71	7.22	7.44	7.32	7.36	2.96	32.29	AA
B/8/79	7.31	7.53	7.25	7.34	3.12	32.55	AA
Sh/9/43	7.33	7.54	7.83	7.22	2.91	32.83	AA
BT2	7.42	7.55	7.49	7.27	3.22	32.95	AA

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

**B2-58: Yield and Quality Trial of Four Test Clones Selected from Chandbagh T. E. , Teliapara T.E., (Satchori Division), Kapnapahar T. E., Madhabpur T. E.; Test Clones– P/CHB/18/67, P/TLP/5/58, P/KPR/56 and P/MDP/12/41 against Standard BT20 (BTRI, 2019-2032).**

A long term experiment was initiated at BTRI Farm in 2019 under Randomized Complete Block Design with 100cm x 60 cm spacing of plants. This experiment was initiated under NATP-2 sub project titled as “**Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based Agroforestry system to mitigate the climate change**”.

The yield data were analyzed and presented in Table 43. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 43. Yield of green leaves

Clone	P/CHB/18/67	P/TLP/5/58	P/KPR/56	P/MDP/12/41	BT20
Treatment mean	110.2	120.5	126.2	135.4	105.2

Treatment difference- Significant (LSD at 5%=12.73)

The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 44.

Table 44. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/CHB/18/67	7.31	7.12	7.32	7.26	3.22	32.23	AA
P/TLP/5/58	7.37	7.22	7.24	7.39	3.21	32.43	AA
P/KPR/56	7.22	7.33	7.54	7.33	3.23	32.65	AA
P/MDP/12/41	7.27	7.36	7.65	7.39	3.25	32.92	AA
BT20	7.21	7.36	7.52	7.43	4.79	34.31	E

**B2-59: Yield and Quality Trial of Four Test Clones Selected from Monipore T. E. , Amrail T. E., Rajghat T.E. (Biddyabil Division); Test Clones– P/MPR/16a/99, P/AML/12/20, P/MPR/16a/78 and P/RJG/6/19 against Standard BT15 (BTRI, 2019-2032).**

A long term experiment was initiated at BTRI Farm in 2019 under Randomized Complete Block Design with 100 cm x 60cm spacing of plants. This experiment was initiated under NATP-2 sub project titled as “**Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based Agroforestry system to mitigate the climate change**”.

The yield data were analyzed and presented in Table 45. The analytical results revealed that all the test clones gave significantly higher yield than the control.

Table 45. Yield of green leaves

Clone	P/MPR/16a/99	P/AML/12/20	P/MPR/16a/78	P/RJG/6/19	BT15
Treatment mean	145.4	136.2	125.5	144.2	115.1

Treatment difference- Significant (LSD at 5%=11.83)

The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 46.

Table 46. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/MPR/16a/99	7.11	7.71	7.31	7.15	3.2	32.48	AA
P/AML/12/20	7.22	7.35	7.42	7.33	2.83	32.15	AA
P/MPR/16a/78	7.35	7.43	7.40	7.33	2.56	32.07	AA
P/RJG/6/19	7.32	7.61	7.52	7.43	2.91	32.79	AA
BT15	7.25	7.79	7.54	7.33	4.26	34.17	E

**B2-60: Yield and Quality Trial of Three Test Clones Selected from Bethelpara para and Lairunpi para from Ruma Upazila of Bandarban District; Test Clones– P/RU/LAI/13, P/RU/BTL/49 and P/RU/LAI/53 against Standard BT19 (BTRI, 2020-2033).**

A long term experiment was initiated at BTRI Farm in 2020 under Randomized Complete Block Design with 100 cm x 60 cm spacing of plants. This experiment was initiated under NATP-2 sub project titled as “Germplasm conservation and farm productivity enhancement through the interaction of shade trees and tea based Agroforestry system to mitigate the climate change”.

**B3: BREEDING OF TEA (NO. OF EXPERIMENTS-10)**

**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 parents was done in 2019:

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.

**Crossing compatibilities and germination:**

Table 47: Crossing compatibilities and germination

Crossing combination		No. of pollinations	No. of fruit set	Fruit setting (%)	No. seeds germinated	Germination (%)
Receiver	Donor					
BT2	x BT17	62	55	88.71	36	65.45
TV1	x BT4	61	53	86.89	22	41.51
BT4	x TV1	56	49	87.50	19	38.78
BT10	x TV26	56	48	85.71	13	27.08
TV18	x BT3	42	28	66.67	9	32.14
TV26	x BT4	42	34	80.95	8	23.53
TV19	x BT2	49	41	83.67	29	70.73
BT2	x TV23	29	25	86.21	16	64.00
TV19	x BT3	29	21	72.41	11	52.38
TR1	x BT2	34	26	76.47	19	73.08
TV26	x BT12	66	59	89.39	18	30.51
BT12	x TV26	34	29	85.29	19	65.52
TV9	x BT2	50	39	78.00	26	66.67
BT6	x TV26	51	42	82.35	23	54.76
TV1	x BT2	35	27	77.14	13	48.15
BT2	x TV19	43	32	74.42	12	37.50
BT2	x TV9	24	19	79.17	14	73.68
BT2	x TR1	76	68	89.47	51	75.00
TV19	x TV1	61	50	81.97	41	82.00
TV26	x BT6	55	47	85.45	21	44.68
TV1	x TV19	51	42	82.35	25	59.52
TV23	x BT2	24	20	83.33	10	50.00
BT4	x TV26	64	59	<b>92.19</b>	52	<b>88.14</b>
TV26	x BT10	86	69	80.23	41	59.42

Percentages of fruit setting (92.19) and germination (88.14) was highest in BT4 X TV26.

### B3-1.3: Establishment of polyclonal seedbaries according to the proposed model by the Institute and observation on the open pollinated progenies.

Saplings of BT1, BT2, BT3, B207/39, BS1/3, BS1/4 and TV1 were raised in Botany nursery. Due to insufficient demand of polyclonal seedbaries by the tea estates, no polyclonal seedbarie was established in 2020.

### 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, 1999-2020)

The plants of this trial were light pruned at 56 cm and there were 20 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table 48. The estimated made tea production in kg/ha is presented in Fig. 23.

Table 48. Yield of green leaves

Clone	BT1	BTS1	PBS	ANPS	T18B3
Treatment mean	576.29	575.51	592.23	582.82	590.17

Treatment difference- Insignificant

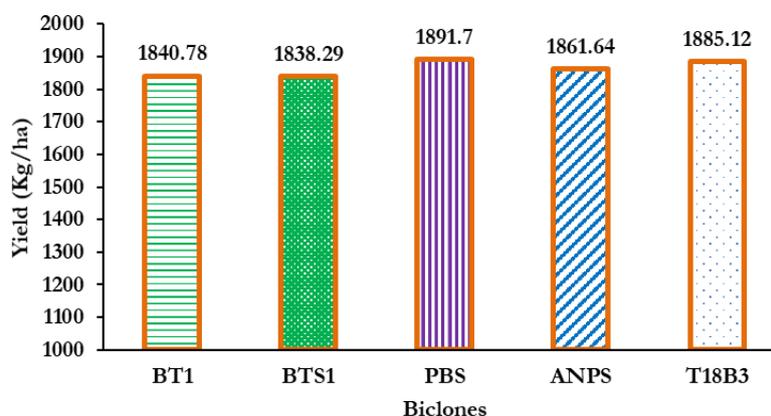


Fig. 23. Comparative yield of clones made tea (kg/ha)

The statistical results reveal that yield difference was insignificant in 2020. The cup quality of made tea for all the treatments was assessed through organoleptic test. The average scores are shown in Table 49.

Table 49. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT1	7.46	7.75	7.35	7.65	2.72	32.93	AA
BTS1	7.51	7.34	7.64	7.46	2.91	32.86	AA
PBS	7.28	7.27	7.22	7.23	2.92	31.92	A
ANPS	7.44	7.58	7.2	7.41	2.95	32.58	AA
T18B3	7.51	7.79	7.57	7.64	2.75	33.26	AA

(A: Average, AA: Above Average, E: Excellent 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) (2002-2020)

The plants of this trial were light pruned at 54 cm and there were 22 plucking rounds in 2020. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-50.

Table 50. Yield of green leaves (g/plant)

Clone	BTS1	BTS3	TV18 × BT3	TS463	BT1	TV1	TV19
Treatment mean	1072.4	1067.84	1091.14	1086.45	1051.08	1063.3	1064.76

Treatment difference- Significant. (LSD value at 5% level of significance= 275.49)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2020. The cup quality of made tea for all the treatments was assessed through organoleptic test. The average scores are shown in Table 51. The estimated made tea production in kg/ha is presented in Fig. 24.

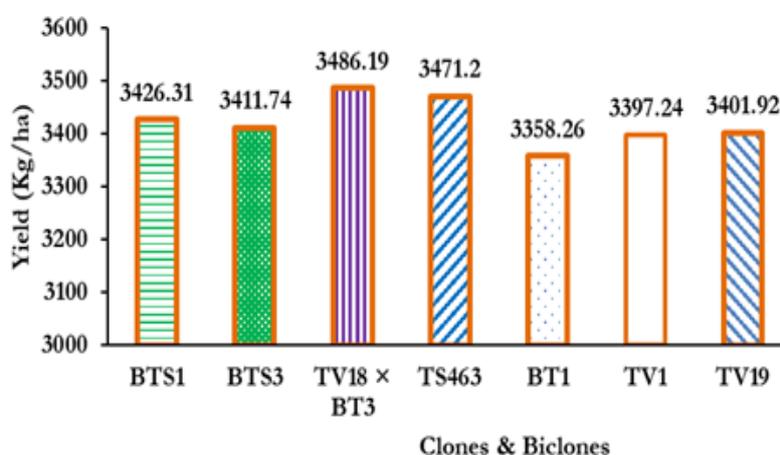


Fig. 24. Comparative yield of clones made tea (kg/ha)

Table 51. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.44	7.42	7.45	7.55	2.92	32.78	AA
BTS3	7.41	7.13	7.35	7.34	2.78	32.01	AA
TV18 × BT3	7.32	7.36	7.21	7.53	2.82	32.24	AA
TS463	7.52	7.47	7.38	7.39	2.85	32.61	AA
BT1	7.22	7.44	7.59	7.43	2.88	32.56	AA
TV1	7.52	7.43	7.31	7.47	2.88	32.61	AA
TV19	7.44	7.42	7.45	7.66	2.95	32.92	AA

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

In all the treatments the cup qualities were 'Above Average'.

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

Plants having fourteen special attributes like leaf color and size, seed bearing habit, disease pest tolerant, plant types etc. were collected from the following tea estates. Planting materials were raised in the nursery and afterwards planted in the field to observe the response of these diverse agrotypes and finally conserved in BTRI Tea germplasm center. Proper care and attention were given to this experiment.

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.

**Table 52: No. of promising germplasm screened from different T.E. and planted in BTRI germplasm center**

Source (Tea estates)	No. of promising germplasm screened	No. of plants/line/germplasm	No. of line/germplasm	Total planted population
Amo	6	10	1	60
Shumshernugger	6	10	1	60
Baraooora	4	10	1	40
<b>Total</b>	<b>16</b>	<b>-</b>	<b>-</b>	<b>160</b>

**B3-11: Detailed survey and assessment of tea seed baries in Bangladesh (1985-).****a. Survey and isolation of mother bush of breeding value in Parkul Tea Estate Seed Barie (2019-2020).**

In 2020, 22 mother bushes having breeding value were selected. Cuttings and seeds were collected. These were kept under observation.

**b. Survey and isolation of mother bush of breeding value in Monipore Tea Estate Seed Barie (2019-2020).**

In 2020, 21 mother bushes having breeding value were selected. Cuttings and seeds were collected. These were kept under observation.

**c. Survey and isolation of mother bush of breeding value in Merina Tea Estate Seed Barie (2019-2020).**

In 2020, 23 mother bushes having breeding value were selected. Cuttings and seeds were collected. These were kept under observation.

**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/MID TERM EXPERIMENTS (NO. OF EXPERIMENTS-3)****B4-10: Effect of drought on morpho-physiological and water relations traits in tea clones at nursery level (2019-).**

Striking Percentage of rooted cuttings, Chlorophyll Stability Index (CSI), Relative Leaf Water Content (RWC) and water relation parameters, Proline content, Poly-phenol content, Vertical Depth of Root, Root Shoot Ratio, Total primary and secondary root length were assessed to screen drought hardy/drought tolerant plant in nursery condition. According to these parameters, two out of four tea accessions were found to be more promising over check and standard variety.

**B4-11: Effect of drought on morpho-physiological and water relations traits in tea clones at field level.**

Chlorophyll Stability Index (CSI), Relative Leaf Water Content (RWC), Proline content, Poly-phenol content, Rate of Photosynthesis, Transpiration loss, Water Use Efficiency, Leaf Water Potential, Vertical Depth of Root, Root Shoot Ratio, Total primary and secondary root length, Total dry matter production, 100 Shoot weight, Number of branching, Pruning Recovery, number of bullation, number of serration,

Number of Pubescence and Wight of pruning litter/ bush at FFP-1 & FFP-2, Average Leaf area were assessed to screen drought hardy/ drought tolerant plant in field condition. According to these parameters, two out of four tea accessions were found to be more promising over check and standard variety.

**B4-12: Sustainable protocol development of artisan tea and different kinds of value added tea.**

The protocol of manufacturing and processing of Jasmine Flavored Tea and Rose Flavored Tea were optimized and standardized. Details data will be published after completion of the experiment.

**Summary of activities of Botany Division-2020**

1. No. of Experimental, Advisory and Official Visit: 92
2. Correspondence: 94
3. Delivered lecture hours for postgraduate diploma/ certificate course at MTC: 16 hours
4. Tea Tasting Session: 05

Tea Tasting Sessions	Date	Venue	No. of Estates	No. of participants
Balishira Valley Tea Tasting Session	08.10.20	BTRI Tea Tasting Room	07	11
Lungla Valley Tea Tasting Session	08.10.20	BTRI Tea Tasting Room	10	14
Luskerpore Valley Tea Tasting Session	11.10.20	BTRI Tea Tasting Room	12	24
Monu Doloi Valley Tea Tasting Session	11.10.20	BTRI Tea Tasting Room	07	19
Juri Valley Tea Tasting Session	12.10.20	BTRI Tea Tasting Room	08	15

5. Received Tea Sample Taste: 1634
6. Seminar/ Course arranged by Botany Division: 04

Seminar/ Course	Date	Venue	Topics
Tea Tasting Course for Army & Navy Officers of Bangladesh	08.10.20	BTRI	Tea Tasting & Quality Control
One Day Seminar	21.10.20	Doloi Valley Club	Nursey Management
One Day Seminar	28.10.20	Luskerpore Valley Club	Nursey Management
One Day Seminar	27.11.20	Sagarnal Tea Estate	Nursey Management

7. Quantity of planting material supplied:

Rooted cutting (nos.)	Seasonal Bi-clonal seeds (kg)
358	769

**AGRONOMY DIVISION**

**Dr. Toufiq Ahmed**  
Principal Scientific Officer

**RESEARCH**

In 2020 Agronomy Division carried out seven (07) 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: Development of a new pruning cycle for higher sustainable tea yield in the context of present climate change (BTRI Main Farm; Duration: 2010-2023)**

**Treatments:**

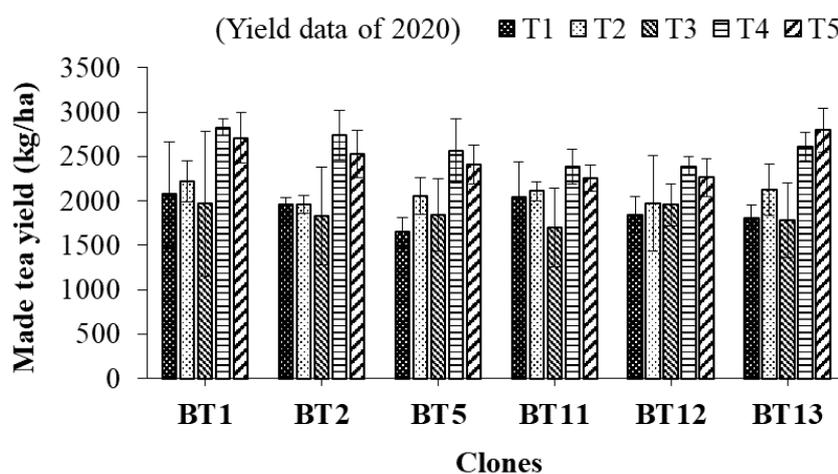
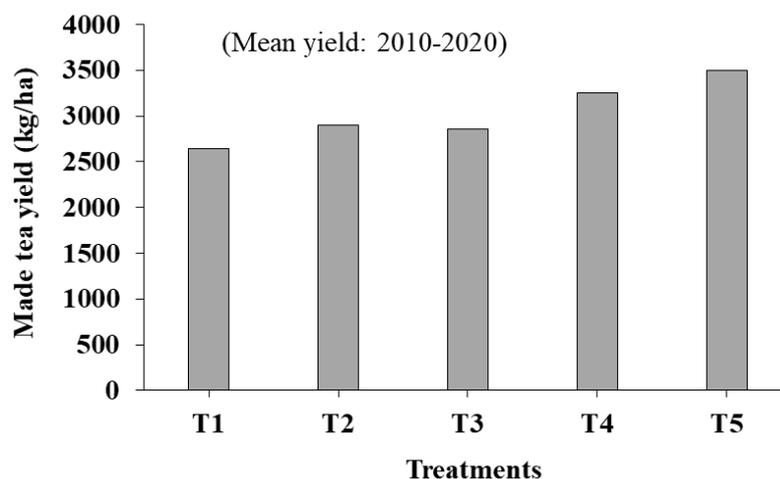
- T<sub>1</sub> : LP - DS - MS
- T<sub>2</sub> : LP - DS - MS - LS
- T<sub>3</sub> : LP - LS - DS - MS
- T<sub>4</sub> : LP - LS - DS - MS - DS - LS
- T<sub>5</sub> : LP - DS - MS - LS - DS - MS - LS

**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 as green leaf from the plots. From the analysis result of yield data obtained in 2020, it was observed that significantly highest yield was obtained in the treatment T<sub>4</sub> and that was followed by T<sub>5</sub>, T<sub>2</sub>, and T<sub>1</sub>; and the lowest was obtained in T<sub>3</sub> (Table 1). Statistically, the highest yield from T<sub>4</sub> is comparable with the yield from T<sub>5</sub>. Similarly, the lowest yield in T<sub>3</sub> is also comparable with the yields from T<sub>1</sub> and T<sub>2</sub>. These differences in yields were mainly due to the differences in the given pruning operations. From the interaction effect, it was observed that highest yield of 2826 kg/ha was obtained in the treatment combination T<sub>4</sub> × BT1 and the lowest yield of 1650 kg/ha was in the treatment combination T<sub>1</sub> × BT5, but statistically the interaction was not significant (Figure 1). From overall analysis (2010-2020) it is observed that longer pruning cycles are providing higher yield of tea (Figure 2). The experiment will be continued till 2023. Final comments will be made thereafter.

**Table 1.** Made tea yield (kg/ha) of different treatments in 2020

Treatments	Yield (kg/ha) 2020
T <sub>1</sub> (LP-DS-MS)	1895 b (LP)
T <sub>2</sub> (LP-DS-MS-LS)	2073 b (DS)
T <sub>3</sub> (LP-LS-DS-MS)	1843 b (LS)
T <sub>4</sub> (LP-LS-DS-MS-DS-LS)	2585 a (MS)
T <sub>5</sub> (LP-DS-MS-LS-DS-MS-LS)	2494 a (MS)
LSD (0.05)	261.4
CV (%)	17.91

**Figure 1.** Interaction effect of different clones with different treatments in 2020**Figure 2.** Average yield of made tea (kg/ha) in different treatments from 2010-2020

## Experiment 2. Effect of different types of plucking policies on yield of tea (BTRI Main Farm; Duration: 2018-2020)

### Treatments: 05

- T<sub>1</sub>: Traditional hand plucking (Control)
- T<sub>2</sub>: Shear plucking
- T<sub>3</sub>: Knife plucking
- T<sub>4</sub>: Single-man operated machine plucking, and
- T<sub>5</sub>: Double-man operated machine plucking

The experiment was laid out in a RCB Design with four replications and total number of plots under the experiment is 20. The experiment initiated on flat area of BTRI Farm in 2018 and continued up to December 2019. In 2020, this experiment was set on tillah area of Bilashcherra Experimental Farm. Results of collected data in 2020 presented here. During the last three years different types of data were collected e.g. harvested green leaf yield, time required to harvest and wastage of leaf during harvest which will be presented in a research paper in a cumulative way.

**Progress:** Data on yield, plucking round, time required for plucking and wastage percentage under each treatment was recorded throughout the experimental period July- December, 2020. From the analysis results it is found that, there is a significant relationship on yield and time required to plucking due to different treatments. Among the treatments maximum yield (1704.3 kg/ha) was obtained in T<sub>3</sub> which is statistically similar with T<sub>1</sub> (1626.8 kg/ha), whereas the lowest yield (1312.9 kg/ha) was obtained in T<sub>4</sub> which is statistically similar with T<sub>5</sub> (1378.2 kg/ha) (Table 2). On the other hand, maximum time (14.522 minutes) was required to pluck one kg green leaf in T<sub>2</sub> treatment whereas the minimum time (4.110 minutes) was required in T<sub>5</sub> treatment. From the recorded data it is found that during plucking 100 kg of green leaf, 1.564 kg green leaf fall in the ground (wastage) in treatment T<sub>2</sub>, whereas it is 1.222 kg and 0.926 kg in case of T<sub>4</sub> and T<sub>5</sub> respectively. There were no wastage in T<sub>1</sub> and T<sub>3</sub>.

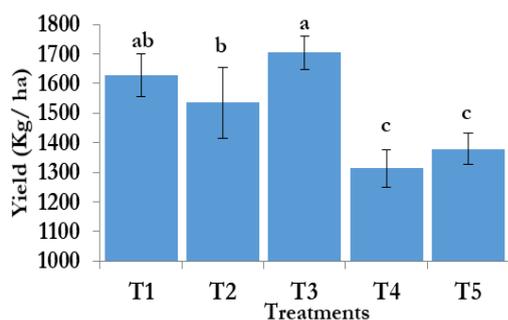


Figure 3. Yield under different plucking policies

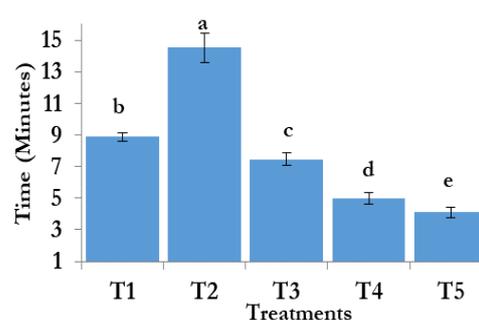


Figure 4. Time required to pluck 1 kg green leaf

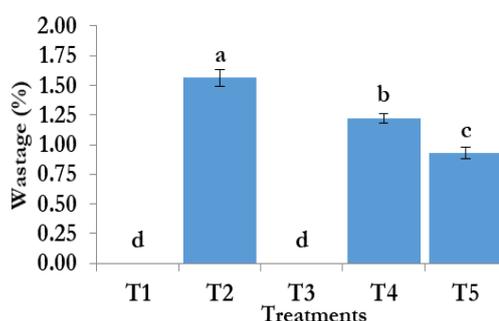


Table 2. Yield, time required to pluck and wastage percentage of different treatments

Treatments	Mean Yield	Mean time (Minutes) required	Mean wastage during plucking (%)
Figure 5. Percent wastage during plucking			
T1	1620.0 ab	6.071 b	0.000 d
T2	1535.7 b	14.522 a	1.564 a
T3	1704.3 a	7.461 c	0.000 d
T4	1312.9 c	4.976 d	1.222 b
T5	1378.2 c	4.110 e	0.926 c
CV	5.00	7.02	5.73
LSD <sub>(0.05)</sub>	116.45	0.8642	0.061

**Observations and recommendations:** From the study it is clear that, there is some direct effect on yield and labour efficiency due to different plucking policies using tools/ machines. From the study the following findings can be made-

1. Women workers are not feeling comfortable to use plucking shear as it is heavy in weight and having some technical problems (Blades become curved and get stucked and sometimes caused hand injury).
2. Single man operated plucking machine is more handy (easy to operate) to use and male worker feel interested to work with it. Though there is some wastage (1.564%) but it can be neglected considering higher efficiency.
3. The plucking efficiency of double man operated plucking machine is higher than the other plucking tools/ machines. It is found problematic within the plantation due to the presence of shade tree, compact plantation and triangular plantation system in tillah. Double man operated plucking machine is also difficult to operate in the high slope tillah area.
4. Female workers feel more comfortable in using plucking knife (Locally called Kachi) whose efficiency found higher than the traditional hand plucking. It is also noticed that yield under knife plucking was higher than the traditional hand plucking.
5. From the study it is found that, during the experimental period number of plucking round is lower in machine plucking (09 rounds) compared to hand plucking (14 rounds), shear plucking (14 rounds) and knife plucking (14 rounds).
6. From the findings of the study it can be said that, in tillah area single man operated machine plucking can be done during the peak season to keep the plucking round within 7-8 days and to cope up with the labour shortage.
7. To facilitate machine plucking in Bangladesh, future plantation should be done following double hedge system keeping the shade tree in border of the rows so that the plucking machines can be operated efficiently.

**Experiment 3: Development of a tool for easy and effective transplanting of tea saplings in the nursery (BTRI Main Farm; Short term: 2019-2020)**

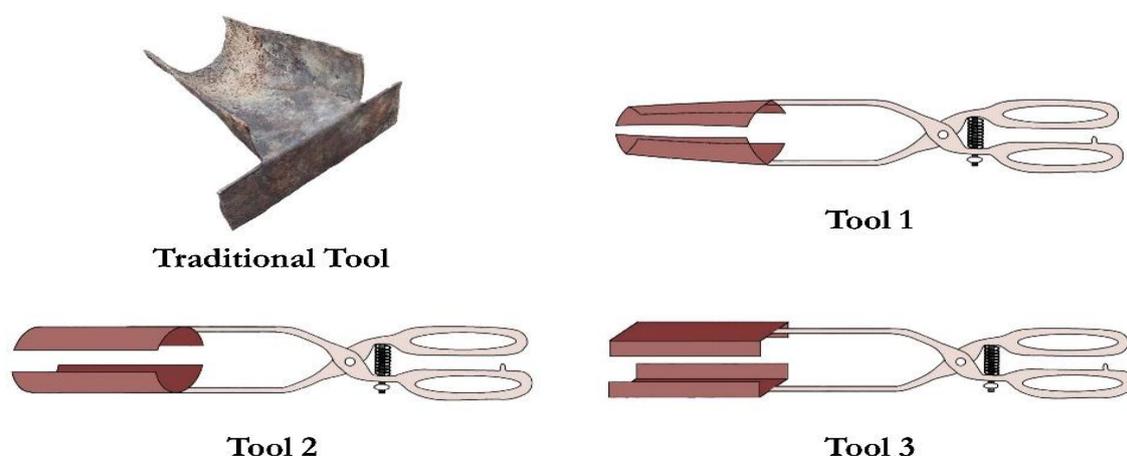
**Treatments:** Tools with different shape (Figure 6) will be used as different treatments of the experiment. The traditional tool of transplanting will be used as control.

T<sub>1</sub> : Transplanting using traditional tool (Control)

T<sub>2</sub> : Transplanting using Tool 1

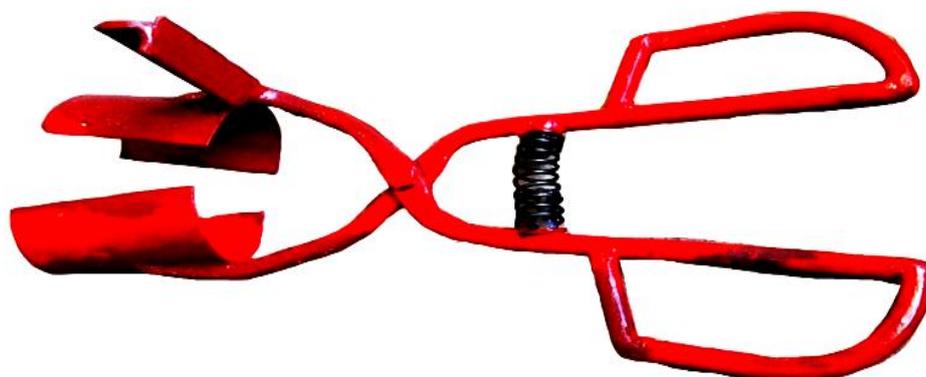
T<sub>3</sub> : Transplanting using Tool 2

T<sub>4</sub> : Transplanting using Tool 3



**Figure 6.** Design of different transplanting tools and the photo of a traditional tool

**Progress:** First, one of the tool (Tool 2) has been developed in the local workshop according to the design (Figure 7). Then a preliminary test was made with the tool in the field. Though the developed tool showed better performance than the traditional tool, the efficiency was not up to the mark as expected. This necessitated to modify the design of the tool. Due to some unavoidable circumstances the experiment didn't continue. The experiment is closed officially but related works for its development will be continued.



**Figure 7.** Developed Tool 2 according to the design

**Experiment 4. Effects of different types of compost on growth and development of clonal tea (BTRI Main Farm; Duration: 2017-2022)**

**Objective:** Generally decomposed cow-dung is suggested from BTRI to use in pit during plantation of tea. Hence, the experiment was set to know the impact of different types of compost on growth, development of young tea plants which might also reduce the impact of drought. A good alternative of cow-dung for tea plantation might be identified from this study.

**Treatments: 04**

T<sub>1</sub>=Applied 2 kg vermi-compost per pit during the plantation

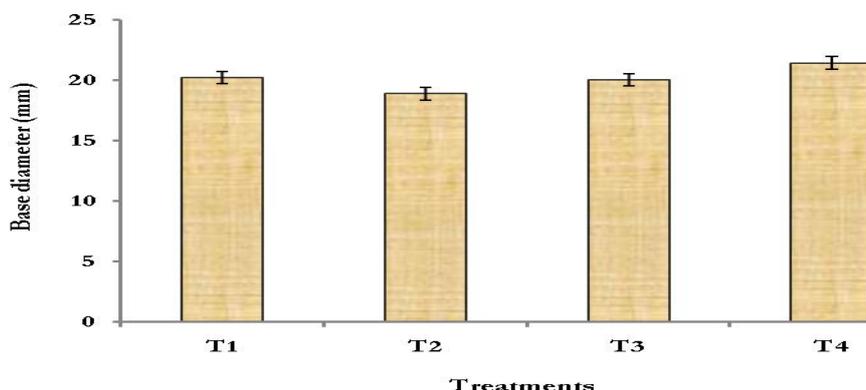
T<sub>2</sub>= Applied 2 kg farm-yard compost per pit during the plantation

T<sub>3</sub>= Applied 2 kg decomposed water hyacinth per pit during the plantation and

T<sub>4</sub>= Applied 2 kg decomposed cow-dung per pit during the plantation (Control)

For all of the above treatments, during the plantation BTRI recommended chemical fertilizers (TSP and MOP) were applied in the pit.

**Progress:** It was the 3<sup>rd</sup> year of young tea plants and data collected mainly on morphological characters e.g. base diameter, harvested green leaf yield from each plot. After analyzing the yield data of 2020, it was observed that yield was not significantly different for treatments at  $p=0.05$ . Among the treatments maximum yield observed in T<sub>4</sub> (531 kg/ha) which was statistically similar with others. Similarly on the basis of collected data during the 3<sup>rd</sup> year, base diameter was not significantly different for treatments. Maximum diameter observed in T<sub>4</sub> (21.45 mm) which was followed by T<sub>1</sub> (20.24 mm), T<sub>3</sub> (20.05 mm) and T<sub>2</sub> (18.92 mm) respectively, presented by the Figure 8.



**Figure 8.** Base diameter of tea plants for treatments in 3<sup>rd</sup> year

**Comments:** It is an ongoing experiment and will be continued up to the end of 2022. During this period, data will be collected on different characteristics in every year. After completion of the experiment, all of the data will be compiled, analyzed and presented in a journal with results and discussion.

**Experiment 5. Effects of foliar application of different chemical fertilizers on growth, development and yield of tea (BEF Farm, Bilashcherra; Duration: 2019-2020)**

**Treatments: 06**

The experiment initiated depending on the hypothesis was- “Drastic and sudden reduction of yield may be due to excess application of macronutrients containing chemical fertilizers on foliage of tea bushes”. Consequently to check the assumption, the experiment consisted with 06 (six) treatments e.g.

T<sub>1</sub> = Control

T<sub>2</sub> = 1% Urea applied as foliar

T<sub>3</sub> = 2% Urea applied as foliar

T<sub>4</sub> = 1% Urea + 1% MOP applied as foliar

T<sub>5</sub> = 2% DAP applied as foliar, and

T<sub>6</sub> = 1% MOP + 1% ZnSO<sub>4</sub> applied as foliar

The experiment was set as Randomized Complete Block Design with 04 replications. In the experimental area, there were 24 plots and each plot with 20 mature, clonal tea bushes. Following the treatments, chemical fertilizers were applied on foliage once in a month.

**Progress:** Like previous year, the experiment continued in 2020. After analyzing the collected data it was observed that yield of tea were not significantly different for treatments at p=0.05. Maximum yield was found in T<sub>3</sub> (2,468 kg/ha) which was statistically similar with other treatments.

Though 100-shoot fresh weight (g) was not statistically different, shoot extension rate (mm/week) was significantly different for treatments, presented in the Table 3. Highest extension of shoot observed in T<sub>3</sub> (58 mm/week) which was followed by T<sub>5</sub> and T<sub>1</sub>.

**Table 3.** Variation of shoot extension and shoot weight due to treatments

Treatments	Shoot extension rate (mm/week)	100-shoot fresh weight (g)
Control (T <sub>1</sub> )	51.0 <sup>a b</sup>	55.3
1% Urea applied on foliage (T <sub>2</sub> )	48.0 <sup>b c</sup>	54.7
2% Urea applied on foliage (T <sub>3</sub> )	58.0 <sup>a</sup>	61.7
1% Urea + 1% MOP applied on foliage (T <sub>4</sub> )	39.0 <sup>d</sup>	61.3
2% DAP applied on foliage (T <sub>5</sub> )	55.0 <sup>a b</sup>	55.0
1% MOP + 1% ZnSO <sub>4</sub> applied on foliage (T <sub>6</sub> )	41.0 <sup>c d</sup>	58.0
Mean	48.7	57.7
CV (%)	9	10
Least significant difference (P=0.05)	7.5	9.3

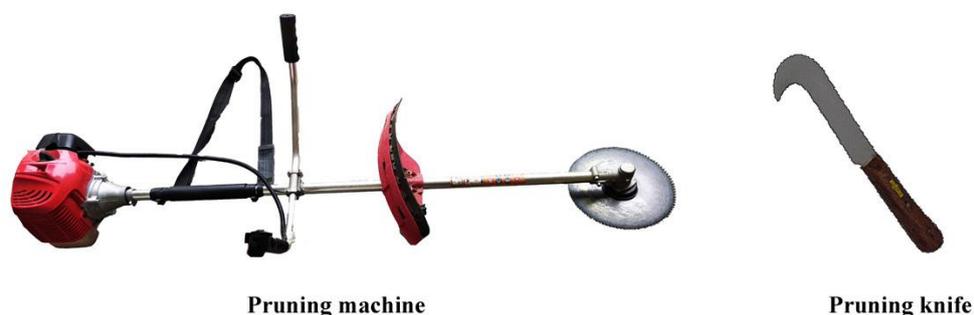
**Observations:** From two years findings of this experiment, it is clear that there is no significant effect of treatments on yield of tea. Though shoot extension rate observed higher in T<sub>3</sub> but 100-shoot fresh weight which considered as one of the major yield contributing factors for tea was nonsignificant for treatments. So, unnecessarily it has no need to apply above chemical fertilizers on foliage. Being a perennial crop, tea plants are required to apply proper amount of chemical fertilizers in soil for sustainable growth, development and yield of tea as well as for developing its proper rooting systems. On the other hand, excess and continuous application of these chemical fertilizers on foliage might do harm on tea plants and yield may be declined after a certain period of time.

#### **Experiment 6: Mechanization in pruning and its impact on the yield of tea (BTRI Main Farm; Duration: 2019-2022)**

##### **Objectives of the study:**

- To check the impact of pruning mechanization on the yield of tea.
- To find out the best pruning policy using pruning/trimming machines.

**Treatments:** Different pruning policies using the machine and traditional pruning knife (Figure 9) were the different treatments of the experiment. The traditional method of pruning using pruning knife was the control treatment. Three pruning policies were tested on four different types of pruning operations (LP, DSK, MSK and LSK).



**Figure 9.** Photos of the pruning machine and the traditional pruning knife

a) Different pruning policies-

T<sub>1</sub> : Manual pruning using traditional pruning knife (Control)

T<sub>2</sub> : Machine pruning only

T<sub>3</sub> : Machine pruning followed by manual repairing

b) On different types of pruning-

- Light Pruning (LP)
- Medium Skiff (MSK)
- Deep Skiff (DSK)
- Light Skiff (LSK)

**Progress:** A mature tea field of BT2 was selected for the experiment. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and total number of plots under the experiment is 36. BTRI recommended 4-years pruning cycle (LP-DSK-MSK-LSK) was followed to prune the tea bushes. All the pruning operations according to the treatments were carried out during December 2019 to February 2020 and related data were recorded. Yield data were collected mostly at weekly interval as green leaf kg/plot during the cropping season of 2020. Pruning related data are summarized in the Table 4 and Table 5 below.

**Table 4.** Comparison between machine and manual pruning based on data of 2020

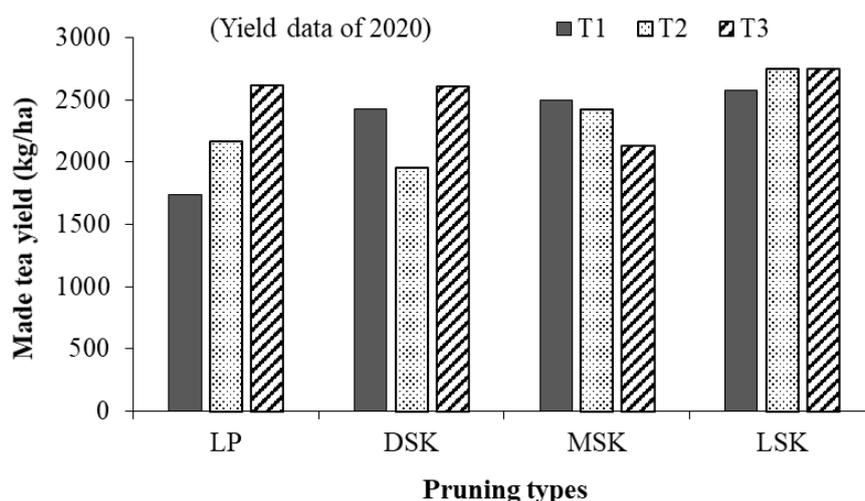
Pruning Type	Machine Pruning		Manual Pruning (On the basis of tasks*)		Ratio (Machine : Manual)
	No. of bushes pruned per hour	Time required to prune one hectare area	No. of bushes pruned per hour	Time required to prune one hectare area	
LP	109	143 hrs	15	1038 hrs	1 : 7.3
DSK	281	55 hrs	31	502 hrs	1 : 9.1
MSK	239	65 hrs	44	354 hrs	1 : 5.4
LSK	234	67 hrs	50	312 hrs	1 : 4.7

\* Considering, manual pruning task LP-120 plants, DSK-250 plants, MSK-350 plants, and LSK-400 plants per man-days; 8 working hours per man-days; 15576 plants per hectare.

**Table 5.** Fuel consumption in machine pruning based on the data of 2020

Pruning Type	Fuel consumption per hectare (Octane in liter)	Fuel consumption per hour (Octane in liter)
LP	54.07	0.49
DSK	22.96	0.54
MSK	24.44	0.50
LSK	25.56	0.50

Considering yield, it was noticed that compared to manual pruning machine pruning did not have significant negative effect on yield; even, the yields were higher in case of LP and LSK (Figure 10). Treatment T1 performed better for MSK and the treatment T3 performed better for LP, DSK and LSK; although the yield differences were not significant.

**Figure 10.** Yield of tea under different treatments on various pruning types

**Experiment 07. Implementation of grafting technique to produce composite tea plant in the nursery for increasing yield and drought resistance capacity of the plant (BTRI V.P Nursery, Duration: 2020-2022)**

**Objective:** To develop drought resistant tea plants as well as to increase the yield.

**Treatments:** 04; Scions collected from BTRI released high yielding clonal tea plants as fresh cuttings are being used as treatments e.g.  $T_1 = BT2$ ,  $T_2 = BT12$ ,  $T_3 = BT15$  and  $T_4 = BT17$ . Bi-clonal seedling tea plants are being used as 'root stocks' for all treatments. With four treatments, complete block design is followed having three replications.

**Progress:** Bi-clonal seeds were sown in December 2019 to get seedlings which used as ‘root stocks’ for cleft grafting. Seeds germinated and some seedlings kept aside to set the experiment on February, 2020. At the beginning of June 2020 when ‘scions’ were available in mother bushes, it was tried to impose the treatments following the basic cleft grafting technique. It was done primarily on 10.6.2020 but the attempt was not successful. After slight modification in the technique, it was done again. But the attempt was failed again. Similarly it was failed for few more attempts. Finally, the success came when the plants after imposing the treatments were covered completely with transparent polythene paper. It was done to make the surrounding environment of grafted plants airtight.

Different growth parameters were recorded regularly from the treatments. It was observed from the analysis of collected data up to this period that emerging of shoots from grafted plant (shoot sprouting) is significantly different for treatments ( $P=0.037$ ). Greater number of sprouting was observed in  $T_3$  which was identical with  $T_2$  but different with others. The lowest was in  $T_4$ . It can be stated in percentage that sprouting percentage was more in  $T_3$  which was followed by  $T_2$ ,  $T_1$  and  $T_4$  respectively, presented in the Table 6. Moreover, shoot extension rate (cm/month) was also significantly different for treatments, presented in the similar table.

**Table 6.** Sprouting percentage and shoot extension rate in different treatments

Treatments	Sprouting percentage (%)	Shoot extension rate (cm/month)
Used BT2 scion ( $T_1$ )	67 <sup>b</sup>	4.83 <sup>a b</sup>
Used BT12 scion ( $T_2$ )	93 <sup>a</sup>	7.83 <sup>a</sup>
Used BT15 scion ( $T_3$ )	93 <sup>a</sup>	5.17 <sup>a b</sup>
Used BT17 scion ( $T_4$ )	60 <sup>b</sup>	3.67 <sup>b</sup>
Mean	78	5.38
CV (%)	18	18
Least significant difference	27	3.43

**Comments:** It is an ongoing experiment and will be continued up to the end of 2022. Through modifying general cleft technique, the success of producing composite tea plants observed in a little scale during the 1<sup>st</sup> year of the experiment. Later, the experiment will be continued comparatively in a larger scale. Moreover to observe the field performances, these composite tea plants will be planted in the main field.

**OTHER ACTIVITIES****Visits:**

Apart from divisional research activities and experimental visits, scientists of BTRI are kept themselves busy to enrich the tea industry through different activities. During the reporting year 2020, researchers of Agronomy division delivered lectures in MTC of PDU, visited different Tea Estates to render advisory services and some other places to accomplish the official tasks which are summarized in Table 7.

**Table 7.** Number of visit paid by the scientific personnel of the division during the reporting year

Reporting year	No. of advisory visits	No. of experimental visits	No. of other official visits	Delivered lectures at MTC, PDU (Hour)
2020	28	80	08	12

**Workshop / Seminar**

Researchers of Agronomy division accomplished 12 workshops in different tea estates to disseminate updated technologies among tea growers and planters on pruning, tipping, plucking, drought management etc.

**BTRI Main Farm**

Mr. Roni Debnath is Farm Supervisor of BTRI Main 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
2020	2,18,000	50,571

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

Reporting year	Green leaf production in kg	Earning from other farm products in Taka
2020	76,006	49,670/-

**Green Leaf Supplied in kg**

Reporting year	Central Factory BTRI	Mini Factory BTRI	Green Tea Factory	Total Green Leaf Production
2020	75,699	-	307	76,006

**Independence and Victory Day**

National Independence Day and Victory Day were celebrated with due solemnity during the reporting year following the guidelines circulated by the Government due to COVID-19 pandemic.

**Meteorological data for the year 2020**

Month	No. rainy days	Rainfall (mm)	Evaporation (mm)	Temperature (°C)		Dew point (°C)	Sunshine hrs.	R.H. (%)
				Max.	Min.			
January	5	20	59.7	23.61	11.11	13.76	4.55	76.19
February	0	0	92.0	27.52	11.27	12.11	6.39	61.02
March	3	4	178.0	29.66	15.12	13.85	7.80	51.97
April	13	204	167.3	31.61	19.32	18.76	6.32	63.94
May	18	333	160.4	30.73	22.09	21.85	5.13	69.23
June	24	503	138.7	31.56	24.38	24.62	3.56	79.04
July	25	380	153.3	30.91	24.07	24.07	2.88	77.92
August	18	219	160.2	31.87	24.36	23.95	4.74	73.37
September	20	345	114.2	31.93	24.85	25.08	4.08	81.47
October	10	195	124.4	31.51	23.15	23.75	5.08	76.44
November	2	9	88.9	30.7	16.98	19.15	7.72	75.54
December	0	0	77.1	24.63	11.39	14.14	5.89	71.18
<b>Total/ Average</b>	138	2212	1514.2	29.69	19.00	19.59	5.35	71.44
	<b>Total</b>	<b>Total</b>	<b>Total</b>	<b>Average</b>	<b>Average</b>	<b>Average</b>	<b>Average</b>	<b>Average</b>

## ENTOMOLOGY DIVISION

**Md. Jahangir Alam**  
Scientific Officer

### STAFF

Dr. Mohammad Shameem Al Mamun, Senior Scientific Officer was transferred to BTRI Substation, Panchagarh on 8<sup>th</sup> March 2017. Mr. Shovon Kumar Paul, Scientific Officer is now in deputation at Malaysia for PhD purpose. The posts of Principal Scientific Officer was lying vacant during the period under report. There was no other change in personnel position of the division.

### RESEARCH

Three experiments under three programme areas were carried out during the year of 2020. The experiments were - Biopesticides as promising alternatives to chemical pesticides for sustainable management of tea insect pests; Ethoprophos: An alternative chemical options for nematode control in tea; Screening of pesticides against *Helopeltis*, Red spider mite, Termites, Nematodes and Thrips in tea; Details of the experiments together with their findings are furnished below:

#### ENT 1. BIO-CONTROL OF PESTS

##### ENT 1.1. Biopesticides as promising alternatives to chemical pesticides for sustainable management of tea insect pests (2019-2024)

###### *Potential effects of **Bracon hebetor** as a bio-control agents for sustainable management of Looper caterpillar*

**Progress:** An experiment was carried out to determine the effects of bio-control agent *Bracon hebetor* as a larval parasitoid against Looper caterpillar infesting tea both in laboratory and field conditions. The caterpillar was collected from different sections of BTRI and Bilashcherra experimental farm and reared in the Entomology Laboratory, BTRI, at 27-30°C temperature and 70-80% relative humidity. The caterpillars were reared on tea leaves in rectangular jars (9.5 cm x 7.5 cm x 20 cm).

In laboratory, *Bracon hebetor* @ 5 adults/30 larva (2<sup>nd</sup> & 3<sup>rd</sup> instar) considered as treatments. Effect of the potentiality of parasitoid on mortality of looper caterpillar was studied.

In field condition, the reared larva (2<sup>nd</sup> & 3<sup>rd</sup> instar) apply to individual of 12 tea plants as 5 larva/plant. The next day the pre counting data of individual plant for larva was taken and then *Bracon hebetor* @ 10 adults/60 larva were applied to selected plots. Data were collected at 24HAT, 48HAT, 72HAT and 96HAT.

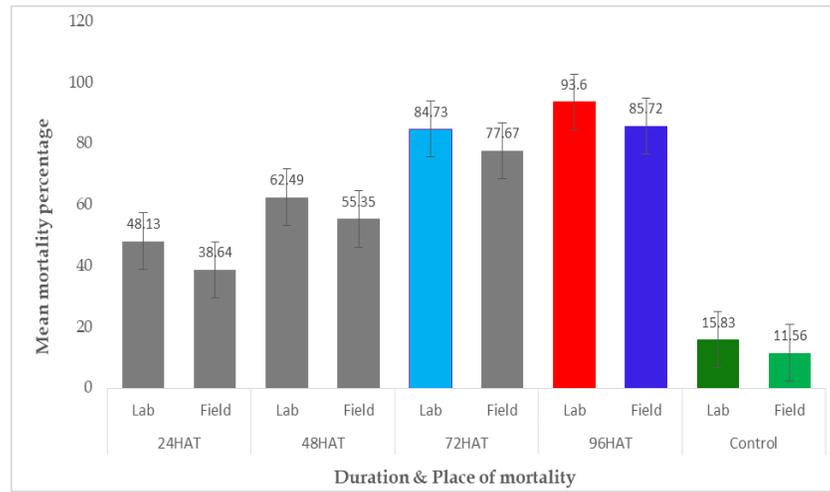


Fig. 1. Percent mortality of looper caterpillar by the larval parasitoid of *Bracon hebetor*

Result revealed that the maximum mortality (93.60%) of looper caterpillar by the larval parasitoid of *Bracon hebetor* was found at 96 HAT in the laboratory condition. And in field, the mortality was 85.72%, reveals that the application of *Bracon hebetor* as a bio control agent is effective and economic tools to control the looper caterpillar in tea.

## ENT 2. Chemical Control

### ENT 2.1. Ethoprophos: An alternative chemical options for nematode control in tea (2020-2022)

**Progress:** An experiment was conducted to evaluate the toxicity of newer nematicides of EC formulation ethoprophos 20% @ 0.5, 0.75 & 1.0 ml/L against plant parasitic nematode in tea. The experiment was conducted at Nematology laboratory and V.P nursery, BTRI. It was laid out in Complete Randomized Design with three replications. The experiment was carried out in three different methods viz, Pot experiment, primary bed experiment & secondary experiment. Pre-treatment observations on the presence of nematodes were made. Second and third round applications were done at 60<sup>th</sup> days and 120<sup>th</sup> days respectively. Post treatment observations were recorded at 15 days intervals and thus a total of twelve observations were recorded. Extraction was done by "Bayerman Funnel Method". Data from the trial have been analyzed by using Henderson & Tilton formula.

**Pot experiment:** In this method, the plastic pot (22 cm dia.) with 5 kg soil was cultured with organic matter or cow-dung and then seedlings were planted in individual pot. Different concentrations of treatments (ethoprophos 20% @ 0.5, 0.75 & 1.0 ml/L) with

standard (Carbofuran 5% @ 165 g/m<sup>3</sup> soil) were applied directly to soil. The soil was then collected and analyzed to find out the nematode population in 10 g soil.

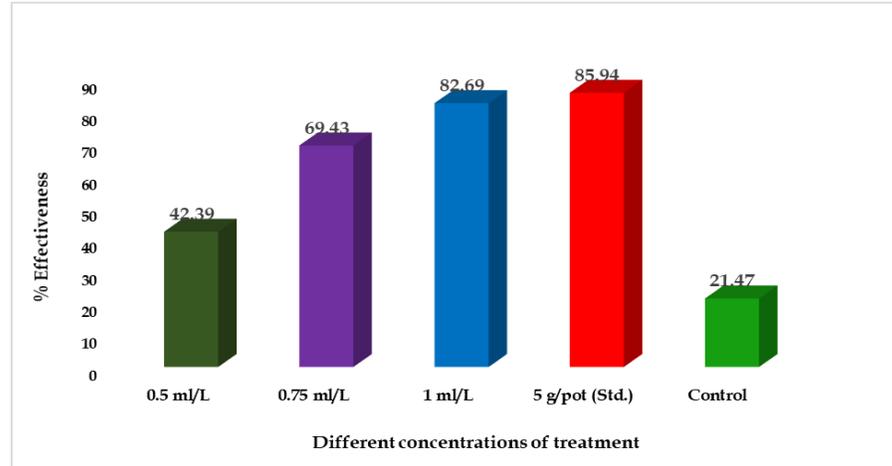


Fig. 2. Percent effectiveness of plant parasitic nematode in pot experiment

Result revealed that significant reduction of nematode populations 82.69% @ 1.0 ml/L in pot experiment, whereas commonly used granular formulation of nematicides (Carbofuran 5%) showed 85.94% reduction over control.

### ENT 3. SCREENING OF PESTICIDES

#### ENT 3.1. Screening of pesticides against *Helopeltis*, Red spider mites, Termites, Nematodes Aphids and Thrips in tea (2017-2018)

**Progress:** During 2020, Seventeen (17) pesticides under different groups were tested against *Helopeltis*, Red spider mite and Termite in the field and the reports were sent to plant protection wing for their standardization (Fig. 3). The result revealed that all the tested pesticides was found satisfactory (>80% effectiveness).

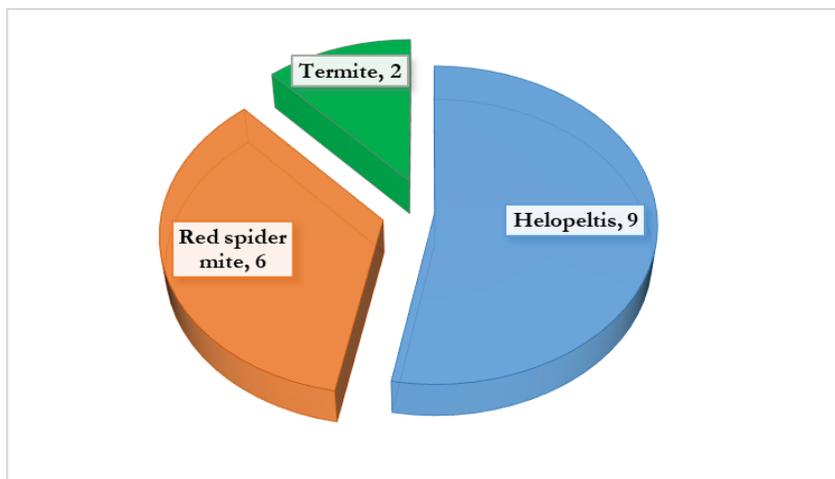


Fig. 3. Number of chemicals trial in the field against different insect pests of tea

## OTHER ACTIVITIES

### Advisory and Experimental visits

A total of Twenty one (21) advisory visits were paid to different tea estates to identify and render advice on specific pest problems and Seventeen (17) 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 Ninety two (92) soil samples were analyzed in the Laboratory for nematode count and reported to different tea estates. A total of Eleven (11) pesticides including insecticides and miticides were received from plant protection wing, Department of Agricultural Extension, Dhaka for field trial during the year 2020.

### Tours/Visits

A total of Twenty seven (27) official visits were paid by the Scientist of the division to different organizations/T.E. 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 three (03) workshops were conducted at different tea estates under different valley circles on tea pest management during 2020.

## PLANT PATHOLOGY DIVISION

**Mohammed Syeful Islam**

Senior Scientific Officer

### (1) STAFF

Mr. Md. Syeful Islam, Senior Scientific Officer, Plant Pathology Division was transferred to BTRI from CHT project, Bandarban and joined with the division on 2<sup>nd</sup> February 2020. The post of one Principle 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.

### (2) RESEARCH

Six experiments (ongoing 5 and new 1) were approved to conduct during 2020. Among these four experiments were carried out under the research program of disease management and other two were under weed management. However the progresses of the experiments are as follows:

#### (1) Title: Management of Red rust disease of tea with Plant Growth Promoting Rhizospheric microbes (PGPR)

Objectives:

1. To isolate the potential Rhizospheric microbes from tea soil.
2. To evaluate Rhizospheric microbes for controlling different tea diseases both in field and laboratory condition.

**Progress:**

There are four microbes like *Trichoderma*, *Bacillus*, *Pseudomonas* and *Rhizoctonia* and were tested against both parasitic and epiphytic diseases of tea in 2018. In case of disease severity scale of parasitic red rust, the lowest severity (44.08) was found with *Trichoderma*, similar responses were found in Mancozeb, Mancozeb + Metalaxyl and Copper Oxychloride (Table 1). Respectively these treatments have a positive progressed by 43.35%, 42.86%, 42.85 and 41.47% (Table 1). *Bacillus*, *Pseudomonas* and *Rhizoctonia* showed significantly different response and found inferior effectiveness then usually used contact fungicides (Table 1).

In case of disease severity scale of epiphytic red rust, the lowest severity (43.03) was found with *Trichoderma* which was statistically similar to Mancozeb, Mancozeb + Metalaxyl and Copper Oxychloride (Table 1). Respectively these treatments have a positive progressed by 46.02%, 45.59%, 45.22 and 45.14% (Table 1). *Bacillus*, *Pseudomonas* and *Rhizoctonia* showed significantly different response and found inferior effectiveness then usually used contact fungicides (Table 1).

There are five microbes like *Trichoderma*, *Bacillus*, *Pseudomonas*, *Streptomyces* and *Rhizoctonia* and were tested against both parasitic and epiphytic diseases of tea in 2020. In case of disease severity of parasitic red rust, the lowest severity (39.01) was found with *Trichoderma* which was 47.93% lower over the control. Similar responses were found in *Bacillus*, *Pseudomonas*, Mancozeb, Copper Oxychloride and Propineb (Table 2). *Streptomyces* and *Rhizoctonia* showed significantly different response and found inferior effectiveness then usually used contact fungicides (Table 2).

In case of disease severity scale of epiphytic red rust, the lowest severity (40.34) was found with *Trichoderma* which was 45.52% lower over the control. Statistically similar response was found in *Bacillus*, Mancozeb, Copper Oxychloride and Proineb (Table 2). *Streptomyces*, *Pseudomonas* and *Rhizoctonia* showed significantly different response and found inferior effectiveness than usually used contact fungicides (Table 2).

Table 1: Disease severity of Red rust against different treatments (2018)

Treatments	Parasitic Red rust		Epiphytic Red rust	
	Percent Disease Index (PDI)	% reduction over control	Percent Disease Index (PDI)	% reduction over control
T <sub>1</sub> = Control	77.82 a	00	79.71 a	00
T <sub>2</sub> = <i>Trichoderma</i>	44.08 f	43.35	43.03 f	40.02
T <sub>3</sub> = <i>Bacillus</i>	52.00 e	33.18	50.48 e	36.68
T <sub>4</sub> = <i>Pseudomonas</i>	67.31 c	13.50	54.40 d	31.75
T <sub>5</sub> = <i>Rhizoctonia</i>	74.48 b	4.29	69.51 b	12.80
T <sub>6</sub> = Carbendazim	60.62 d	22.10	66.13 c	17.04
T <sub>7</sub> = Copper oxychloride	45.55 f	41.47	43.73 f	45.14
T <sub>8</sub> = Mancozeb	44.46 f	42.86	43.37 f	45.59
T <sub>9</sub> = Mancozeb+ Metalaxyl	44.47 f	42.85	43.66 f	45.22
	R <sup>2</sup> = 0.2993		R <sup>2</sup> = 0.2464	

Table 2: Disease severity of Red rust against different treatments (2020)

Treatment	Parasitic Red rust		Epiphytic Red rust	
	Percent Disease Index (PDI)	% reduction over control	Percent Disease Index (PDI)	% reduction over control
T <sub>1</sub> = Control	74.92 a	00	74.04 a	00
T <sub>2</sub> = <i>Bacillus</i>	46.99 bc	37.28	46.11 bcd	37.72
T <sub>3</sub> = <i>Streptomyces</i>	48.32 b	35.50	47.880 bc	35.33
T <sub>4</sub> = <i>Pseudomonas</i>	46.99 bc	37.28	48.77 b	34.13
T <sub>5</sub> = Mancozeb	42.12 bc	43.79	43.89 bcd	40.72
T <sub>6</sub> = <i>Rhizoctonia</i>	48.77 b	34.91	50.54 b	31.74
T <sub>7</sub> = Copper oxychloride	42.12 bc	43.78	41.67 cd	43.72
T <sub>8</sub> = Carbendazim	48.77 b	34.91	48.32 bc	34.73
T <sub>9</sub> = Propineb	41.23 bc	44.97	41.67 cd	43.72
T <sub>10</sub> = <i>Trichoderma</i>	39.01 c	47.93	40.34 d	45.52
	R <sup>2</sup> = 0.4472		R <sup>2</sup> = 0.4322	

In concluding, it may be subjected to be considered that as bio pesticides *Trichoderma* and *Bacillus* significantly reduce the disease severity both parasitic and epiphytic red rust of tea.

**(2) Title: Identification of potential infection source of Epiphytic red rust disease of tea****Objectives:**

1. To find out the potential source of epiphytic red rust infection in case of field factors.
2. To develop sustainable control measures of epiphytic red rust effectively.

**Progress:**

1. Infected pruning litres remain in the tea fields are the **main source** of epiphytic red rust disease. It causes highest disease index (PDI= 93.50) that is 76.95% more over the LP+ cleaned sections (Table 1).
2. Tea bushes of MSK and LSK skiff sections are more vulnerable to the disease showing the PDI of 90.54 and 93.50 respectively that are 52.63 and 71.34% more than LP+ cleaned sections. Because more soil touching old leaves are attached with the tea bushes which act as better carrier as well as the **secondary source** of the disease (Table 1).
3. Cleaning and sanitations are also the important factors in LP and DSK pruning. Plants parts and debris are the **tertiary source** of the said disease. Only cleaning and sanitation reduce the infection of 18.68% and 5.28% in LP and DSK sections respectively (Table 1).

This experiment will be closed 2020.

Table 1: Showing Percent Disease Index of Epiphytic Red rust in different conditions

Treatment	Percent Disease Index (PDI)				
	2018	2020	Average		% Changes
T <sub>1</sub> = LP + cleaned	51.91 g	53.76 f	52.84 g		00
T <sub>2</sub> = LP + Not cleaned	65.33 ef	60.08 e	62.71 f	18.68%	18.68%
T <sub>3</sub> = DSK + cleaned	68.17 e	67.97 d	68.07 e		28.82%
T <sub>4</sub> = DSK + Not cleaned	73.15 cd	70.19 c	71.67 d	5.28%	35.64%
T <sub>5</sub> = MSK	76.62 c	84.68 b	80.65 c		52.63%
T <sub>6</sub> = LSK	84.80 b	96.28 a	90.54 b		71.34%
T <sub>7</sub> = Pruning litre	90.79 a	96.20 a	93.50 a		76.95%

**(3) Title: Effect of Leaf Reduction in MSK/ LSK sections on the incidence & severity of Red rust and Black rot diseases of tea.****Objectives:**

1. To find out the best cultural practices for controlling Epiphytic Red rust disease by reducing very old leaves during LSK and MSK pruning operation.

**Progress:**

Disease severity of both Red rust and Black rot were reduced gradually by the increasing of reduction of very old leaves from the base of tea bushes. In both cases the minimum PDI (22.67 and 18.86) were found in the plots receiving 20 inches of leaf reduction from the base of tea bushes. Statistically these were similar to that of 15 inches reduction (Table 1). There is a great impact of leaf reduction by 91% and 98% on reducing disease severity of Red rust and Black rot by 13.58 and 12.99 respectively (Figure 1).

Table 1: Disease severity of Red rust and Black rot against different treatments (2020)

Treatment	Percent Disease Index (PDI)			
	Red rust		Black rot	
T <sub>1</sub> = Control (No leaf reduction)	52.00 a	00	41.00 a	00
T <sub>2</sub> = 5 inches (12.70 cm)	38.67 b	25.63%	35.33 b	13.83%
T <sub>3</sub> = 10 inches (25.40 cm)	30.00 c	42.30%	29.67 c	27.63%
T <sub>4</sub> = 15 inches (38.10 cm)	26.67 cd	48.71%	26.33 cd	35.78%
T <sub>5</sub> = 20 inches (50.80 cm)	22.67 d	56.40%	18.86 d	54.00%

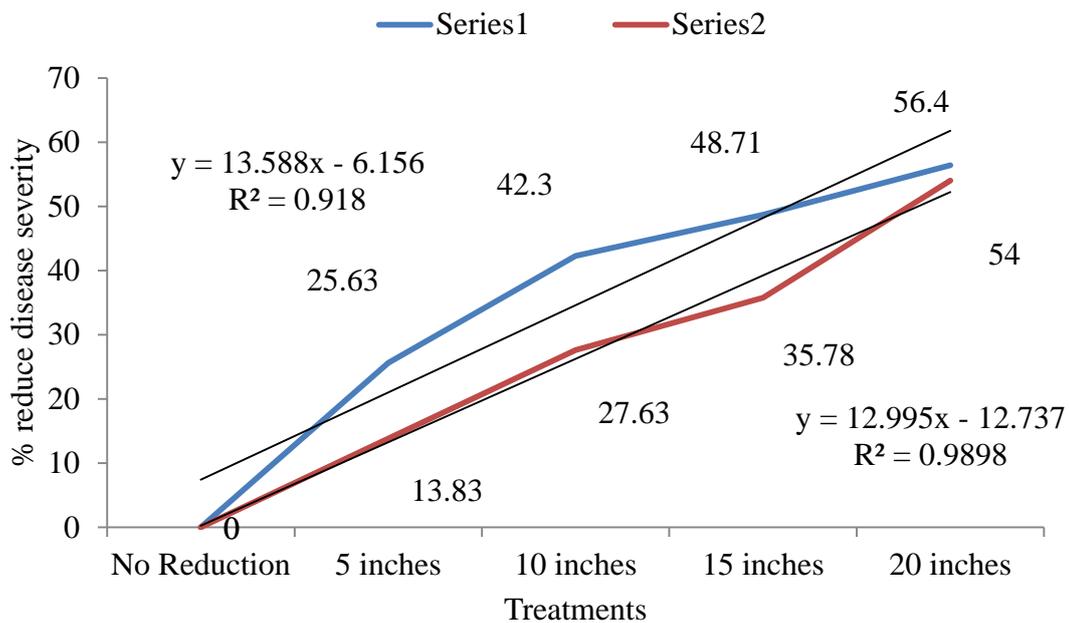


Figure 1: Showing the impact of leaf reduction on reducing the disease severity of Red rust and Black rot diseases.

Table 2 was revealed that, the highest yield of made tea was found in T<sub>3</sub> (10 inches) and this is statistically (P= 0.05) identical to T<sub>4</sub> and T<sub>5</sub>. Though 19.83% yield was found to be increased over the control in T<sub>5</sub>, but also numerically the yield was decreased from T<sub>4</sub>. By the reduction of very old leaves there were positive regression coefficients of 0.9087 and 0.7917 of Red rust and Black rot respectively for increasing the yield (Table 2). The experiment will be continued.

Table 2: Yield of made tea ( $\text{kg ha}^{-1}$ ) against different treatments of leaf reduction (2020)

Treatments	Yield of made tea ( $\text{kg ha}^{-1}$ )	% Increased over the control	Regression between yield and disease severity	
			Red rust	Black rot
T <sub>1</sub> = Control (No leaf reduction)	1,788.00 c	00	-1.37868	-1.74623
T <sub>2</sub> = 5 inches (12.70 cm)	1,896.00 b	6.04	P= 0.0120	0.0432
T <sub>3</sub> = 10 inches (25.40 cm)	2,125.50 a	18.87	R <sup>2</sup> = 0.9087	R <sup>2</sup> = 0.7917
T <sub>4</sub> = 15 inches (38.10 cm)	2,168.70 a	21.29		
T <sub>5</sub> = 20 inches (50.80 cm)	2,142.60 a	19.83		

**(4) Title: Reduction of weed infestation through integrated weed management practices in mature tea plantations.**

Objectives:

1. To reduce the intensity of tea weeds with different components
2. To find out the effect of different integrated approaches on tea production.

Progress:

Table 1 showing that T3 provides maximum weed reduction percentage (67%) over the control which is followed by T5, where weed reduction percentage is 63.46%. T5 is followed by T2 and T4, where weed reduction percentage is 34.23% and 29.60% over the control for the study period. It can be concluded that, after chilling operation, application of Indaziflam and Paraquat provide the maximum weed reduction percentage and provide maximum time of weed free condition as well.

Yields found from different treatment combination shows that higher mean yield (1837 kg/ha) was obtained from T3 which is following by T5, Where the mean yield is 1785 kg/ha (Table 2). Yield found from the treatment T5 was followed by the yield from the treatment T4 (1716 kg/ha) & T2 (1691 kg/ha). The lowest yield (1605 kg/ha) was obtained from T1, where regular practice was done. From this result it was revealed that highest yield was obtained from T3 which is 14.45% over the control.

The figure 1 illustrates that, there is a fairly strong negative relationship between weed growth% and mean yield kg/plot parameter. If weed growth percentage reduces, there is an upward movement of yield parameter & if the weed percentage parameter increases, there is a downward movement of yield parameter.

Table 1: Growth of weeds in percentage over the different treatment combination

Treatments	Weed growth%	Reduction of weed growth% over the control
T <sub>1</sub> = Control	54.16 c	00
T <sub>2</sub> = Chilling (Mechanical control) + Pendimithalin (pre-emergent herbicide) + paraquat (post-emergent herbicide)	35.62 b	34.23%
T <sub>3</sub> = Chilling (Mechanical control) + Indaziflam (pre-emergent herbicide) + Paraquat (post-emergent herbicide)	18.00 a	67%
T <sub>4</sub> = Simultaneous application of Pendimithalin + paraquat + Sickling	38.125 b	29.60%
T <sub>5</sub> = Simultaneous application of Indaziflam + paraquat + Sickling.	19.79 a	63.46%

Table 2: Yield gained from different treatment combination

Treatments	Mean yield of green leaf (kg/ plot)	Mean yield of green leaf (kg/ ha)	Mean yield of made tea (kg/ ha)
T <sub>1</sub>	11.16 c	6,980 c	1,605 c
T <sub>2</sub>	11.76 b	7,350 b	1,691 b
T <sub>3</sub>	12.78 a	7,988 a	1,837 a
T <sub>4</sub>	11.94 b	7,463 b	1,716 b
T <sub>5</sub>	12.42 a	7,763 a	1,785 a
LSD at 5% level	0.56		
CV	1.75		

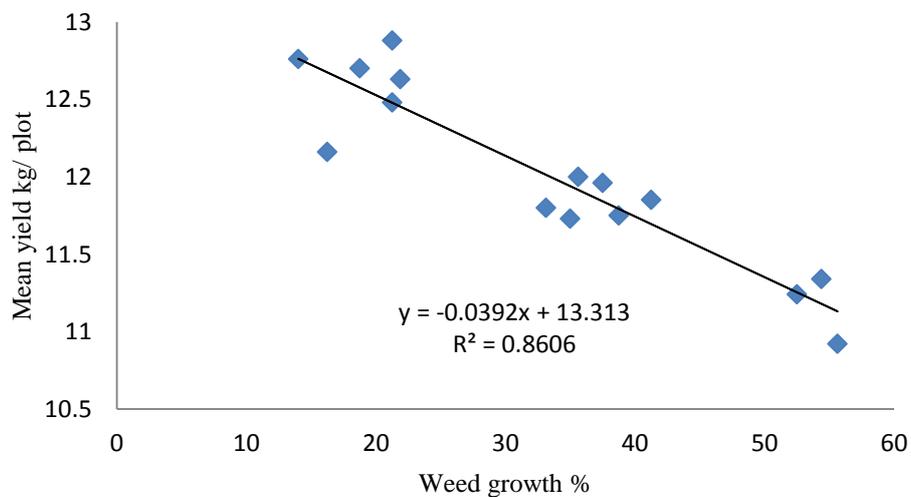


Fig 1: Correlation between weed growth% and mean yield kg/plot

**(5) Title: Studies on Integration and Economics of Nitrogen fertilizer and Integrated Weed Management in young mature tea.**

**Objectives:**

1. To optimize of N fertilizer rate for young tea in different growth stages of weeds.
2. To find out the effect of different N rates on tea- weed competition.
3. To determine the economical weed control method in young tea.

**Progress:**

The lowest and statistically ( $P= 0.05$ ) similar weed density was found in an interaction effect of  $W_3$  (Paraquat) and  $W_4$  (Glyphosate) with all doses of fertilizer. It reflects that only Paraquat and Glyphosate have impact of reducing the weed density (Table 1). Weed height in same trends of treatments. There is a great effect of Glyphosate with  $F_2$  and  $F_3$  were found on the highest plant height of tea bushes (91- 93 cm). In case of number of shoots of tea bushes varied from 15- 19. Statistically ( $P= 0.05$ ) similar effect on number of tea shoots were found in all combination of treatments (Table 1). The experiment will be continued.

Table 1: Showing the interaction effects of fertilization and weed management on the weeds and development of tea bushes.

Treatments		Parameters			
Main treatment (Fertilizer)	2nd Treatment (Weed control)	Weed density $ft^{-1}$ ( $929cm^{-1}$ )	Weed height (cm)	Plant height (cm)	No. of shoot
$F_1$ = Urea: 250 kg, TSP: 92 kg MOP: 123 kg	$W_1$ = Control	119.40 a	37.000 a	80.400 d	16.000 a
	$W_2$ = H.W	22.60 b	21.800 b	84.400 abcd	19.000 a
	$W_3$ = Paraquat	13.40 cd	12.400 cde	87.800 abcd	16.600 a
	$W_4$ = Glyphosate	8.00 d	8.600 de	91.000 ab	16.600 a
$F_2$ = Urea: 330 kg, TSP: 110 kg MOP: 200 kg	$W_1$ = Control	114.80 a	24.200 b	80.400d	16.600 a
	$W_2$ = H.W	19.90 b	23.800 b	85.200 abcd	17.000 a
	$W_3$ = Paraquat	13.20 cd	13.400 cd	81.800 cd	15.400 a
	$W_4$ = Glyphosate	12.20 cd	7.000 e	93.000 a	17.200 a
$F_3$ = Urea: 370 kg, TSP: 123 kg MOP: 250 kg	$W_1$ = Control	118.80 a	14.600 c	88.000 abcd	17.200 a
	$W_2$ = H.W	23.20 b	25.800 b	83.400 abcd	15.800 a
	$W_3$ = Paraquat	18.60 bc	14.000 cd	89.600 abc	16.600 a
	$W_4$ = Glyphosate	6.20 d	7.600 e	92.000 ab	17.400 a

**(6) Title: Screening of new fungicides and herbicides against different diseases and weeds in tea.**

Objectives:

- To evaluate and standardize new fungicides and herbicides against different tea diseases and weeds.

Progress

A total of seventeen fungicides and eleven 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.

**(3) OTHER ACTIVITIES**

A total of Twenty eight (28) advisory visits were paid to different tea estates to identify and render advice on specific disease and weeds problem and thirty one (31) correspondences issued to different tea estates in respect of identification of various diseases and their control measures during the reporting year. Twenty-seven (27) experimental visits were made with particular preference to experimental data collection in tea estates. Besides, three (03) official visits were paid by the scientists of the division to different organizations for official purposes.

The scientific personnel of the division delivered lectures on tea disease and weeds management at annual courses held at BTRI main station, Srimangal.

No workshop was carried out during the reporting year. Three (3) hours lecture was paid to MTC module on tea disease and weed management. There are two scientific research articles were published during the reporting year. There are twenty eight different groups of fungicides and herbicides were standardized also in same year.

## STATISTICS & ECONOMICS DIVISION

**Dr. Shefali Boonerjee**

Senior Scientific Officer

### STAFF

Dr. Shefali Boonerjee, Senior Scientific Officer joined on 23<sup>rd</sup> June 2015 in this Division. 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 two experiments running in this division regarding economic efficiency of tea production and evaluation of technologies. The present situation of these experiments is summarized below.

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

SE1.1. Economic efficiency of the test clones of BTRI. This experiment has undertaken to evaluate the economic efficiency of the test clones from which commercial clone (s) will be released. The economic performance is needed to be understood before commercial release of a clone. The test clones are examined in the experimental plots for 10 to 12 years to study the different performances of yield, quality, stress tolerance etc. Along with these attributes the economic performance is also needed to be understood before commercial release of the elite clones. The Study of economic performance in the controlled condition of the experimental plots for 10-12 years are enough to estimate the profitable efficiency of these clones in future.

With the view of importance, the experiment has been started at November 2018. Initially 2 experimental plots of BTRI farm have been selected for data collection which are named as Bt. 40 and Bt. 43. The data from both the plots regarding green leaf production, expenditure of worker's wages and other cultural operations are being collecting. The secondary data collection of production and approximate expenditure of last 10 years is also going on.

#### Objectives

- Study the economic efficiency of the test clones in respect of yield.
- Find out the economic efficient test clone(s) comparing internal rate of return.
- Use of economic performance as a parameter for suitable selection of significant clone(s).

**Progress:** Data from both the plots regarding green leaf production, expenditure of worker's wages and other cultural operations are being collecting. The secondary data collection of production and approximate expenditure of last 10 years is also going on. The collected data of production and expenditure were summarized and presented in the Table 1, 2, 3 & 4.

Table 1. Total expenditure and labor wages in different cultural practices (2020) in experiment Bt. 43.

**Table 1. Test clones/clone wise production and comparative cost of different cultural practices (2020) in experiment Bt. 40**

Clones/Test clones	Production (kg)	Cost of cultural operation (Tk.)						
		Plucking	Fungicide &weedicide	Insecticide	Fertilizer	pruning	Other works	Total cost
T1	-	-	45.41	124.51	105.85	102.85	34.28	412.9
T2	75400	432.00	45.41	124.51	105.85	102.85	34.28	844.90
T3	68100	432.00	45.41	124.51	105.85	102.85	34.28	844.90
T4	76300	432.00	45.41	124.51	105.85	102.85	34.28	844.90
T5	78650	432.00	45.41	124.51	105.85	102.85	34.28	844.90
T6	71150	432.00	45.41	124.51	105.85	102.85	34.28	844.90
T7	92500	432.00	45.41	124.51	105.85	102.85	34.28	844.90

**Table 2. Benefit cost analysis of Expt. Bt 40.**

Clones/Test clones	Green Leaf Production	Made Tea Production	Cost per kg	Total cost	Total Benefit	BCR
T1	46100	10603	180.9	1918082.7	2120600	1.1056
T2	68950	15858.5	180.9	2868802.65	3171700	1.1056
T3	66100	15203	180.9	2750222.7	3040600	1.1056
T4	69900	16077	180.9	2908329.3	3215400	1.1056
T5	65800	15134	180.9	2737740.6	3026800	1.1056
T6	67800	15594	180.9	2820954.6	3118800	1.1056
T7	77050	17721.5	180.9	3205819.35	6202525	1.9348

**Table 3. Total expenditure and labor wages in different cultural practices (2020) in the experiment Bt. 43**

Clones/Test clones	Production (kg)	Cost of cultural operation (Tk.)						
		Plucking	Fungicide &weedicide	Insecticide	Fertilizer	pruning	Other works	Total cost
T1	46000	518.80	68.12	137.39	100.0	120.0	48.00	992.31
T2	30550	508.80	68.12	137.39	100.0	120.0	48.00	992.31
T3	50800	508.80	68.12	137.39	100.0	120.0	48.00	992.31
T4	50550	508.80	68.12	137.39	100.0	120.0	48.00	992.31
T5	32250	508.80	68.12	137.39	100.0	120.0	48.00	992.31

**Table 4. Benefit cost analysis of Expt. Bt 43.**

Clones/Test clones	Green Leaf Production	Made Tea Production	Cost per kg	Total cost	Total Benefit	BCR
T1	56660	13031.8	180.9	2357452.62	2606360	1.1056
T2	32250	7417.5	180.9	1341825.75	1483500	1.1056
T3	61800	14214	180.9	2571312.60	2842800	1.1056
T4	56950	13098.5	180.9	2369518.65	2619700	1.1056
T5	46650	10729.5	180.9	1940966.55	2682375	1.3820

NB: The experiment plots are same in size and the conditions are controlled. The expenditure divided equally into the plots of corresponding test clones

## SE 2: EVALUATION OF TECHNOLOGIES.

SE 2.1. Adoption of BTRI Innovated 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 and made a great impact on the tea industry providing these technologies. Bangladesh tea has increased its productivity remarkably from the last few decades. One of the reasons behind such improvement is the utilization of scientific technologies like superior planting materials, authentic control measures of pest and disease management, proper agronomic practices, increase of soil fertility and pH control etc. BTRI has so far released 20 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 has been explored. The collected data of total 144 gardens were summarized according to valley wise and management wise adoption of clone plantation. From the result it was observed that, about 41.64% land of total tea area of the 7 valleys is occupied by clonal plantation with the average production of 1607.48 kg/ha. The use of BT and TV clones were 45.05% and 40.20% with the average production of 1591 and 1667 kg/ha respectively. Among the valleys, the highest BTRI released clones were adopted by Chittagong valley which is 74.62% of their clone area. After then the higher percentage of BT clones were planted in Luskerpur valley (68.31%) followed by North Sylhet (51.79%), Lungla (51.28 %), Monu-Doloi (48.78 %) and Juri (47.69%) valley of their clone area respectively. The Balisera valley has the lowest (35.63%) clone area of which only 21.82% is occupied by BT clones. In case of different managements, it was observed that about 60% to 65% of clone area of NTC, New Sylhet TE Ltd. and Deundi Tea Co. Ltd. was planted with BT clones. The Duncun Brothers (BD) Ltd. and Finlay were also used BT clones which was 30.22% and 8.35% of their total clone areas (Table 5). Beside BT clones, the clone areas

were planted by TV clones along with some other introduced or garden clones. The data on using of cultural practices like pruning cycle, plant to plant spacing, pests and disease control measures were also collected in the same time through the questionnaire from the estates and the results are under analyzing. From the study, the percentage of clone plantation was also observed in BTB managed gardens (Table 6).

**Table 5. The clone plantation in the gardens under different management.**

Management	TEs	Seedling % of total tea are		Clone area (%) of total tea area				
		Area (%)	Av. yield (kg/h)	Total clone area (%)	BT %	Av. yield of BT area (kg/h)	TV %	Av. yield of TV area (kg/h)
Finlays	7	63.76	1425	35.3	8.35	1500	72.2	1900
NTC	11	47.43	886	50.48	61.95	1416	32.9	1417
BTB	3	56.00	864	41.41	57	1386	42.81	1291
Duncun	16	61.22	1338.5	33.64	30.22	1695	41.93	1950
Deundi Tea Co. Ltd.	4	53.60	1215	46.40	60.55	1533	40	1500
The New Sylhet TE Ltd.	1	14.90	1200	85.09	65.55	1800	26.75	1700

**Table 6. Clone plantation in BTB managed gardens.**

Garden name	Total tea area (ha)	Total clone area (%)	BT clones (%)	TV clones (%)	Average production (kg/ha)
Deuracherra	430.97	40.18	58.26	41.74	1175
New Samanbagh	472.1	45.75	53.70	46.30	1350
Patharia	395.81	41.43	54.88	45.12	1500

## STATISTICS

### 1. Estimation of Annual Crop for 2021:

#### A. Annual crop forecasting using theoretical production of last year

Suppose actual production up to August 2021 is 52.148 million kilograms. What would be the estimated production for 2021?

$$\begin{aligned}
 \text{Estimated production} &= \frac{\text{Actual production up to the month (August 2021)} \times 100}{\text{Theoretical \% production to the month (2020)}} \\
 &= \frac{52.148 \times 100}{52.443} \\
 &= 99.44 \text{ million kg}
 \end{aligned}$$

B. Annual crop forecasting (2021) using time series data (last 20 years) was done.

**Methodology**

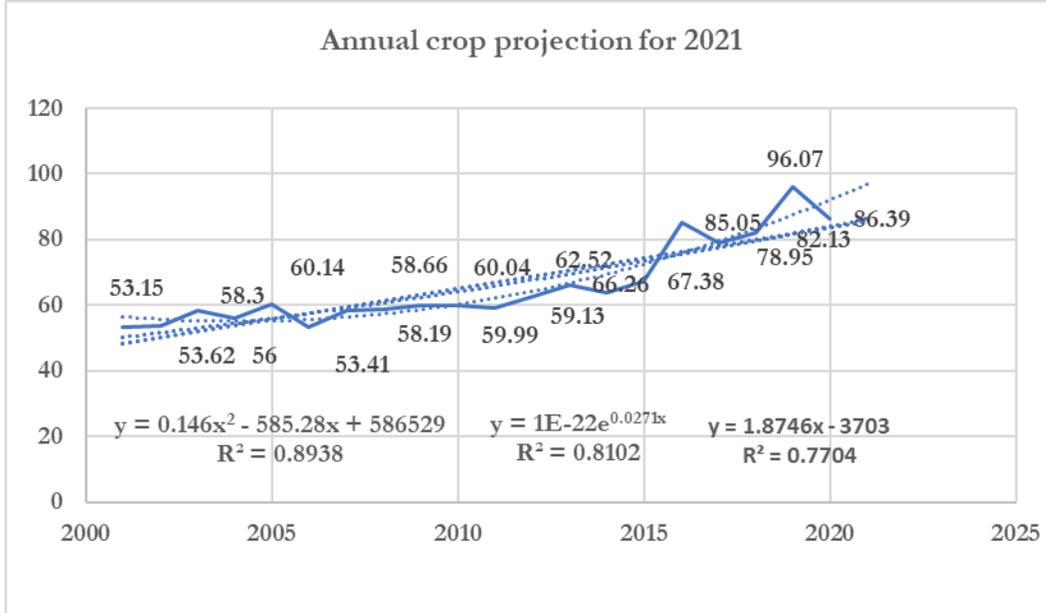
- Correlation analysis for assessing the relationship of forecasted year and other observed last year's production
- Regression analysis for dependency analysis and forecast crop production
- Trend analysis of time series data
- Linear, Polynomial and Exponential Growth Model

**Table 7. Correlation regression analysis using last 20 years data for forecasting the tea crop of 2021**

Sl	Year	Production (Mkg)	linear (0.62)	Polynomial (.7557)	exponential (.673)
1	2001	53.15	51.4615	56.5187	52.24120275
2	2002	53.62	52.731	55.7654	53.2858868
3	2003	58.3	54.0005	55.3011	54.35146174
4	2004	56	55.27	55.1258	55.43834532
5	2005	60.14	56.5395	55.2395	56.54696366
6	2006	53.41	57.809	55.6422	57.6777514
7	2007	58.19	59.0785	56.3339	58.83115186
8	2008	58.66	60.348	57.3146	60.00761724
9	2009	59.99	61.6175	58.5843	61.20760878
10	2010	60.04	62.887	60.143	62.43159692
11	2011	59.13	64.1565	61.9907	63.68006156
12	2012	62.52	65.426	64.1274	64.95349214
13	2013	66.26	66.6955	66.5531	66.25238791
14	2014	63.88	67.965	69.2678	67.57725813
15	2015	67.38	69.2345	72.2715	68.92862219
16	2016	85.05	70.504	75.5642	70.30700992
17	2017	78.95	71.7735	79.1459	71.71296171
18	2018	82.13	73.043	83.0166	73.14702876
19	2019	96.07	74.3125	91.8763	74.60977331
20	2020	86.39	75.582	91.625	76.10176884
21	2021	?	76.8515	<b>96.3627</b>	77.62360027
SD		12.63562887	7.87704035	13.27483057	7.868345685
Mean		65.963	63.522	65.835	63.464

Standard deviation close to original time series indicated good estimated model.

**Graph 1: Yield trend in correlation regression analysis using last 20 years data for forecasting the tea crop of 2021**



In the correlation regression analysis using time series data, three observations were found in Polynomial (96.362), Exponential (77.62) and linear (76.851) model for the estimation of annual crop of 2021. In Polynomial model the estimated data was found more relevant to last 20 years examined production data along with the closer SD value of time series data. So, the estimated crop for 2021 will be **96.362** million kg. (NB. The analysis was done depending only on the yield parameter of the last 20 years. The climatic factors (e. g. rainfall parameters, temperature, RH, day length, wind velocity etc.) along with the pest and disease infestations are directly influence the yield of crop as well as the projection.

**Conclusion:** Correlation analysis using time series data showed estimated production of 96.362 M. Kg tea for the year 2021, whereas the analysis with actual production of the passing months of the year 2021 showed the result of 99.44 M. Kg tea. The forecasted production is nearly same in case of both analyses. However, the difference showed in these analyses is may be for the influences of environmental and other related factors over the production of crop in 2021. So, the forecasted crop for 2021 from regression co-relation analysis (96.362 M kg.) will be appropriate.

**2. Estimation of Cost of Production (COP) for the crop of BTRI farms (BEF, BTRI and Kality) in 2020:** The cultivation cost and the factory cost of 2020 of BTRI farms has determined. The summary of the estimation has given below.

**Table 8. Production and per kg cost of green leaves and made tea produced in BTRI Farms in 2020**

Item	BEF	BTRI	Kality	Total
Produced Green Leave (Kg.)	630420	76006	39983	746409.00
Produced made Tea (Kg)	146041	17530	9260	172831.00
Field Cost/Kg (Tk)	29.60*4.5	37.0*4.5	25.42*4.5	30.67(Avg.)
Others cost/kg	2.11	-	2.97	2.54
Factory Cost/Kg (Tk)		34.90		34.90
Cost of made tea/ Kg (Tk)	170.21	201.4	152.26	174.62 (Avg.)

(N. B. Nursery cost, extension cost and staff salary were excluded)

$$\begin{aligned} \text{Total Field cost (Tk.)} &= 19981663.00 + 2831723.00 + 1135775 \text{ (BEF + BTRI + Kality)} \\ &= 23931161.00 \end{aligned}$$

$$\text{Total factory cost (Tk.)} = 6032908.95$$

$$\text{Total cost (Tk.)} = 23931161.00 + 6032908.95 = 29964070.00$$

$$\text{Total return (Tk.)} = 30221228.66 \text{ (Selling price of total made tea @174.86 Tk.)}$$

$$\text{Total Income (Tk.)} = 257158.70$$

$$\text{BCR (\%)} = (\text{Total Return} / \text{Total Cost}) \times 100$$

$$= (30221228.66 / 29964070.00) \times 100 = 100.8$$

(Benefit Cost Ratio is greater than 1, i. e. 100.8%, shows the profitable condition of the farms.)

**Table 9. Tea Production, Internal Consumption, Export and Import of Bangladesh**

Year	Production (Mkg)	Internal Consumption (Mkg)	Export (Mkg)	Import (Mkg)
2001	53.15	36.95	12.92	-
2002	53.62	41.50	13.65	-
2003	58.30	37.44	12.18	-
2004	56.00	43.33	13.11	-
2005	60.14	43.30	9.01	-
2006	53.41	40.51	4.79	-
2007	58.19	46.27	10.56	-
2008	58.66	52.12	8.39	-
2009	59.99	53.74	3.15	4.5
2010	60.04	57.63	0.91	6.0
2011	59.13	58.50	1.47	7.0
2012	62.52	61.19	1.50	8.5
2013	66.26	64.00	0.54	11.6
2014	63.88	67.17	2.66	6.9
2015	67.38	77.57	0.54	10.68
2016	85.05	81.64	0.62	8.83

2017	78.95	85.93	2.56	6.29
2018	82.134	90.45	0.643	7.45
2019	96.07	95.20	0.60	2.73
2020	86.394	95.02	2.17	0.68

Source: BTB

**Table 10. Month wise tea production (Mkg) of last five years in Bangladesh**

Month	Production (mkg)					
	2015	2016	2017	2018	2019	2020
January	0.104	0.093	0.157	0.331	0.495	0.175
February	0.006	0.013	0.016	0.038	0.114	0.026
March	0.475	2.506	1.152	1.556	1.917	1.625
April	3.083	5.096	4.382	3.505	6.110	2.356
May	5.510	6.445	5.934	6.334	7.645	8.655
June	6.945	11.227	8.584	7.634	11.667	8.963
July	9.391	11.395	11.206	10.985	11.104	12.178
August	9.851	11.182	10.648	12.477	13.505	11.321
September	9.218	12.716	9.784	12.008	13.382	12.144
October	9.746	10.907	11.464	11.863	13.407	11.486
November	7.844	9.000	9.075	9.147	10.300	10.495
December	5.205	4.470	6.547	6.256	6.423	6.961
Total	67.378	85.05	78.95	82.134	96.069	86.394

Source: BTB Monthly Bulletin

## OTHER ACTIVITIES

### Annual Returns of BTB and BCS

The annual returns of BTRI farm including Bilashcherra experimental farm and sub stations on land use, tea seeds, plants and tea waste and also on employment and employment cost (BTB return Form No. 1 & 3) were prepared for the period of 2019 and sent to BTB. The annual statistical return of manpower and labor welfare and on tea garden land (BCS form No. 2 & 3) of BTRI farms including sub stations for 2020 had also sent to BCS office, Dhaka.

### Courses on tea culture

The Scientific personnel of the division delivered lectures on tea Statistics and Economics at 55<sup>th</sup> Annual Course of BTRI held at BTRI Main Station, Srimangal.

### Advisory visits

In 2020, a total of fourteen (14) conjoined advisory and monitoring visits were paid by the scientific personnel of the department to different tea estates and rendered advice as per the estate's requirements. Advisory correspond letter and report were issued according to the visit.

**BILASHCHERRA EXPERIMENTAL FARM**

BTRI, SREEMANGAL

In Charge: A.K.M Ashraful Haque

**STAFF**

There was no other change in the staff position during the 2020.

**FARM****Table 1.** Land Distribution

Sl. No.	Description	Area (ha)
	Tea cultivated area	121.56
	I. Plucking Area	
	1. Immature Tea (under 5 years)	11.15
	2. Tea bushes 6 to 10 years	06.40
(a)	3. Tea bushes 11 to 40 years	36.91
	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, Fallow and Waste Land	57.44
	<b>Total Area of the Farm</b>	<b>228.36</b>

**Table 2.** Crop Production 2020

Black Tea		Green Tea		Total	Total Made	Tea	Average Production
Green Leaf (kg)	Made Tea (kg)	Green Leaf (kg)	Made Tea (kg)	Green Leaf (kg)	Tea (Black Tea+ Green Tea)	cultivated area (In 2018)	(Made Tea/Tea cultivated area in 2018)
630406	146041	2160	463	632566	146504	110.64	1324.15

**Table 3.** Green leaf Production of the Farm in the Year 2020

Name of the Month	Month-wise crop production in 2020 (kg)		
	Green Leaf for Black Tea	Green Leaf for Green Tea	Grand Total
January	0	0	0
February	0	0	0
March	2884	0	2884
April	15372	0	15372
May	62726	207	62933
June	79631	277	79908
July	113190	657	113847
August	96738	238	96976
September	89223	428	89651
October	57192	177	57369
November	89925	176	90101
December	23525	0	23525
<b>Total</b>	630406	2160	632566

**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)
917	All seeds were sent to BTRI		-	-

### Extension and Development

It has a nursery with the average capacity of 100000 plants. Water supply, labor houses, roads and bridges were regularly maintained. 7425 tea saplings were infilled in section no 3 and 14650 tea saplings were infilled in section no 12 in the year 2020 and . 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 Fatickchari Sub-station  
Chattogram**

**Personnel**

Mr. Md. Moshir Rahman Akonda (Scientific Officer, Plant Pathology Division) performed his duties as Officer-In-Charge during the reporting year. Md. Rayhan-Ur-Rahaman (Scientific Officer, Botany division) transferred from the Sub-station to BTRI, Srimangal on 13 August 2020. However, Mr. Ajit Chandra Chowdhury (Senior Farm Assistant) and Mr. Md. Kamal Hossen (Upper Divisional Assistant) carried out their responsibilities as in before, consecutively.

**Production of green leaves**

During the year, about 65,921 Kg of green leaves were plucked from the existing tea plantation and sold to Kaiyacherra Dolu Tea Estate @ Tk. 36 per Kg.

**Distribution of improved planting materials**

About 12, 48,200 no. of fresh cuttings were collected from the mother bush area and 810 Kg of bi-clonal tea seeds were harvested from the Seed-bari of the sub-station. The materials were distributed to the different tea gardens, small tea growers and Chattogram Hill Tract project (CHT), Bandarban.

**Infilling Program**

About 27,768 tea saplings were planted to fill the vacancies in the existing young tea plantation during the reporting year.

**Soil Analysis**

The Sub-station received around 150 no. soil samples from different tea gardens for analysis during the period.

**KALITI SUB-STATION**

**Kulaura, Moulvibazar**

**STAFF**

During the reporting year 2020, there was no change in personnel position of the sub-station.

**PRODUCTION**

Year	Production of green leaf (kg)	Fresh cutting supplied to different Tea Estates (No.)	Tea plants raised in the nursery (No.)
2020	39,983*	There was no demand of fresh cutting from Tea Estates during the reporting year to the sub-station.	7,000**

\*Produced green leaves were sent to BTRI Black Tea Factory for manufacturing.

\*\*Plants raised in the nursery mainly used for infilling in vacancies of the sub-station.

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

Suman Sikder

Senior Planning Officer &amp; Project Director

Senior Tea Maker Mr.Md. Amir Ali, B.Sc. (RU), Bangladesh Tea Research Institute Joined BTRI SUB-Station Bandarban on 2019. There were no other changes in the personnel position of the Sub-station during the reporting year.

**Extension Progress**

There was a total no. of small grower under registration 328, No. of small grower under tea cultivation 115, total land under tea cultivation 520 Acre in the year 2020. Provided technical support all over the year to small holding tea growers. Co-ordinated sales of green leaves all over the year.

**Works under the Project**

1. Given newly registration small tea grower 193 N0s.
2. Tea sapling raised 10.50 lac.
3. Land lease for tea sapling production 2.38 Acre.
4. Training of different topics such as tea plantation, land preparation, pruning, plucking, disease and pest management, Total no. of farmer 775 under 31 batches.
5. Necessary repairing of the office building has been done in the reporting year.
6. Proper maintenance of mother bush plot around the year.
7. Made tea processed from factory 5650 kg in 2020.

**BTB REGIONAL STATION, PANCHAGARH****Dr. Mohammad Shameem Al Mamun**

Senior Scientific Officer (Entomology)

&amp;

Project Director, Northern Bangladesh Project

**STAFF**

Mr. Md. Amir Hossain, Development Officer, PDU transferred from BTB-CHT Project, Banderban and joined on 19 July 2020 at BTB Regional station, Panchagarh. Mr. Md. Nasir Uddin, Accountant, BTRI was transferred from BTRI, Srimangal and joined on 15 July 2020 at BTB Regional station, Panchagarh. Mr. Yasin Arafat, Stenotypist, BTRI transferred from BTB Regional station, Panchagarh to BTB, Head Office, Chattagram on 16 July 2020. Mr. Md. Mominul Islam Khan, Driver was resigned from BTB on 3 December 2020. There was no other change in the personnel position of the BTB Regional station, Panchagarh during the period under report.

**Statistical Information**

In 2020, 10 registered and 17 unregistered tea gardens and 7,310 small scale tea gardens in the plains of North Bengal (Panchagarh, Thakurgaon, Lalmonirhat, Dinajpur and Nilphamari) produced a total of 10.30 million kg of made tea. In other words, 11.92 percent tea has been added to the national production from the tea plantations in the northern plains. In 2020, tea has been cultivated on a total of 10,170.57 acres of land in five districts of Northern Bangladesh. A total of 5,12,83,386 kg of green tea leaves have been produced from these tea gardens, from which 10.30 million kg of made tea has been produced in 18 running tea factories of Panchagarh and Thakurgaon which is the highest record of tea industry in North Bengal. In 2019, the area under tea cultivation in North Bengal was 8,680.86 acres and the amount of tea production was 9.60 million kg. Compared to the previous year, the cultivation of tea has increased by 1,489.89 acres and 7.11 lakh kg more tea has been produced in 2020. A total of 32 tea factories have been approved from Bangladesh Tea Board in Panchagarh, Thakurgaon and Lalmonirhat districts upto December 2020.

**Development Project**

A development project entitled “Extension of Small Holding Tea Cultivation in Northern Bangladesh” under Bangladesh Tea Board, Ministry of Commerce funded by Bangladesh Tea Board Own Fund as Overseas Development Assistance (ODA) and European Commission (EC) Revolving Fund was implemented at BTB Regional Station, Panchagarh since September 2015. The total budget allocation of the project is 740.00 lakh taka. The duration of the project is September 2015 to June 2021. 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 lakh tea saplings of appropriate clone/variety at the cheapest rate to the tea growers of that locality each year. About 538.77 hectare of lands was extended and 1,133 small tea growers were registered under this project. About 9.75 tea saplings were raised in the nursery and 8.21 lac tea saplings have been distributed to the registered small grower at the subsidized rate @ Tk. 2.00/Saplings upto December 2020. A total of 230 pruning knives and spray machines were distributed at free of cost to the registered marginal farmers in the project area upto December 2020. The financial and physical progress of the project is 81.76% and 77.80%, respectively. The project will be completed in June 2021.

### **Advisory visit**

A total of Two hundred twenty five (225) advisory visits were paid to different tea gardens and small tea growers' gardens in northern Bangladesh (Panchagarh-98, Thakurgaon-51, Nilfamari-60 & Dinajpur-16) under BTRI, PDU, Northern Project and rendered advice on tea cultivation in scientific way during 2020. Thirty eight (38) samples of tea plants/plant parts were received from different small tea growers' garden in respect of identification of various pests, diseases, other nutrient deficiencies, and suggested their remedies during the reporting year.

### **Official visit**

A total of Eleven (11) official visits were paid to different organizations including Mymensingh, Jamalpur, Sherpur; BARC, Dhaka; Bangladesh Tea Board, Chattagram; and Ministry of Commerce, Dhaka.

### **Training/Workshop**

A total of Ten (10) training workshop were conducted by BTRI and PDU for small tea growers in Panchagarh, Thakurgaon, Nilfamari & Dinajpur on different aspects of tea culture under the umbrella of "Camellia Khola Akash School" during 2020. Besides, Twenty one (21) training/seminar/rally/motivation workshops were conducted for small tea growers at different upazillas under Northern Bangladesh Project during 2020.

### **Miscellaneous**

"Bangabandhu Tea Galley- an initiative of Mujib Centenary" was inaugurated at BTB Regional Office, Panchagarh by the Honorable Chairman, Bangladesh Tea Board Major General Md. Jahirul Islam, ndc, psc on 20 October 2020.

Major General Md. Jahirul Islam, ndc, psc, Chairman, Bangladesh Tea Board visited BTB Regional Station, Small scale tea gardens, Bought leaf tea factory and attended in a meeting of exchange of views with stakeholders of tea industry of Panchagarh on 20 October 2020.

The journey of “Camellia Open Sky School- a diverse initiative of Bangladesh Tea Board” was also began at Tetulia, Panchagarh on 25 October 2020 as per planned & instructed by Major General Md. Jahirul Islam, ndc, psc, Chairman, Bangladesh Tea Board. A total of 45 training session including manual/virtual were conducted under this programme.

## Other activities of the divisions during 2020

Sl.	Item	Soil Science	Botany	Agronomy	Entomology	Plant Pathology	St. & Eco.	Bio-Chemistry
01	No. of experiments	9	40	07	03	06	2	2
02	No. of experimental visits	38	8	80	90	27	15	6
03	No. of advisory visits	18	12	28	27	28	4	-
04	No. of advisory correspondence	203	94	09	17	31	5	-
05	No. of official visits	4	72	08	-	03	12	-
06	No. of soil, fertilizer & dolomite samples analyzed	3232	-	-	-	-	-	-
07	No. of nursery soil, water & cowdung samples analyzed for nematodes	-	-	-	-	-	-	-
08	No. of pesticide residue analysis (commercial)	-	-	-	-	-	-	-
09	No. of pesticide residue analysis (Experimental)	-	-	-	-	-	-	-
10	Physical test of pesticides in Lab.	-	-	-	10	-	-	-
11	No. of pesticides/ Weedicides tested in tea fields	-	-	-	15	28	-	-
12	No. of circulars/pamphlets/leaflets issued to T. E.	-	-	-	-	-	-	-
13	No. of workshop/seminar conducted	-	4	12	3	-	-	-
14	MTC module conducted (Hours/year)	10	16	12	-	3	-	-
15	Attended national seminar, conference, symposium & workshop	1	-	-	-	-	-	-
16	Attended international seminar, conference & symposium	-	-	-	-	-	-	-
17	Attended Training/Course	1	3	-	-	1	-	-
18	No. of research paper published	1	-	1	-	2	-	-
19	No. of Fresh cutting supplied	-	-	218000	-	-	-	-
20	No. of Rotted cutting supplied	-	358	50571	-	-	-	-
21	Biclinal seed supply to T. E.	-	769	-	-	-	-	-
22	Tea tasting	-	5	-	-	-	-	-
23	Received Tea Sample Tasting	-	1634	-	-	-	-	-