ANNUAL REPORT
2022

BANGLADESH TEA RESEARCH INSTITUTE
SRIMANGAL-3210, MOULVIBAZAR
An organ of
BANGLADESH TEA BOARD
171-172, Baizid Bostami Road
Nasirabad, Chattogram
www.btri.gov.bd

ANNUAL REPORT 2022

BANGLADESH TEA RESEARCH INSTITUTE
SRIMANGAL-3210, MOULVIBAZAR
An organ of
BANGLADESH TEA BOARD
171-172, Baizid Bostami Road
Nasirabad, Chattogram
www.btri.gov.bd

ANNUAL REPORT 2022

Published by	Director Bangladesh Tea Research Institute Srimangal-3210, Moulvibazar
Publisher's name	Dr. Md. Ismail Hossain
Published year	2022
Compiled by	Md. Riyadh Arefin Scientific Officer (Botany Division)
Cover and Design	Md. Riyadh Arefin Scientific Officer (Botany Division)
Printing press	**Obri Printing Artisan** **Station Road, Srimangal-3210, Moulvibazar**

RATE OF SUBSCRIPTION

Taka 250.00 per copy (Home)
US $ 15.00 per copy (Abroad)

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

CONTENTS

DIRECTOR'S REPORT
STAFF

The report of the technical staff shows the position as on 31 December 2022

Director : Dr. Md. Ismail Hossain
B.Sc .Ag.(Hons)
M.S in Crop Botany & Ph.D. (BAU)

TECHNICAL DIVISIONS

1. DEPARTMENT OF CHEMISTRY

Chief Scientific Officer : Vacant

A. SOIL SCIENCE DIVISION

Principal Scientific Officer	:	Ashim Kumar Saha B.Sc. (Hons), M.Sc (DU)
Senior Scientific Officer	:	Dr. Apu Biswas B.Sc. (Hons), M.S. (DU), PGD (India)
Senior Scientific Officer	:	Kanij Fatema Tuz Zohora B.Sc. (Hons), M.S. (CU)
Scientific Officer	:	Naim Mustafa Ali B.S. (Hons), M.S. (DU)
Scientific Officer	:	Farhana Jahan Chowdhury B.S. (Hons), M.S. (CU)
Scientific Officer	:	Shuva Das B.S. (Hons), M.S. (CU)

B. BIOCHEMISTRY DIVISION (Vacant)

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	:	Muhammad Abid Hasan Chowdhury B.S. (Hons), M.S. (CU)

2. DEPARTMENT OF CROP PRODUCTION

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

A. BOTANY DIVISION

Chief Scientific Officer	:	Dr. Md. Abdul Aziz B.Sc. (Hons), M.Sc. (RU) Dipl. (China), Ph.D. (RU)
Senior Scientific Officer	:	Md. Moshiur Rahman Akonda B.Sc.Ag. (Hons), M.S. (BAU)
Scientific Officer	:	Md. Riyadh Arefin B.Sc.Ag. (Hons), M.S. (BSMRAU)
Scientific Officer	:	Md. Rayhan-Ur- Rahaman B.Sc.Ag. (Hons.), M.S. (BSMRAU)
Scientific Officer	:	Selina Akther Lipa B.S. (Hons), M.S. (CU)
Senior Farm Assistant	:	Vacant

B. AGRONOMY DIVISION

Chief Scientific Officer	:	Dr. Toufiq Ahmed B.Sc.Ag. (Hons) M.S. (BAU), Ph.D. (Sri Lanka)
Principal Scientific Officer	:	Dr. Mohammad Masud Rana B.Sc.Ag. (Hons) M.S. (BAU), Ph.D. (China)
Senior Scientific Officer	:	Vacant
Scientific Officer (Transferred to Lalmonirhat Substation)	:	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

A. ENTOMOLOGY DIVISION

Principal Scientific Officer	:	Dr. Mohammad Shameem Al Mamun B.Sc.Ag. (Hons.), M.S. (BAU), PGD (India), Ph.D (SUST)
Senior Scientific Officer	:	Dr. Shovon Kumar Paul B.Sc.Ag. (Hons.) (KU), M.S. (BSMRAU)
Scientific Officer	:	Md. Jahangir Alam B.Sc.Ag.(Hons), M.S. (BAU)
Senior Farm Assistant	:	Md. Abul Kalam Azad Dip.-in-Agric. (Dhaka)

B. PLANT PATHOLOGY DIVISION

Principal Scientific Officer	:	Mohammed Syeful Islam B.Sc.Ag. (Hons), M.S. (BAU)
Senior Scientific Officer	:	Raihan Mujib Himel B.Sc.Ag. (Hons.), M.S. (BSMRAU)
Scientific Officer	:	Vacant

TECHNOLOGY DIVISION

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

BTRI SUB-STATION, FATIKCHARI, CHATTOGRAM

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

BTRI SUB-STATION, KALITI, KULAURA

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

BTRI REGIONAL STATION, PANCHAGARH

Officer in-charge	:	Md. Amir Hossain DO, PDU
Senior Scientific Officer	:	Mohammad Sayadul Huq M.Sc (NU)
Senior Farm Assistant	:	Md. Zayed Imam Siddique Dip.-in-Agric. (Rangpur)

BILASHCHERRA EXPERIMENTAL FARM

Officer in-charge	:	Md. Rayhan-Ur- Rahaman B.Sc.Ag. (Hons.), M.S. (BSMRAU) And Raihan Mujib Himel B.Sc.Ag. (Hons.), M.S. (BSMRAU)
Field Assistant	:	Ajit Kumar Sarker Dip.- in-Agric. (Mymensingh)
Field Assistant	:	Zobayer Ahamed Dip.- in-Agric. (Rangpur)

RESEARCH

This report reflects the research and other activities of the institute for the year 2022 starts from 1st January to 31rd December.

During the year under report, a total of 76 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 1899 advisory soil, paid soil, fertilizer, compost and others samples were analyzed during 2022.

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 germplasms 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 germplasms 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. 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 2022. A total of 12,35,400 fresh cuttings, 42202 rooted cuttings and 489 kg bi-clonal seeds were distributed to different tea estates in the year 2022. 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, seven 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 numerous experimental, advisory and official 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 2021' was published in 2022.

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. Md. Ismail Hossain)
Director (In-charge), BTRI.

SOIL SCIENCE DIVISION

Ashim Kumar Saha
Principal Scientific Officer

STAFF

Mr. Ashim Kumar Saha promoted as Principal Scientific Officer and Mrs. Kanij Fatema Tuz Zohora promoted as Senior Scientific Officer on 16 August 2022. One (01) Scientific Officer post was lying vacant during the period. Mr. Apu Biswas joined at BTRI on 20 November 2022 after completing his Ph.D. deputation period. There was no other change in the personnel position of the division during the period under report.

RESEARCH

A total of seven experiments were conducted during the year 2022 by Soil Science Division. Progress of the experiments is given below.

SS 1: EVALUATION OF PHYSICAL PROPERTIES OF SOME SELECTED TEA SOILS OF BANGLADESH & THEIR INFLUENCE ON CHEMICAL PROPERTIES & YIELD OF TEA

The life cycle of tea plant is long, yields tend to decline after four or five decades and plant death or stunted growth is a common occurrence in above 40-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 was helpful to assess the impact of long-term tea cultivation on soil physical properties and how it correlates with crop yield.

Methodology:

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

a) Texture
b) Structure
c) Bulk Density
d) Particle Density
e) Pore space %
f) Water Holding Capacity

Chemical properties were determined also. All the data was statistically analyzed by using standard statistical packages.

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

Duration: 2017-2022

Progress, 2022:

Table: 1. Valley wise Soil Physical Properties of different Tea Estates

Valley	Name of the tea estates	Texture	Structure	Color	Moisture %	Bulk density (gcm^{-3})	Particle density (gcm^{-3})	Pore space (%)	Water holding capacity %
Balisera	BTRI	SCL	SAB	Greenish Gray	17.16	1.85	2.4	22.92	70%
	BEF	SCL	SAB	Gray-Greenish Gray	22.73	1.89	2.28	18.86	64%
	Fyzabad	SL	SAB	Greenish Gray	20.65	1.65	2.31	28.86	65%
	Jagcherra	L	SAB	Gray	16.32	1.62	2.1	22.85	72%
	Mirzapore	SCL	G	Pale green	18.26	1.66	2.46	32.52.	72%
	Nurjahan	SL	SAB	Gray	12.58	1.66	2.46	32.52	78%
	Parkul	SL	SAB	Pale green	12.32	1.65	2.32	28.88	69%
Chattogram	BTRI Sub Station, Fatickchhari	SL	SAB	Light Brown-Gray	12.64	1.72	2.5	31.2	64%
	Bashkhali Substation	SCL	SAB	Light brown	9.65	1.70	2.43	30.04	56%
	Naseha	SL	G	Light brown	8.69	1.72	2.55	32.53	53%
	Neptune	SL	G	Light Brown-Gray	10.65	1.7	2.5	30.56	54.00%
	Oodaleah	SL	SAB	Gray-Light Olive Gray	15.22	1.74	2.58	32.56	54%
Juri	Bahadurpur	SCL	SAB	Grey	5.52	2.08	2.43	14.4	72%
	Fatehbagh	SL	SAB	Pinkish gray	22.18	1.62	2.5	35.2	80%
	Pallathal	SL to LS	SAB & G	Light Brown	1.23	2.01	2.54	20.87	68%
	Rajkie	CL	SAB & G	Gray	8.28	1.76	2.35	25.11	67%
	Rashidabad	SCL	SAB	Light Reddish brown	5.53	2.07	2.48	16.53	72%
	Sagurnal	CL	SAB	Pinkish gray	8.58	1.63	2.09	22.01	70%
Lungla	Amenabad	SL	SAB	Light reddish brown	15.64	1.6	2.4	33.33	72%
	Chandbagh	SL	SAB	Pale red	2.89	1.85	2.3	19.57	88%
	Etah	SL	G	Light Brown	2.44	1.55	2.6	40.39	68%
	Gazipore	SL to L	G	Pale Yellow	5.51	1.89	2.54	25.59	56%
	Karimpur	SCL	SAB	Pale red	9.68	1.5	2.64	43.18	59%
	Kality Sub Station	SCL	SAB	Light Brown	8.53	1.78	2.5	28.8	70%
	Monipur	SCL	SAB	Light Brownish Gray	17.61	1.76	2.64	33.33	60%
	Rehana	Cl	SAB	Pinkish white	21.93	1.63	2.46	33.74	76%
Luskerpore	Baikanthapore	CL	AB	Gray	10.74	2.2	2.5	12	54%
	Chandpore	SCL	SAB	Greenish Gray	8.23	1.52	2.35	30.82	65%
	Deundi	SCL	AB	Dark Gray	12	1.45	2.45	40.82	60%
	Luskerpore	SCL	SAB	Greenish Gray	5.23	1.75	2.41	27.34	58%
Monu Doloi	Phulbari	CL	AB	Pinkish gray	12.36	1.65	2.32	28.88	65%
	Srigobindpur	SCL	SAB	Pale green	16	1.87	2.27	17.62	80%
North sylhet	Affiffanagar	S	AB	Light Brown-Gray	12.64	1.72	2.55	32.55	65%
	Lackaturoa	S	G	Light brown	10.23	1.56	2.34	33.33	68%
	Mulnicherra	S	AB	Light brown	8.96	1.53	2.11	27.49	56%

* AB= Angular Blocky, CL= Clay Loam, G= Granular, L= Loam, LS= Loamy Sand, S=Sand, SCL= Sandy Clay Loam, SL= Sandy Loam, SAB= Sub Angular Blocky,

Table: 2. Valley wise Soil Chemical Properties of different Tea Estates

Valley	Name of the tea estates	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
Balisera	BTRI	5.04	0.95	0.14	12.07	77.89	105.62	32.41
	BEF	5.4	1.27	0.126	22.77	65.56	115.2	29.52
	Fyzabad	4.8	0.098	0.058	9.23	49.56	112.65	43.25
	Jagcherra	5.3	1.36	0.041	15.29	63.28	95.2	20.69
	Mirzapore	4.9	0.65	0.05	5.6	88.34	285.4	75.4
	Nurjahan	4.5	1.11	0.12	21.18	42.87	225.62	43.25
	Parkul	4.9	1.02	0.083	18.23	65.32	125.23	23.25
Chattogram	Bashkhali Substation	4.6	0.55	0.072	10.76	67.30	80.23	20.26
	Fatickchhari Sub Station	4.8	1.15	0.065	10.25	65.23	98.25	25.63
	Naseha	4.6	1.1	0.046	15.23	80.12	125.65	45.23
	Neptune	4.5	1.08	0.056	15.02	118.52	312.4	89.65
	Oodaleah	4.5	1.25	0.041	8.68	61.08	88.65	23.25
Juri	Bahadurpur	4.9	0.9	0.093	20.14	88.69	145.6	36.22
	Fatehbagh	4.8	1.11	0.115	32.15	62.48	207.6	32.52
	Pallathal	5.09	1.75	0.028	22.36	204.4	242.32	64.42
	Rajkie	4.5	1.04	0.016	23.14	61.08	156.32	22.36
	Rashidabad	4.8	1.69	0.171	56.88	141	358.2	71.04
	Sagurnal	4.5	1.03	0.105	9.32	36.25	98.02	19.68
Lungla	Amenabad	4.82	1.05	0.108	19.61	100.52	104.2	27.56
	Chandbagh	5.1	1.3	0.055	3.22	74.48	209.4	43.36
	Etah	4.8	1.03	0.105	75.27	74.78	109	21.36
	Gazipore	4.5	1.67	0.17	8.17	42.87	95.23	18.36
	Kality Sub Station	4.5	1.39	0.14	11.61	65.28	98.76	28.69
	Karimpur	5.1	1.13	0.117	22.01	55.64	194	26.52
	Monipur	4.7	1.62	0.164	28.17	129.71	102.36	35.68
	Rehana	4.6	0.7	0.074	8.66	145.81	98.63	29.32
Luskerpore	Baikanthapore	5.08	1.66	0.169	5.69	56.32	173.2	34.46
	Chandpore	4.9	1.11	0.12	10.15	56.88	179.62	32.65
	Deundi	4.62	1.37	0.14	4.22	90.48	207.6	24.52
	Luskerpore	4.4	0.65	0.058	9.87	102.32	86.35	15.29
Monu Doloi	Phulbari	4.9	1.14	0.115	12	66.24	169.36	23.65
	Srigobindpur	4.8	1.25	0.17	22.36	44.4	72.32	34.42
North Sylhet	Affiffanagar	4.6	1.41	0.141	8.74	135.31	105.98	29.62
	Lackaturoa	5.3	0.76	0.032	16.52	39.34	184.2	16.69
	Mulnicherra	5.2	0.89	0.014	7.95	27.43	203.4	21.59

105 soil samples were collected from 35 different Tea Estates of 7 Valley in Bangladesh. Soil texture, structure, soil color, soil moisture percentage, bulk density, particle density, pore

space & water holding capacity and some chemical properties were determined (Table 2). Soil textural classes were ranged from sandy to sandy clay loam whereas soil structural classes were angular blocky to granular. Soil Color was ranged from light brown to dark grey. Bulk density, particle density, pore space and water holding capacity of soil were ranged from 1.5 to 2.08 gcm^{-3}; 2.11 to 2.64 gcm^{-3}; 12 to 43.08% and 53 to 88%, respectively. Generally uncompacted soils containing 50% pore space with a bulk density of 1.1 to 1.6 gcm^{-3} are ideal for agricultural soils. Soil minerals have an average particle density of 2.65 gcm^{-3}. Compacted soils have large bulk density of 1.5 to 1.8 gcm^{-3}. Sandy soils have larger bulk density than clayey soils because of smaller total porosity. Tea soil textural classes ranges from sandy to sandy clay loam. The physical properties of soils found in the experiment are within the critical ranges.

The highest pH value was 5.4 for Bilashcherra Experimental Farm and lowest pH was 4.4 for Luskerpore tea estate. The highest O.C and Total N were 1.69 and 0.171 for Rashidabad Tea Estate and lowest were 0.65 and 0.50 for Mirzapore Tea Estate, respectively. Available Phosphorous was highest (75.27 mg/kg) in Etah Tea Estate and the lowest (3.22 mg/kg) in Chandbagh Tea Estate. Available potassium; available calcium and available magnesium were ranged from 27.43 to 204.4 mg/kg; 72.32 to 312.4 mg/kg; 15.29 to 89.65 mg/kg respectively. This experiment was finished in December, 2022.

SS 2: STATUS OF MICRONUTRIENTS (Cu, Fe, Mn & Zn) IN SOME SELECTED TEA SOILS OF BANGLADESH.

Micronutrients are very important for plants to complete their life cycles but need only in a small amount. Micronutrients such as Cu, Fe, Mn, 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 (Cu, Fe, Mn & Zn) in tea garden 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.

Duration: 2017-2022

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

Progress: 2022:

Table: 3. Valley wise soil Micronutrients status of different Tea Estates.

Valley	Sl. No.	Name of the tea estates.	Micronutrients (mg/kg)			
			Cu	Fe	Mn	Zn
Balisera	1	BTRI Farm	0.16	6.70	1.60	0.69
	2	BEF	0.27	11.06	4.07	0.62
	3	Jagcherra	0.13	16.13	2.98	0.38
	4	Mirzapore	0.20	6.23	16.85	0.15
	5	Nurjahan	0.5	23.3	12.2	1.1

Chattogram	1	Fatickchari Sub-Station	0.16	13.76	19.08	0.15
	2	Naseha	0.41	25.78	3.50	0.07
	3	Neptune	0.46	25.09	13.12	0.58
	4	Oodaleah	0.20	4.44	3.46	0.07
Juri	1	Dakshingul	0.20	6.66	23.07	13.43
	2	Fatehbagh	0.08	17.78	6.06	0.21
	3	Pallathal	0.14	5.90	53.16	0.91
	4	Rajkie	0.13	1.52	7.02	2.99
	5	Sagurnal	0.2	14.26	57.6	1.61
	6	Silloah	0.08	34.45	11.01	0.11
Lungla	1	Ameenabad	0.28	3.10	70.26	0.29
	2	Chandbagh	0.13	12.66	48.07	0.75
	3	Etah	0.45	8.39	28.82	0.15
	4	Ghazipore	0.50	10.04	3.94	0.32
	5	Kality Sub-Station	0.69	13.04	1.72	0.21
	6	Kality	0.20	24.25	6.05	0.71
	7	Monipur	0.22	12.32	48.49	0.79
	8	Rehana	0.09	8.18	4.6	0.02
Luskerpore	1	Baikunthapur	0.14	0.57	55.41	0.94
	2	Chandpore	0.26	1.14	2.98	1.71
	3	Chundicherra	0.19	4.08	20.80	0.91
	4	Deundi	0.05	6.10	12.78	0.04
	5	Luskerpore	0.04	1.70	2.56	1.03
Monu Doloi	1	Srigobindpur	0.35	2.25	27.17	0.49
North Sylhet	1	Lackatoora	0.24	18.26	13.63	0.09
	2	Malinicherra	0.21	22.44	18.46	0.55

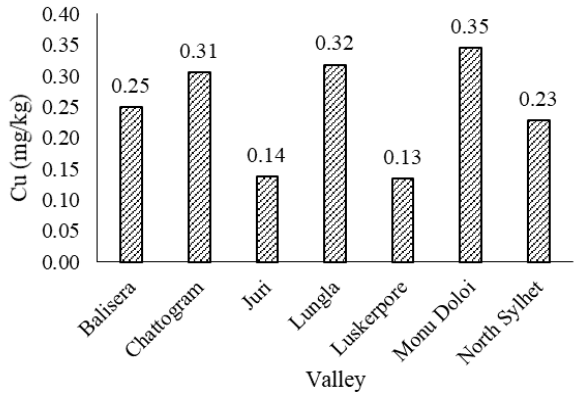


Figure: (a)

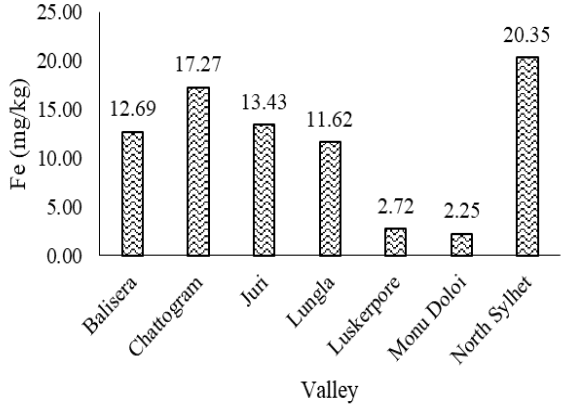


Figure: (b)

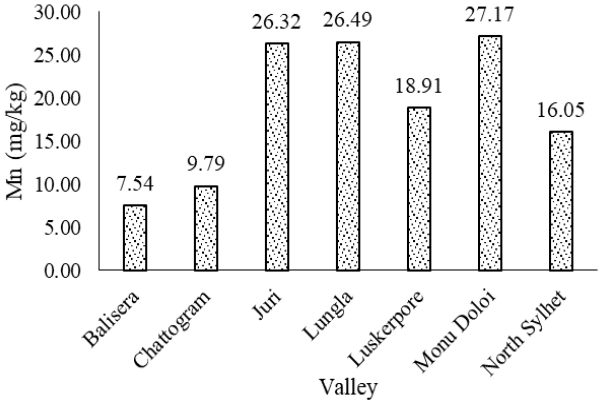


Figure: (c)

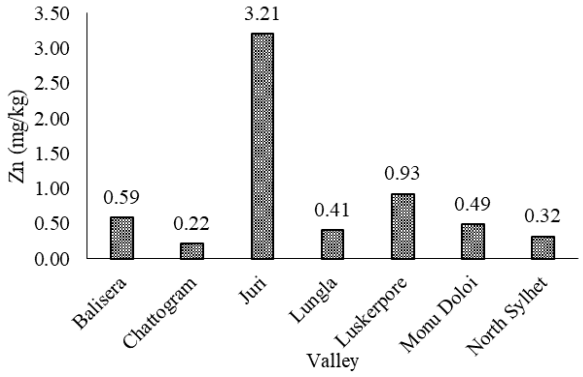


Figure: (d)

Figure: 1. The changes of Valley wise soil micro nutrient status.

Conclusion:

Micronutrient analysis of the collected **651 soil samples from 47 tea** estates of Bangladesh has been done. This Experiment has finished in December, 2022. The highest and lowest Cu was found in Monu Doloi and Luskerpore valley, respectively whereas highest and lowest Fe concentration were found North Sylhet and Monu Doloi valley, respectively. On the other hand, the maximum and minimum concentration of Mn were found in Lungla and Balisera valley, respectively and that of Zn were found in Juri and Chattogram valley, respectively.

SS 3: PRESENT STATUS OF HEAVY METALS (Cr, Cu, Fe, Mn, Ni, Zn) IN TEA SOILS, GREEN LEAVES AND MADE TEA IN BANGLADESH.

Tea is rich in many trace inorganic elements. In addition to many essential elements required for human health, some heavy metals 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.

Duration: 2018-2022

Progress:

46 soil, 18 green leaves and 07 made tea (black) Golden Broken Orange Pekoe (GBOP), Pekoe Fannings (PF), Churamoni Dust (CD) and Orthodox grade samples and 01 made tea (green) were collected from Korotoa tea estate and Kazi & Kazi tea estate of Panchagarh district. 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 of 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. The physical, chemical and biochemical analysis of the collected soil, leaf and made tea samples such as moisture, soil textural class, pH, organic carbon, total nitrogen, available phosphorus, exchangeable potassium, calcium, magnesium, sulphur, boron, iron, manganese, zinc, copper, lead, cadmium, chromium, nickel as well as protein content, total polyphenol, theaflavin, thearubigin and caffeine content of made tea has been completed.

Information on soil type, physiographic region and topography of the sampling locations as well as the history of fertilizers and pesticides application, yield of tea, age of tea plants, plant spacing etc. at each of the tea gardens of Panchagarh, Chattogram, Moulvibazar and Sylhet districts were recorded. The concentrations of chromium, copper, iron, manganese, nickel, and zinc in the soils of the different tea gardens were ranged between 2 - 73, 0.86 - 23, 3084 – 47120, 21 – 1274, 3 – 23 and 2 – 465 mg/kg, respectively. The mean concentrations of chromium, copper, iron, manganese, nickel, and zinc in the tea leaves were 12.86, 14.67, 185, 641, 4, and 43.79 mg/kg, respectively. The mean concentrations of chromium, copper, iron, manganese, nickel and zinc in the made tea were 21, 17.51, 373, 613, 6.29 and 134 mg/kg, respectively. The concentrations of iron and nickel in the tea leaves and made tea and zinc in the tea leaves were within the permissible limits of heavy metals in plants. It should be mentioned here that although a target was made in the initial sampling plan to collect more samples from different tea gardens of Bangladesh, it was not entirely possible due to the COVID-19 Pandemic situation in Bangladesh, and therefore, the length of the fieldwork in

2020 to 2021 was cut short. Other heavy metals such as Cd, Pb, Hg etc. were unable to analyzed due to the lacking of the analytical facility in the laboratory.

Laboratory analytical data of the collected soil, leaf and made tea samples as well as the environmental data were compiled and stored properly for further use. This Experiment was finished in December, 2022.

SS 4: DETERMINATION OF CRITICAL VALUES OF NUTRIENTS IN TEA SOIL AND PLANT LEAF IN SYLHET, CHATTOGRAM AND PANCHAGARH REGION.

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.

Duration: 2018-2022

Progress:

Table: 4. Physico-chemical properties of tea garden soils (Valley-wise)

No.	Valley	Texture	pH	O. C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
1.	Balisera	SL-SCL	3.9-5.2	0.56-1.36	0.061-0.140	2.35-89.09	37.69-125.11	38.65-105.82	3.82-112.15
2.	Chittagong	SL-SCL	4.0-5.0	0.55-1.29	0.059-0.139	8.74-56.72	44.56-135.31	64.28-196.27	13.25-44.60
3.	Juri	SL-SCL	4.0-5.1	0.50-1.27	0.055-0.131	5.64-45.84	22.43-204.40	60.32-182.22	4.59-24.81
4.	Luskerpore	SL-SCL	3.8-4.6	0.43-1.11	0.051-0.123	3.79-39.29	32.12-128.31	51.02-115.14	5.92-30.50
5.	Monu Doloi	SL-SCL	3.9-4.9	0.61-1.25	0.065-0.125	6.34-78.37	32.87-108.74	72.32-225.62	18.52-43.25
6.	North Sylhet	SL-SCL	4.2-4.7	0.57-1.34	0.062-0.144	9.24-44.54	38.23-106.65	78.25-181.56	7.44-37.27
7.	Panchagarh	SL-SCL	4.7-6.2	1.49-2.09	0.120-0.211	12.74-68.55	27.95-88.28	110.25-285.36	30.57-88.78

SCL= Sandy Clay Loam, SL= Sandy Loam

Pot experiments could not be initiated due to lacking of Green house facilities at BTRI. This Experiment has finished in December, 2022.

SS 5: COMPARATIVE STUDY OF CONSERVATION AND CONVENTIONAL AGRICULTURE PRACTICE IN SMALL HOLDING TEA CULTIVATION IN RESPONSE TO CLIMATE CHANGE.

Introduction:

Conservation Agriculture (CA) comprises the practical application of three principles, namely: nor minimum mechanical soil disturbance, rational crop biomass soil cover and crop diversification, in conjunction with other complementary improved agricultural practices of integrated crop and production management. Numerous studies conducted across varied ecologies of South Asia have shown the potential benefits of CA component technologies with respect to natural resource conservation, efficiency of use of external inputs, crop yield

enhancement, soil health improvement, economic farm profitability and adaptation to climate change to address the food, energy and water nexus and meet sustainable development goals. The objective of this research is to efficient use of external and natural resources to reduce the mortality rate of new plantation in dry season and to minimize soil erosion with nutrient.

Methodology:

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.

Duration: 5 years (2020-2025)

Progress:

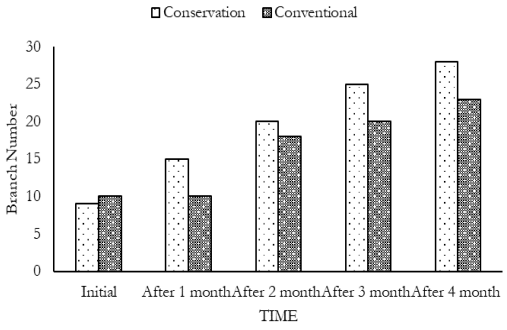
Table: 5. Initial soil properties

Treatment	Sample No	Texture	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)
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

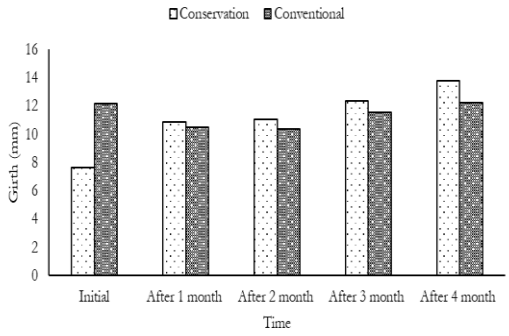
SCL= Sandy Clay Loam

Table: 6. Changes of soil properties at the end of 2022

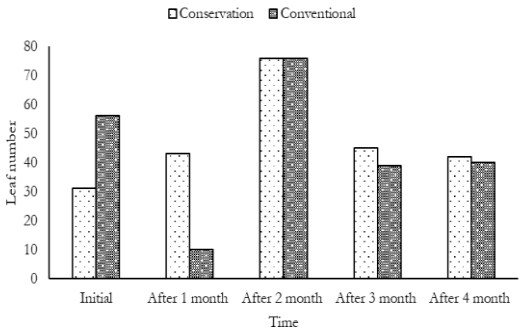
Treatment	Sample No	Texture	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
Conventional Method	1	SCL	5.0	1.01	0.100	6.08	24.18	162.8	26.22
	2	SCL	5.1	0.69	0.070	3.50	19.80	133.1	15.85
Conservation Method	1	SCL	5.0	1.07	0.10	8.17	35.12	141.2	22.30
	2	SCL	5.2	1.24	0.125	5.34	48.25	145.4	26.45

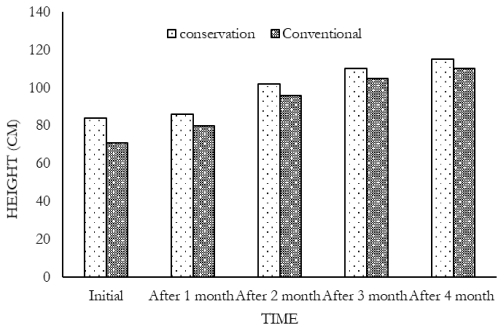


(a) Branch Number of tea plants



(b) Girth (mm) of tea plants





(c) Leaf Number of tea plants **(d) Height (cm) of tea plants**

Figure: 2. Changes of plant growth parameters over time

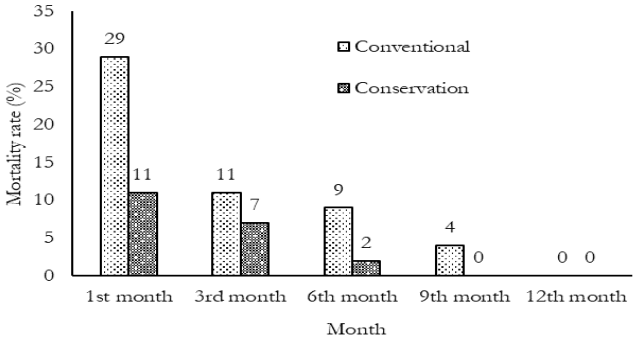


Figure: 3. Changes of mortality rate of tea plants over time

From the finding it can be stated that soil chemical parameter had slightly increased over conventional method. Mortality rate is higher in conventional method than conservation method over time. Plant growth is higher in conservation method. This experiment will be continued in 2023.

SS 6: EFFECT OF DIFFERENT MULCHING MATERIALS ON SOIL PROPERTIES, EARTHWORM POPULATION AND GROWTH OF YOUNG TEA.

Objectives:

Mulching is an important cultural practice for soil-moisture conservation in tea fields. Different mulches have variable effects on soil physical and chemical properties and plant growth. The practice of mulching in tea plantations is commonly known as thatching. New clearings under young tea remain exposed to the vagaries of weather, until such time as the tea forms a canopy and provides an adequate soil cover. As a consequence, new clearings are vulnerable to erosion, soil-moisture evaporation, and effects brought on by the proliferation of weeds. In order to minimize these adverse effects, it is necessary to provide ground cover with dead or live mulches.

Location: Bilashcherra Experimental Farm and Luskerpore Tea Estate

Duration: 2020-2022

Plot size: 1.50 m^2

Number of plants per plot: 6 Nos

Replication: 03
Design: RBD
Treatment:

T_1 = Control
T_2 = Boga Medula (5 cm layer) 3.75tons/ha
T_3 = water hyacinth 5cm layer.
T_4 = Guatemala Grass 2.5ton/ha
T_5 = Citronella Grass 2.5ton/ha
T_6 = Straw 20 tons/ha
T_7 = Banana Tree 20 tons/ha
T_8 = Pruning litter 10 ton/ha
T_9 = Weeds (5 cm layer) 20 tons/ha

Progress, 2022:

Table: 7. Initial Soil Status of BEF and Luskerpore T.E. (2020)

Physical Properties					
BEF					
Treatment	**Texture**	**Soil Structure**	**Color**	**Moisture (%)**	**Bulk Density (gm/cm³)**
T_1	SCL	Sub angular blocky	Grey	28.75%	1.88
T_2	SCL				
T_3	SCL				
T_4	SCL				
T_5	SCL				
T_6	SCL				
T_7	SCL				
T_8	SCL				
T_9	SCL				

Luskerpore Tea Estate					
Treatment	**Texture**	**Soil Structure**	**Color**	**Moisture (%)**	**Bulk Density (gm/cm³)**
T_1	SCL	Sub angular blocky	Greenish Grey	7.15%	1.70
T_2	SCL				
T_3	SCL				
T_4	SCL				
T_5	SCL				
T_6	SCL				
T_7	SCL				
T_8	SCL				
T_9	SCL				

Chemical Properties					
BEF					
Treatment	**pH**	**O.C (%)**	**Total N (%)**	**Av. P (mg/kg)**	**Av. K (mg/kg)**
T_1	4.6	0.71	0.074	6.33	48.97
T_2	4.7	0.58	0.062	8.85	47.72
T_3	4.7	0.99	0.103	22.63	90.32
T_4	4.8	1.18	0.120	7.60	49.01
T_5	4.8	1.37	0.140	16.28	38.32
T_6	4.8	0.99	0.102	24.35	80.36
T_7	4.9	1.11	0.115	14.92	93.45

T_8	4.6	1.06	0.110	7.55	40.82
T_9	5.0	1.24	0.128	6.82	102.85
Luskerpore Tea Estate					
T_1	4.1	1.04	0.108	2.73	32.53
T_2	4.2	0.95	0.10	4.06	33.31
T_3	4.2	0.90	0.095	5.13	49.65
T_4	4.4	0.92	0.098	9.19	38.01
T_5	4.1	0.95	0.10	5.43	47.83
T_6	4.2	1.09	0.120	2.50	54.14
T_7	4.4	1.10	0.114	5.18	31.21
T_8	4.2	1.03	0.108	5.64	33.06
T_9	4.3	0.90	0.098	15.51	39.09

Table: 8. Final Soil Status of BEF and Luskerpore T.E. (2022)

Physical Properties

BEF

Treatment	Texture	Soil Structure	Color	Moisture (%)	Bulk Density (gm/cm³)
T_1	SCL	Granular	Grey	19.02	1.35
T_2	SCL			22.28	1.46
T_3	SCL			24.80	1.45
T_4	SCL			25.14	1.56
T_5	SCL			18.59	1.49
T_6	SCL			22.36	1.42
T_7	SCL			25.62	1.50
T_8	SCL			20.00	1.56
T_9	SCL			20.59	1.39

Luskerpore Tea Estate

Treatment	Texture	Soil Structure	Color	Moisture (%)	Bulk Density (gm/cm³)
T_1	SCL	Granular	Greenish Grey	10.32	1.46
T_2	SCL			13.07	1.40
T_3	SCL			23.86	1.46
T_4	SCL			16.96	1.32
T_5	SCL			18.25	1.40
T_6	SCL			15.00	1.35
T_7	SCL			22.23	1.40
T_8	SCL			16.58	1.45
T_9	SCL			19.69	1.52

Chemical Properties

BEF

Treatment	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
T_1	4.9	1.01	0.104	45.80	60.94	182.40	30.08
T_2	5.1	1.22	0.125	34.15	73.52	143.60	45.58
T_3	5.2	1.17	0.120	23.61	110.98	125.26	46.58
T_4	5.0	1.25	0.108	23.01	124.60	136.26	65.78
T_5	5.0	1.20	0.120	32.68	98.94	125.40	72.70
T_6	4.9	1.48	0.144	18.01	143.18	95.60	36.20
T_7	5.0	1.34	0.130	20.00	90.68	82.80	40.52

T_8	5.1	1.25	0.108	28.90	89.56	96.60	43.54
T_9	5.2	1.39	0.111	29.89	189.44	150.20	36.35
Luskerpore Tea Estate							
T_1	4.8	1.05	0.108	9.07	60.01	157.40	30.08
T_2	4.89	1.30	0.135	18.33	75.94	173.60	25.58
T_3	5.0	1.22	0.118	32.08	108.79	180.26	38.58
T_4	5.0	1.48	0.145	29.77	90.98	142.26	25.78
T_5	5.1	1.50	0.156	21.37	70.52	116.40	22.70
T_6	4.8	1.38	0.140	18.46	60.16	95.60	17.20
T_7	5.0	1.48	0.142	14.99	42.36	90.80	13.52
T_8	5.2	1.52	0.136	24.98	79.55	99.60	28.04
T_9	5.0	1.69	0.142	20.05	127.41	130.20	29.89

Table: 9. Mortality rate of different treatments.

Treatment	Bilashcherra Experimental Farm	Luskerpore Tea Estate
T_1	33.33 %	50.00 %
T_2	0.00 %	16.67 %
T_3	0.00 %	0.00 %
T_4	0.00 %	16.67 %
T_5	0.00 %	0.00 %
T_6	0.00 %	16.67 %
T_7	0.00%	0.00%
T_8	0.00 %	0.00 %
T_9	0.00 %	0.00%

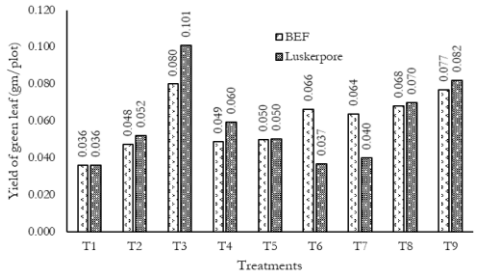
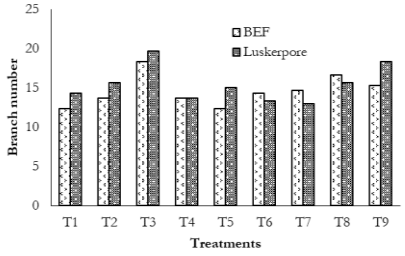
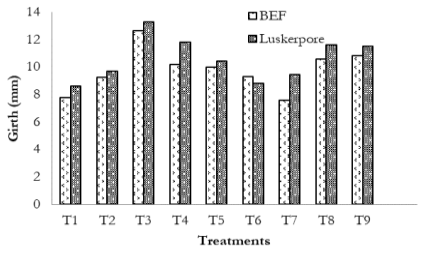


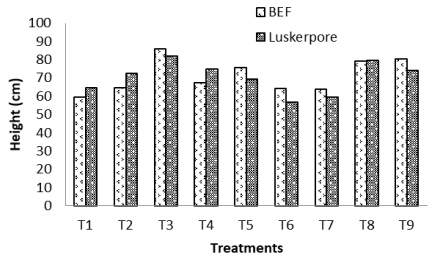
Figure: 4. Yield of green leaf g/plot of BEF and Luskerpore T. E.



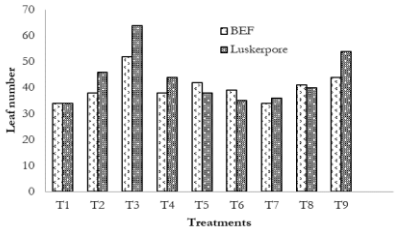
(a) Branch Number of Tea plants



(b) Girth (mm) of tea plant

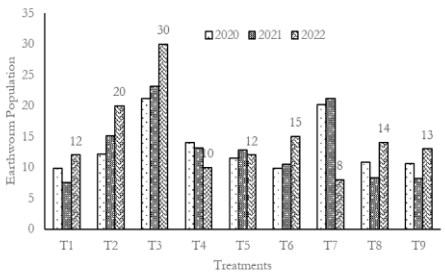


(c) Height (cm) of tea plants

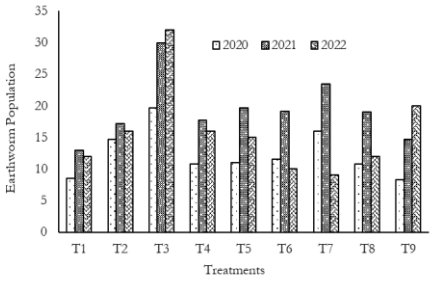


(d) Leaf number of tea plants

Figure: 5. Effect of different mulching materials on the growth of tea plant



(a) BEF



(b) Luskerpore T. E.

Figure: 6. Effect of different mulching materials on the earthworm population

From the soil analysis report it was shown that soil physical and chemical status had increased after mulching applications. From the all graph and statistical analysis result it was shown that Treatment T_3= Water hyacinth gave highest result on plant growth, earthworm population and yield of tea where T_6= Straw and T_7= Banana showed lowest result. Mortality rate% had decreased 0.0% from 33.33% (T1) for BEF and 0.0% to 16.67% (T2, T4, T6) from 50% (T1) for Luskerpore Tea Estate. The yield of tea was significant at 0.05% level. The experiment was finished in December, 2022.

SS.7: Formulation of a New Organic Fertilizer cum Pesticides: FCP (Organo 2 in 1) and study the efficiency on tea plant.

Objectives:

1. For formulation a new pattern of a fertilizer.
2. To determine the quality and effectiveness of the organic fertilizer.
3. To determine the effectiveness of the organic fertilizer as bio pesticide.
4. To improve the soil health and growth of tea as well as increase the yield of tea.

Methodology:

Design: RBD
Location: BTRI Farm
Duration: January, 2022 – December, 2023

1st Phase – Foliar Spray (2022-2023)	2nd Phase – Broadcasting (2023) (Treatment = 8, Replication =3)	1st and 2nd Phase (2022-2023) Pot Experiment (Treatment = 6, Replication =5)
T_1= Control T_2= BTRI RFD T_3= FCP 2% foliar spray T_4 = FCP 4% foliar spray T_5 = FCP 6% foliar spray T_6 = FCP 8% foliar spray T_7 = Zinc 2% foliar spray T_8 = Boron 2% foliar spray	T_1= Control T_2= 100% RFD T_3= FCP 1 ton/ha T_4 = FCP 1 ton/ha + 80% T_2 T_5 = FCP 2 ton/ha T_6 = FCP 2 ton/ha + 60% T_2 T_7 = FCP 3 ton/ha T_8 = FCP 3 ton/ha + 40% T_2	T_1= Planting with only soil T_2= Planting with soil + Cowdung T_3= Planting with soil + Cowdung + 4 gm FCP T_4 = Planting with soil + Cowdung + 8 gm FCP T_5 = Planting with soil + Cowdung + 12 gm FCP T_6 = Planting with soil + Cowdung + 16 gm FCP

Table: 10. FCP nutrient status Analysis Result

Parameter	Content	Parameter	Content
Color	Gray	C:N	7.97:1
Physical Condition	Non-Granular	Total K %	14.46
Odor	Nill	Total Ca %	82.25
Moisture %	12.22	Total Mg %	6.58
pH	8.74	Total Zn %	0.13
O.C %	23.60	Total Mn %	0.15
Total N%	2.96	Total Cu %	0.03

Table: 11. Effect Foliar application of FCP on Yield of Mature Tea

Treatment	Average green leaf (kg/plot)	Green Leaf (kg/ha)	Made tea (kg/ha)	Rate of increase over control
T_1	2.88	6200.717	1426.165	0.0%
T_2	3.24	6960.573	1600.932	12.3%
T_3	3.32	7132.616	1640.502	15.0%
T_4	3.41	7340.502	1688.315	18.4%
T_5	3.47	7455.197	1714.695	20.2%
T_6	3.55	7627.24	1754.265	23.0%
T_7	2.99	6437.276	1480.573	3.8%
T_8	3.01	6465.95	1487.168	4.3%

Table: 12. Initial Soil nutrient Status of Pot Experiment

Treatment	Texture	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
T_1	SCL	4.9	1.19	0.019	3.11	17.98	79.85	30.38
T_2	SCL	5.0	1..01	0.101	12.65	40.10	96.63	56.98
T_3	SCL	4.6	0.89	0.090	15.98	46.58	85.78	56.25
T_4	SCL	4.5	0.94	0.094	25.63	65.21	69.75	78.12
T_5	SCL	4.7	1.05	0.100	18.78	12.35	96.00	25.65
T_6	SCL	4.4	.078	0.064	32.56	45.69	86.25	45.32

Table: 13. Changes of Soil nutrient Status at end of 2022

Treatment	Texture	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
T_1	**SCL**	5.1	1.19	0.120	52.66	81.08	122.20	54.38
T_2	SCL	5.1	1.14	0.116	60.00	83.76	110.40	66.80
T_3	SCL	5.2	1.21	0.125	66.67	105.92	141.00	77.18
T_4	SCL	5.2	1.08	0.110	99.96	68.02	232.00	89.54
T_5	SCL	5.1	1.29	0.130	58.40	79.82	289.00	60.40
T_6	SCL	5.0	1.12	0.116	85.93	72.22	291.80	83.96

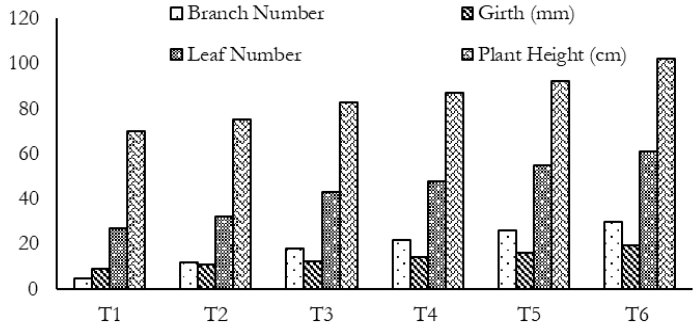


Figure: 7. Effect of different treatments on growth parameters of tea plants in pot experiment

Conclusion:

From the result (Foliar spray) it has been shown that treatment T6= 8% FCP give the highest yield 1754 kg/ha with 23% rate of increase where treatment T7= Zinc 2% foliar spray and T8= Boron 2% foliar spray has the lowest yield 1481 kg/ha and 1487 kg/ha respectively. The growth of tea plants was increased with the increase of doses of fertilizer. The mortality rate of tea plant in pot experiment was zero. The experiment will be continued in 2023.

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 1753 soil samples (142 advisory and 1611 paid) and 66 other samples

from 94 tea estates were analyzed for different purposes, the breakup of which is presented in table 12.

Table 14. Number of samples analyzed

Year	Advisory Soil	Soil	Fertilizer	Lime/ Dolomite	Leaf	Water	Compost	Total (Fertilizers & others)	Total (Soils & others)
2022	142	1611	32	17	00	00	17	66	1819

Table 15. List of Tea Estates from where soil and other samples were received or collected and analyzed during the year 2022

Afifanagar	Deanston	Lackatoorah	Phulcherra
Allynugger	Deundi	Lalchand	Pooteacherra
Ameenabad	Dhamai	Lallakhal	Premnagar
Amo	Dildarpur	Lungla	Rajghat
Amrail	Dinarpur	Luskerpore	Rajkie
Bahadurpur	Etah	Madhabpur	Rajnagar
Baikanthapur	Ghazipore	Madhupur	Rampore
Balisera	Grand Sultan Tea Resort & Golf	Marina	Rangapani
Baraoora	Habibnagar	Mertinga	Rungicherra
Bejoya	Hajinagar	Mirzapore	Sabari
Bidyabheel	Hamidia	Monipur	Sagurnal
Bilashcherra	Hatimara	Monipur	Saif
Boban	Horincherra	Moulvi	Sathgao
Brindabon	Hossainabad	Nahar	Shumshernugger
Chaklapunji	Jagcherra	Nalua	Silloah
Champarai	Jagcherra	New Samanbagh	Sonarupa
Chandbagh	Jhemai	Noyapara	Sreebari
Chandpore	Julekhanagar	Nurjahan	Srigobindpur
Chatlapore	Kalikabari	Ootterbhag & Indanugger	Teliapara
Chaundeecherra	Kality	Pallathal	Udnacherra
Clevedon	Kapnapahr	Paragon Agro	Wahidabad
Dakshingul	Karimpore	Parkul	Zarreen
Daragaon	Khan	Patrokhola	
Dauracherra	Kurmah	Phulbari	

OTHER ACTIVITIES

Advisory correspondence

A total of 166 advisory letters to different tea estates on soil, fertilizers, dolomite, compost and other soil related aspects were sent during the year 2022.

Tours

During the year under report officers of the division paid a total 19 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 2022. 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
Principal Scientific Officer

STAFF

Mr. Muhammad Abid Hasan Chowdhury, Scientific Officer served as the sole researcher within the Biochemistry division during the reported period. Dr. Mohammad Masud Rana, who held the position of Principal Scientific Officer within the Agronomy division, assumed the additional responsibility of overseeing the Biochemistry division. The posts of Principal Scientific Officer and Senior Scientific Officer within the Biochemistry division remained vacant during the period under report.

RESEARCH

In the year 2022, the Biochemistry division carried out a total of two experiments: one was an ongoing experiment, while the other was a new one. The progress of these experiments is outlined below.

Experiment 1: Effect of storage time and packaging materials on the quality of black tea (BTRI, Short Term: 2022-2024)

Objectives of the study:

- To monitor how the flavor attributes of tea changes over time during storage.
- To identify the best packaging material for the storage of tea.
- To determine the shelf life of tea under a specific packaging material.

Treatments:

There are two sets of treatments in this study which are as follows-

a) Different packaging materials (7)-

P1 : Polyethylene pack
P2 : Foil pack
P3 : Stand-up pouch
P4 : Jute bag (with inner liner)
P5 : WPP bag (with inner liner)
P6 : Kraft paper bag (4 layered, with aluminum foil)
P7 : Chest box (with aluminum foil)

b) Different storage periods (24)-

S1 to S24 : From 1 to 24 months, respectively.

So, total number of tea samples will be analyzed = 7 × 24 × 3 (replication) = 504

Progress:

As per the treatment, a total of 168 containers/bags/sacs with different types of packaging material have been made (Figure 1). Black tea samples were stored in these 168 containers. Every month, respective tea samples are being analyzed biochemically in the lab for quantification of different biochemical components (moisture content, polyphenols, caffeine, theaflavins, thearubigins, and total colour). Results are summarized below in brief.

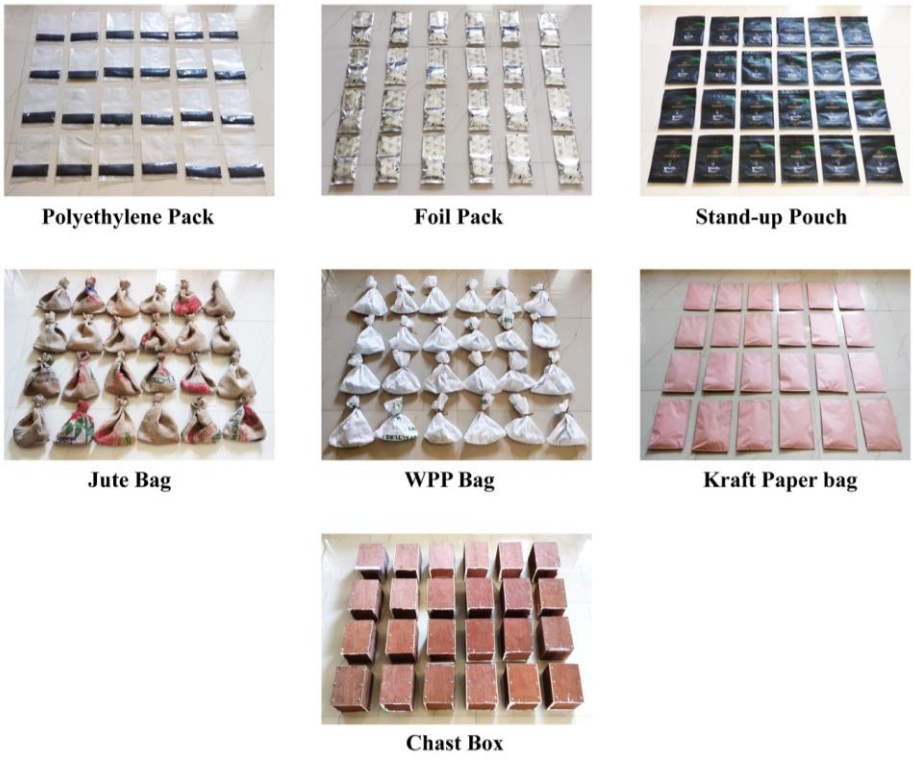


Figure 1. Prepared containers/bags/sacs with different types of packaging material for storing tea.

Moisture content

Results showed that after one month of storage, moisture contents of the black tea samples under different treatments were within 4.86-5.88%; which increased gradually and reached to 7.14-9.58% after 6 months of storage period (Figure 2). Stand-up pouch performed better and WPP bag exhibited poorer results compared to others in terms of moisture content.

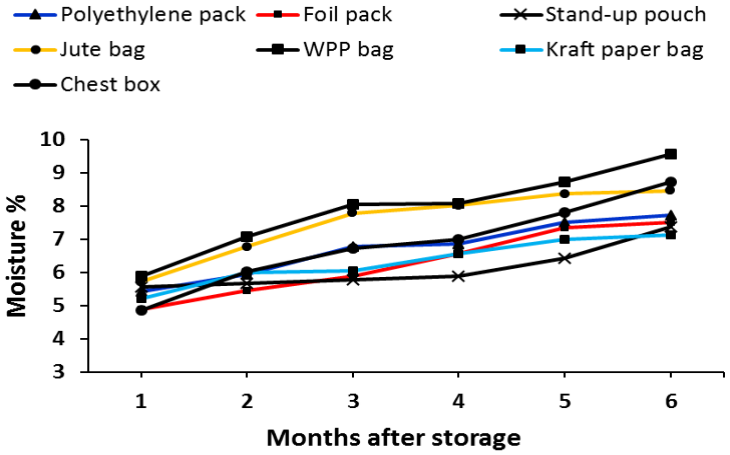


Figure 2. Moisture contents of black tea samples after different periods of storage within different packaging materials.

Polyphenols content

Data showed that after one month of storage, polyphenols contents of the black tea samples under different treatments were within 17.36-19.67%; which decreased gradually and reduced to 5.80-10.73% after 6 months of storage period (Figure 3). The tea chest box showed superior performance in retaining polyphenols content, while the kraft paper bag showed worse than the others in terms of polyphenols content.

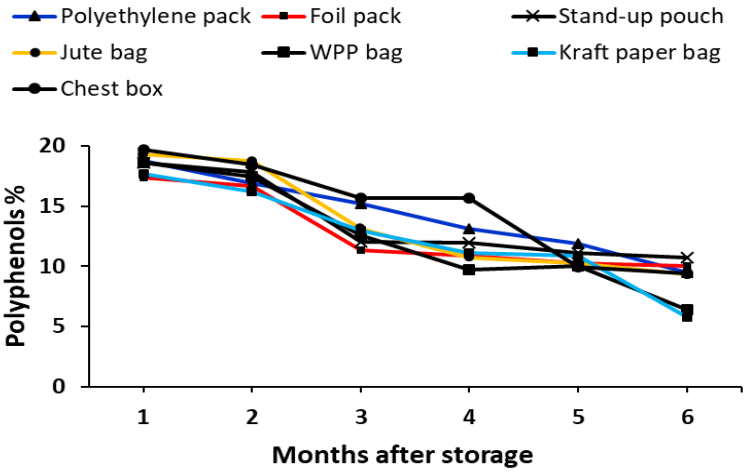


Figure 3. Polyphenols contents of black tea samples after different periods of storage within different packaging materials.

Caffeine content

After one month of storage, caffeine contents of the black tea samples under different treatments were within 3.39-4.29%; which decreased gradually and reduced to 1.42-2.58% after 6 months of storage period (Figure 4). Stand-up pouch performed better and kraft paper bag performed worse than the others in terms of caffeine content.

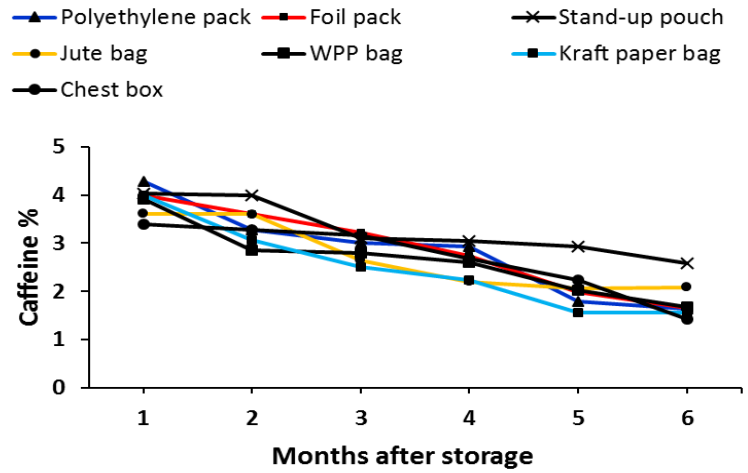


Figure 4. Caffeine contents of black tea samples after different periods of storage within different packaging materials.

Theaflavins content

Data showed that after one month of storage, theaflavins contents of the black tea samples under different treatments were within 1.01-1.15% and then the contents found increased slightly after two months of storage (1.05-1.25%). Thereafter, the theaflavins contents decreased gradually and reduced to 0.52-0.66% after 6 months of storage (Figure 5). The foil pack demonstrated superior performance in terms of theaflavins content and the chest box exhibited lower theaflavins content than the others after 6 months of storage.

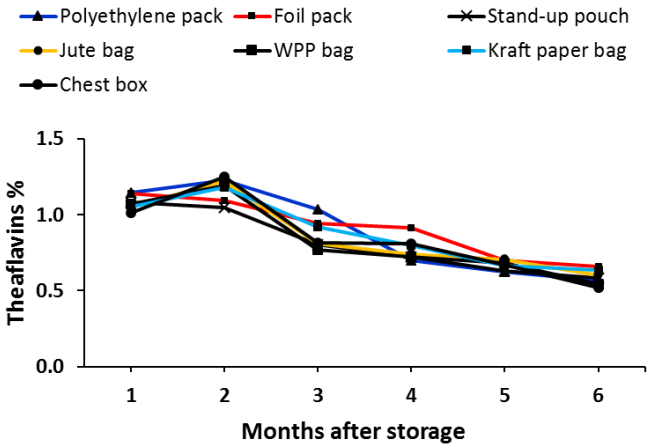


Figure 5. Theaflavins contents of black tea samples after different periods of storage within different packaging materials.

Thearubigins content

Thearubigins contents followed similar trend with theaflavins contents. Results showed that after one month of storage, thearubigins contents of the black tea samples under different treatments were within 10.26-11.34% and then the contents found increased slightly after two months of storage (11.04-12.86%). Thereafter, the thearubigins contents decreased gradually and reduced to 7.25-9.05% after 6 months of storage period (Figure 6). Stand-up pouch performed better considering low thearubigins content and jute bag performed worse than the others.

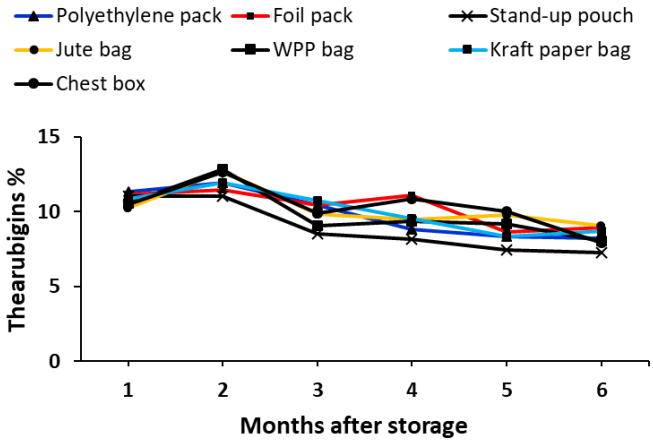


Figure 6. Thearubigins contents of black tea samples after different periods of storage within different packaging materials.

TR/TF Ratio

Results showed that after one month of storage, the TR/TF ratio of the black tea samples under different treatments were within 9.76-10.33 and then the contents found increased gradually till 6 months of storage (12.44-15.23), as illustrated in Figure 7. The stand-up pouch demonstrated superior performance in terms of TR/TF ratio and the chest box exhibited poorer performance than the others after 6 months of storage.

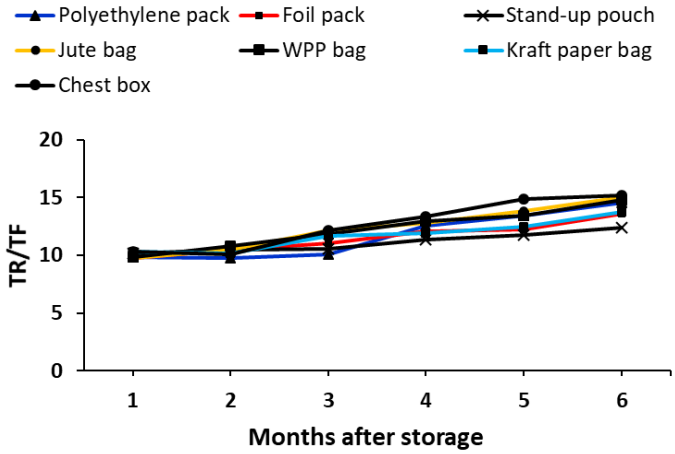


Figure 7. TR/TF ratios of black tea samples after different periods of storage within different packaging materials.

Total colour

Results showed that after one month of storage, total colour score of the infusions of the black tea samples under different treatments were within 1.52-2.41 and the colour score increased gradually up to 4 months of storage (3.89-4.66, after 4 months). Thereafter, the colour score decreased gradually and were within 2.89-3.39 after 6 months of storage period (Figure 8). Total color score of WPP bag was highest and foil pack was lowest than the others.

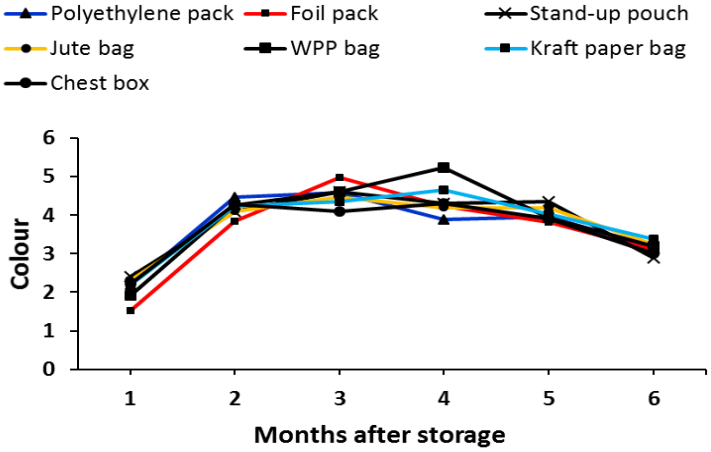


Figure 8. Total colour score of black tea samples after different periods of storage within different packaging materials.

Experiment 2: Effect of Brassinosteroids on the yield and quality improvement by influencing formation of biochemical components in tea (BTRI Farm, Short Term: 2022-2023)

Objectives of the study:

- To improve the yield and quality of the tea by the application of phytohormone Brassinosteroids.

Treatments:

There were two sets of treatments in this study which are as follows-

a) Different concentrations of 24-epibrassinolide as foliar spray (4)-

T1: 0 ppm (control), **T2**: 0.02 ppm, **T3**: 0.10 ppm, **T4**: 0.50 ppm

b) Spraying in different seasons (3)-

S1: Early-season (March, April, May; one spray in each month)

S2: Mid-season (June, July, August; one spray in each month)

S3: Late-season (September, October, November; one spray in each month)

Total number of plots = 4 × 3 × 3 (replication) = 36

Progress:

The phytohormone Brassinosteroids was applied in the respective plots as foliar spray according to the predetermined doses in the early-season and mid-season. However, application of Brassinosteroids in the plots selected for late-season spray could not be carried out due to some unavoidable circumstances. Results obtained from the early-season and mid-season spray are summarized below.

The study revealed contrasting effects of Brassinosteroids on tea yield depending on the season. In the early season, there was a noticeable negative impact, while in the mid-season, a significant positive effect was observed, as illustrated in Figure 9. In the mid-season, when the dosage of Brassinosteroids increased, so did the yield, with the highest yield recorded in the T4 treatment (0.50 ppm). The experiment will be continued to see the effects for all three seasons and economic analysis will be carried out to find out the appropriate dose and financial benefit.

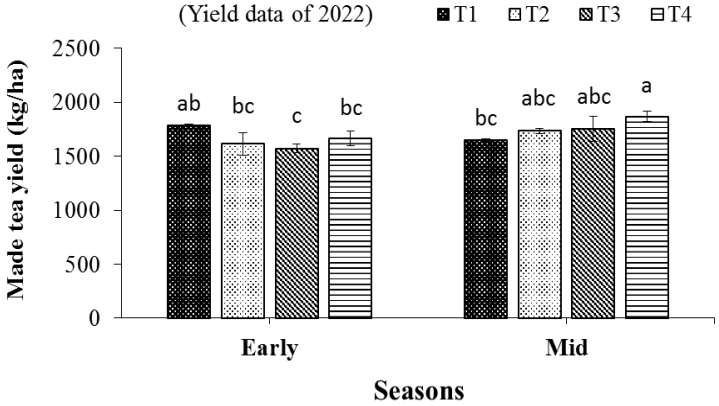


Figure 9. Interaction effect of different doses of Brassinosteroids and different seasons on the yield of tea.

BOTANY DIVISION
Dr. Md. Ismail Hossain
Director (In charge)
and
Dr. Md. Abdul Aziz
Chief Scientific Officer

STAFF

Dr. Md. Abdul Aziz was promoted to Chief Scientific Officer and Mr. Md. Moshiur Rahman Akonda was promoted to Senior Scientific Officer on 16 August 2022. Mr. Md. Rayhan-Ur-Rahaman, Scientific Officer was passed away on 16 July 2022 due to a road accident. The post of one Scientific Officer, and one Field Assistant were vacant. There were no other changes in personnel position of the division during the period under report.

Forty six 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.

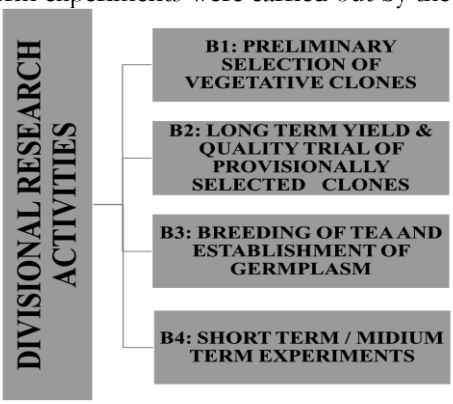


Fig 1. Divisional Activities of Boatny Division (2022)

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 (1993-2023)

19 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 2108 cuttings from 13 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 (1993-2023)

Thirty-three 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 3208 cuttings from previously selected 21 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 (2007-2023)

09 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 1158 cuttings from 7 bushes of section no. 1 of Baraoorah Tea Estate were collected and planted in the nursery.

B2: LONG TERM YIELD & QUALITY TRIAL OF PROVISIONALLY SELECTED CLONES (NO. OF EXPERIMENTS-22)

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-).

The plants of this trial were light pruned at 66 cm in 2022. There were 22 plucking rounds in 2022. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-1.

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

Clone	MZ/39	E/4	D/13	B2T1	BR2/97	SDL/1	BT2
Treatment mean	Released as BT21	1020.9	823.21	869.78	845.49	983.63	846.11

Treatment difference- Significant (LSD value at 5% level of significance= 105.20)

The analytical results reveal that yield difference was highly significant (at 5% level of significance) in 2022. Test clones SDL/1, E/4 and B2T1 were significantly higher in terms of yield with the control BT2 while the test clone D/13 and BR2/97 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 2. The estimated made tea production in kg/ha is presented in Fig. 2.

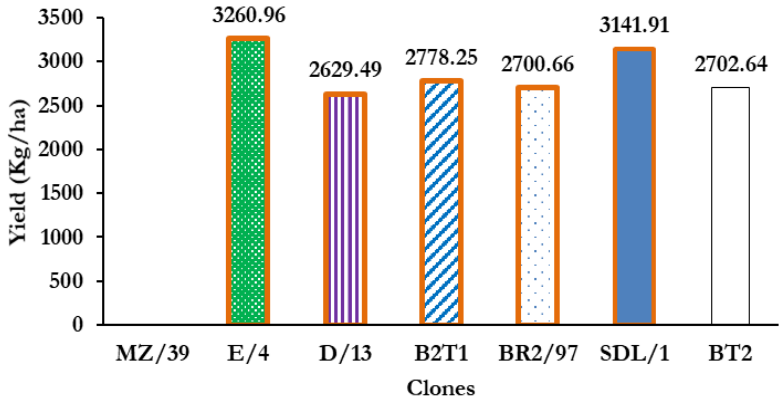


Fig. 2. Comparative yield of clones made tea (kg/ha)

Table 2. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
MZ/39	7.57	7.35	7.59	7.42	2.69	32.62	AA
E/4	7.63	7.55	7.38	7.45	2.62	32.63	AA
D/13	7.52	7.46	7.51	7.51	2.83	32.83	AA
B2T1	7.36	7.28	7.21	7.31	2.68	31.84	AA
BR2/97	7.49	7.48	7.38	7.47	2.71	32.53	AA
SDL/1	7.41	7.43	7.46	7.37	2.57	32.24	AA
BT2	7.51	7.47	7.41	7.34	2.66	32.39	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-).

The plants of this trial were light pruned at 66 cm in 2022. There were 22 plucking rounds in 2022. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-3.

Table 3. Yield of green leaves

Clone	A/8/37	A/8/55	A/8/62	A/8/66	BT2
Treatment mean	966.14	1051.05	923.05	886.80	910.45

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) gave higher yield than control 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 4.

Table 04. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/37	7.34	7.52	7.52	7.31	2.78	32.47	AA
A/8/55	7.29	7.41	7.51	7.41	2.69	32.31	AA
A/8/62	7.31	7.38	7.57	7.37	2.79	32.42	AA
A/8/66	7.54	7.54	7.44	7.58	2.82	32.92	AA
BT2	7.52	7.46	7.59	7.65	2.73	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. 3.

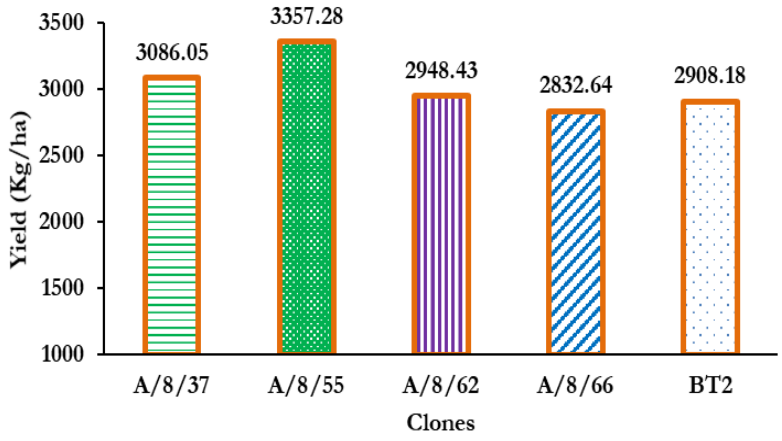


Fig. 3. Comparative yield of clones made tea (kg/ha)

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-).

The plants of this trial were light skiffed at 84 cm and there were 23 plucking rounds in 2022. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-5

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

Clone	A/17/16	Ph/9/1	Ph/9/9	Sh/B/6/46	BT1
Treatment mean	955.13	866.97	970.89	1125.41	890.92

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. 4. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 6.

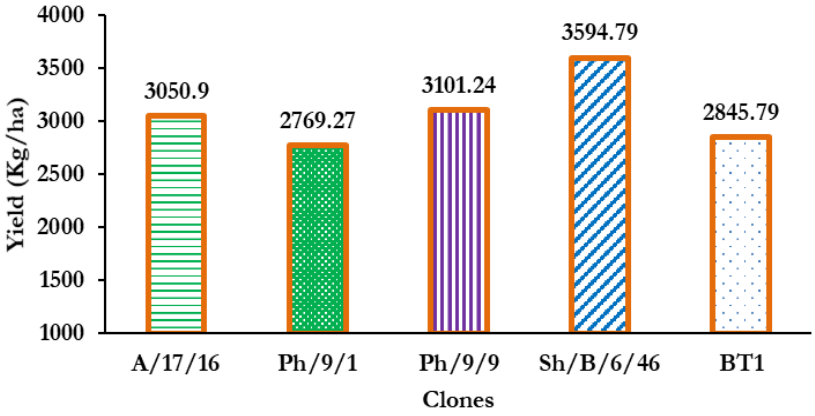


Fig. 4. Comparative yield of clones made tea (kg/ha)

Table 6. Quality scores

Clone	Infusion	Liquor colour	Brisk-ness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/17/16	7.53	7.33	7.41	7.46	2.74	32.47	AA
Ph/9/1	7.34	7.43	7.37	7.46	2.68	32.28	AA
Ph/9/9	7.48	7.49	7.55	7.43	2.72	32.67	AA
Sh/B/6/46	7.48	7.43	7.44	7.46	2.67	32.48	AA
BT1	7.32	7.35	7.49	7.41	2.74	32.31	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-).

The plants of this trial were light skiffed at 84 cm and there were 22 plucking rounds in 2022. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-7. The estimated made tea production in kg/ha is presented in Fig. 5.

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

Clone	Ph/9/4	Ph/9/25	Ph/9/40	BS/67	BT5
Treatment mean	592.23	417.22	616.11	666.17	563.5249

Significant (LSD value at 5% level of significance= 133.10)

The statistical results reveal that yield difference was significant in 2022. The yield performance of test clone Ph/9/4, 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 8.

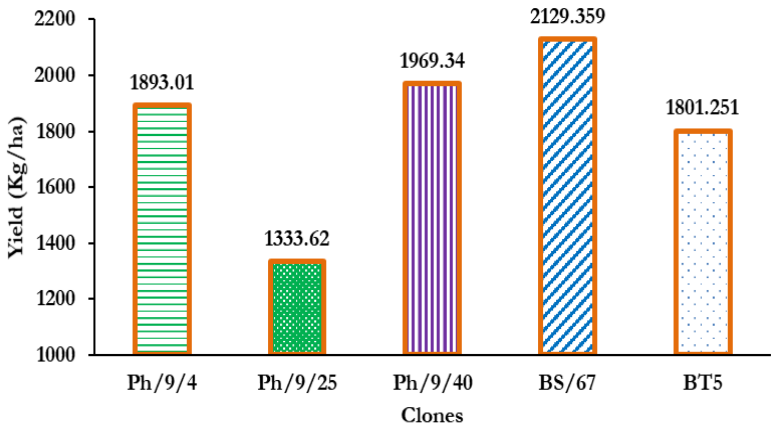


Fig. 5. Comparative yield of clones made tea (kg/ha)

Table 8. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/4	7.38	7.54	7.43	7.46	2.68	32.49	AA
Ph/9/25	7.32	7.36	7.43	7.51	2.67	32.29	AA
Ph/9/40	7.33	7.35	7.36	7.42	2.71	32.17	AA
BS/67	7.53	7.54	7.56	7.46	2.65	32.74	AA
BT5	7.49	7.51	7.53	7.44	2.75	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-).

The plants of this trial were deep skiffed at 64 cm in 2021. There were 25 plucking rounds in 2022. 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 (g/plant)

Clone	A/8B/1	Ph/9B/1	Ph/9/11	BT1
Treatment mean	1095.35	1209.95	1068.47	1033.68

Treatment difference- Significant (LSD value at 5% level of significance= 98.11)
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. 6. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 10.

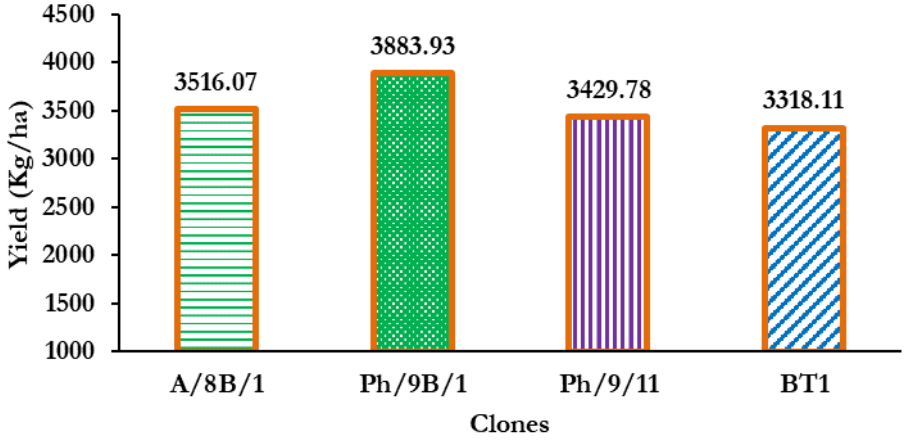


Fig. 6. Comparative yield of clones made tea (kg/ha)

Table 10. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8B/1	7.44	7.64	7.43	7.45	2.62	32.58	AA
Ph/9B/1	7.41	7.45	7.51	7.54	2.84	32.75	AA
Ph/9/11	7.59	7.53	7.45	7.34	2.77	32.68	AA
BT1	7.57	7.64	7.41	7.38	2.82	32.82	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.

B2-46: 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 light skiffed at 78 cm and 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-11.

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

Clone	D1/18	D/6	D/10	D/12	BT5
Treatment mean	1406.87	1384.36	1267.68	1351.74	1198.14

Treatment difference- Significant (LSD value at 5% level of significance=127.65)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2022. 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. 7.

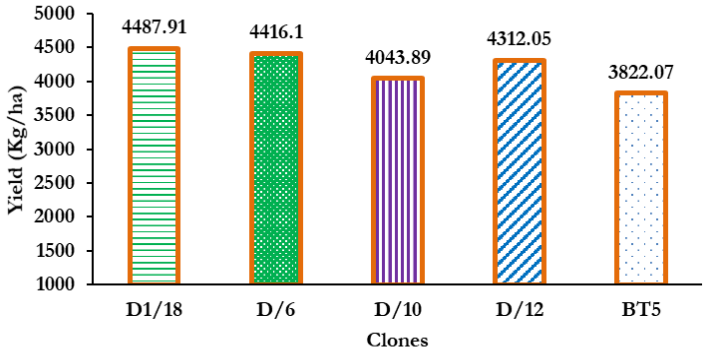


Fig. 7. Comparative yield of clones made tea (kg/ha)

The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 12.

Table 12. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
D1/18	7.65	7.48	7.54	7.43	2.85	32.95	AA
D/6	7.49	7.56	7.54	7.75	2.89	33.23	AA
D/10	7.21	7.53	7.45	7.53	2.96	32.68	AA
D/12	7.38	7.68	7.48	7.38	2.77	32.69	AA
BT5	7.34	7.72	7.36	7.59	2.91	32.92	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-).

The plants of this trial were medium skiffed at 76 cm in 2022. There were 26 plucking rounds in reporting year. Recommended doses of fertilizer & usual cultural practices were applied. The yield data were analyzed and presented in Table-13.

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

Clone	Ph/9/92	BS/3	Ph/9/108	G/61/8	BT15
Treatment mean	1154.67	1138.74	1082.17	1134.46	978.41

Treatment difference- Significant (LSD value at 5% level of significance= 62.18)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2022. The yield performances of all the test clones were higher than the control BT15. The estimated made tea production in kg/ha is presented in Fig. 8. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 14.

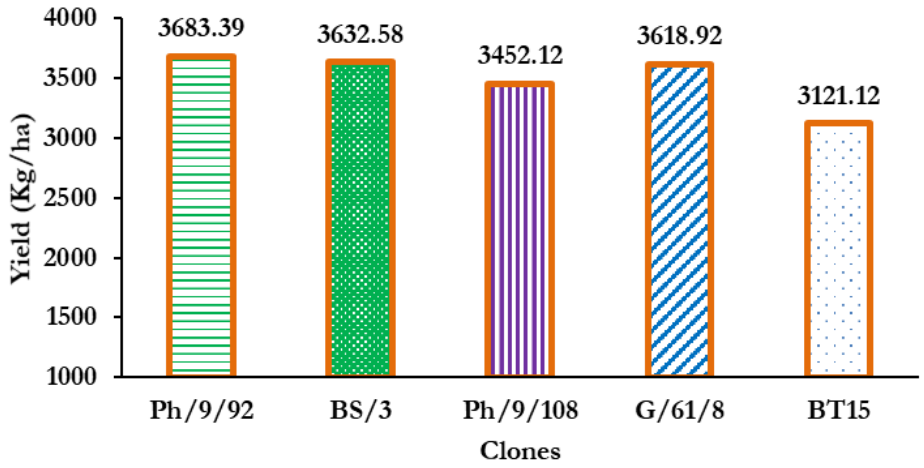


Fig. 8. Comparative yield of clones made tea (kg/ha)

Table 14. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/92	7.55	7.44	7.68	7.52	2.83	33.02	AA
BS/3	7.23	7.52	7.19	7.39	2.68	32.01	AA
Ph/9/108	7.53	7.73	7.45	7.64	2.86	33.21	AA
G/61/5	7.56	7.54	7.65	7.85	2.84	33.44	AA
BT15	7.79	7.84	7.81	7.33	3.54	34.31	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 light pruned at 58 cm and there were 22 plucking rounds in the reporting year. 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/8/124	Sh/10/2	A/8/125	A/11/38	BT2
Treatment mean	1072.94	1009.67	1118.96	1037.94	889.14

Treatment difference- Significant (LSD value at 5% level of significance= 71.18)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2022. 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. 9. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 16.

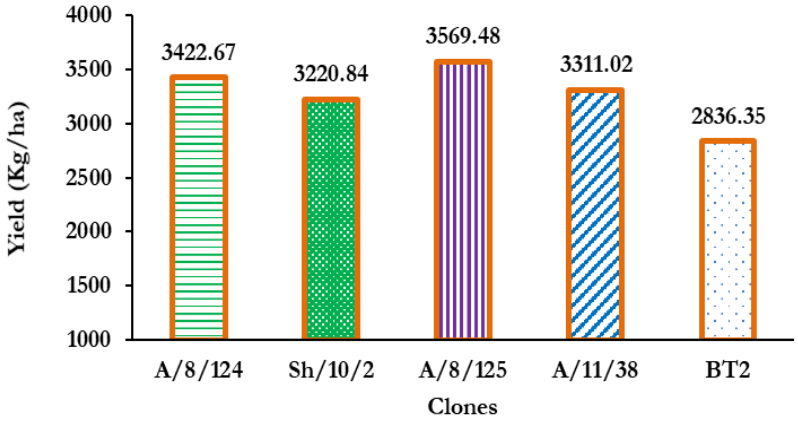


Fig. 9. Comparative yield of clones made tea (kg/ha

Table 16. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/124	7.53	7.53	7.44	7.41	2.85	32.76	AA
Sh/10/2	7.46	7.41	7.58	7.41	2.82	32.68	AA
A/8/125	7.78	7.54	7.72	7.54	2.65	33.23	AA
A/11/38	7.38	7.54	7.32	7.54	2.85	32.63	AA
BT2	7.58	7.59	7.43	7.62	2.69	32.91	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.

B2-49: 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 light skiffed at 58 cm there were 31 plucking round during the cropping period. 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	Sh/D/13/4	BS/91/6	Sh/10/5	A/8/128	BT2
Treatment mean	1035.82	1004.67	906.64	911.17	781.97

Treatment difference- Significant (LSD value at 5% level of significance= 173.97)

The analytical results revealed that all test clones are comparable in terms of yield. The estimated made tea production in kg/ha is presented in Fig. 10. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 18.

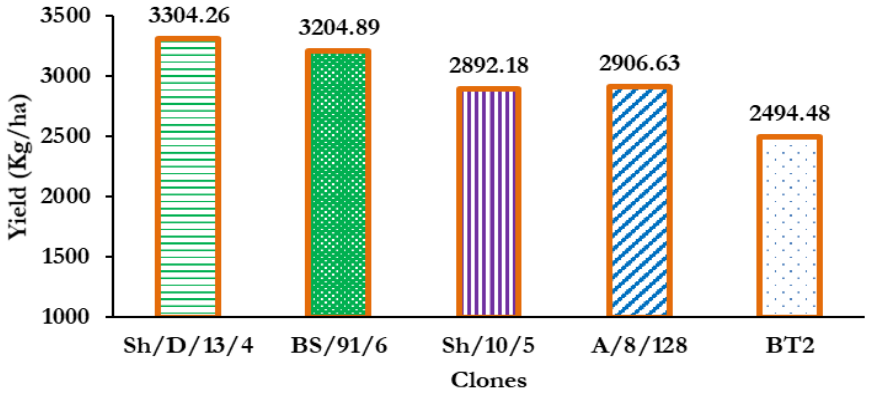


Fig. 10. Comparative yield of clones made tea (kg/ha)

Table 18. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/D/13/4	7.48	7.27	7.53	7.39	2.84	32.51	AA
BS/91/6	7.51	7.39	7.31	7.47	2.82	32.5	AA
Sh/10/5	7.43	7.61	7.43	7.51	2.78	32.76	AA
A/8/128	7.52	7.51	7.41	7.53	2.71	32.68	AA
BT2	7.36	7.53	7.39	7.43	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.

B2-50: 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 medium light skiffed at 74 cm in 2022 and there were 28 plucking rounds during the cropping period. 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

Clone	BT17	B/8/79	Sh/9/43	B/8/93	BT2
Treatment mean	1054.98	1015.97	1022.48	1041.24	1004.68

Treatment difference- Insignificant

The estimated made tea production in kg/ha is presented in Fig. 11. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 20.

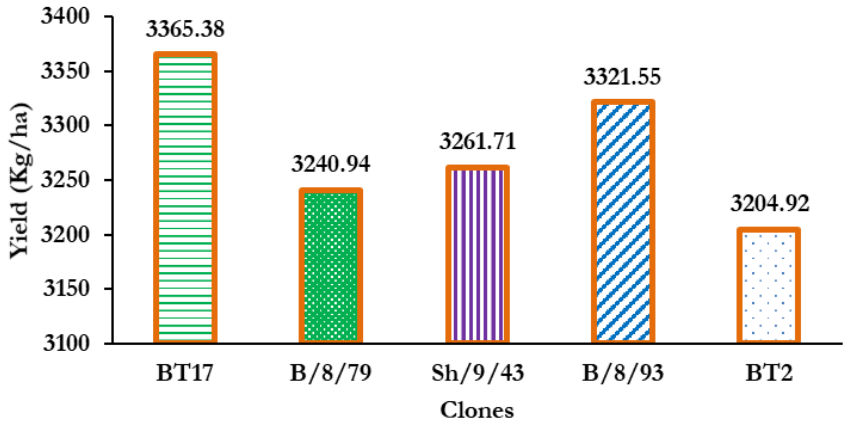


Fig. 11. Comparative yield of clones made tea (kg/ha)

Table 20. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT17	7.25	7.41	7.46	7.43	2.72	32.27	AA
B/8/79	7.41	7.22	7.52	7.41	2.83	32.39	AA
Sh/9/43	7.48	7.33	7.63	7.29	2.62	32.35	AA
B/8/93	7.55	7.52	7.27	7.43	2.35	32.12	AA
BT2	7.59	7.53	7.17	7.52	2.68	32.49	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 deep skiffed at 66 cm and there were 25 plucking round during the cropping period. 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

Clone	BTS1	A/8/194	Sh/9/65	BT17	BT2
Treatment mean	884.84	948.54	912.47	852.97	819.47

Treatment difference- Significant (LSD value at 5% level of significance= 42.87)

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. 12. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 22.

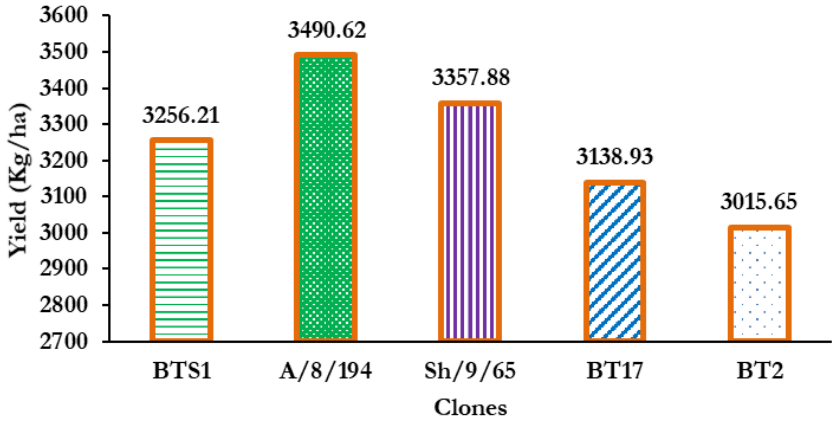


Fig. 12. Comparative yield of clones made tea (kg/ha)

Table 22. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.28	7.46	7.46	7.41	2.72	32.33	AA
A/8/194	7.46	7.21	7.52	7.45	2.78	32.42	AA
Sh/9/65	7.49	7.32	7.65	7.27	2.59	32.32	AA
BT17	7.33	7.34	7.44	7.44	2.64	32.19	AA
BT2	7.42	7.69	7.39	7.37	2.84	32.71	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 plants were light pruned at 55 cm and the yield data were analyzed and presented in Table 23.The trial was initiated in May 2017 at BTRI farm under Latin Square Design with 105cm x 60cm spacing.

Table 23. Yield of green leaves

Clone	B/8/97	Sh/9/71	A/8/217	B/8/101	BT2
Treatment mean	348.54	314.58	381.47	301.18	300.14

Treatment difference- Insignificant

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.

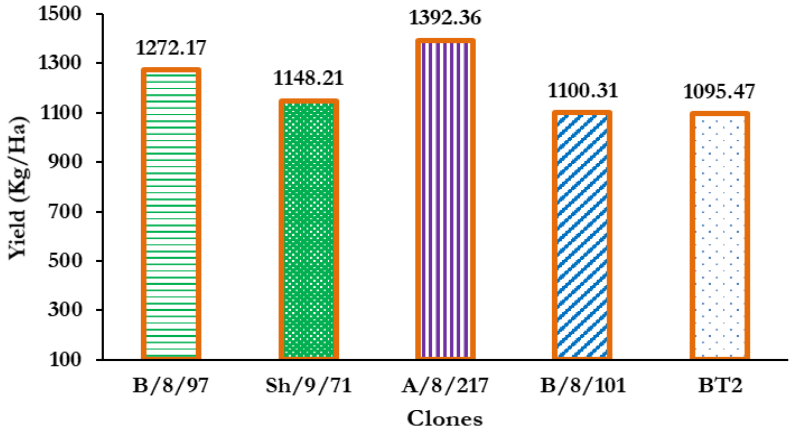


Fig. 13. Comparative yield of clones made tea (kg/ha)

Table 24. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.22	7.63	7.33	7.16	3.13	32.47	AA
Sh/9/71	7.26	7.34	7.45	7.36	2.84	32.25	AA
A/8/217	7.34	7.46	7.43	7.32	2.52	32.07	AA
B/8/101	7.39	7.63	7.53	7.38	2.89	32.82	AA
BT2	7.28	7.71	7.55	7.32	3.21	33.07	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 light pruned at 55cm in 2022. 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

Clone	B/8/131	B/8/144	Sh/9/85	A/8/254	BT2
Treatment mean	352.95	315.25	266.77	358.72	263.87

Treatment difference- Insignificant

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.

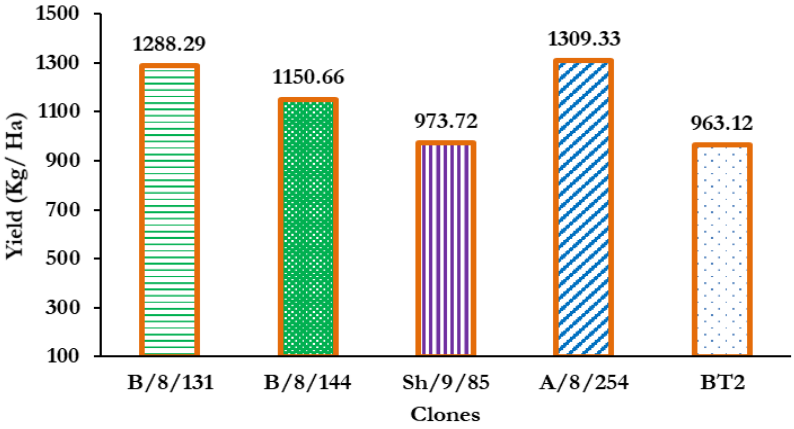


Fig. 14. Comparative yield of clones made tea (kg/ha)

Table 26. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/131	7.35	7.73	7.33	7.41	2.95	32.77	AA
B/8/144	7.26	7.77	7.44	7.51	2.84	32.82	AA
Sh/9/85	7.24	7.56	7.61	7.44	2.93	32.78	AA
A/8/254	7.33	7.46	7.31	7.26	2.98	32.34	AA
BT2	7.38	7.58	7.38	7.74	2.96	33.04	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. The experimental plants were skiffed at 50 cm. 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 27.

Table 27. Yield of green leaves

Clone	P/RJG/8/80	P/AML/14/98	P/RJG/11/106	P/MDP/13/70	BT2
Treatment mean	346.65	371.34	326.86	344.75	301.88

Treatment difference- Insignificant

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.

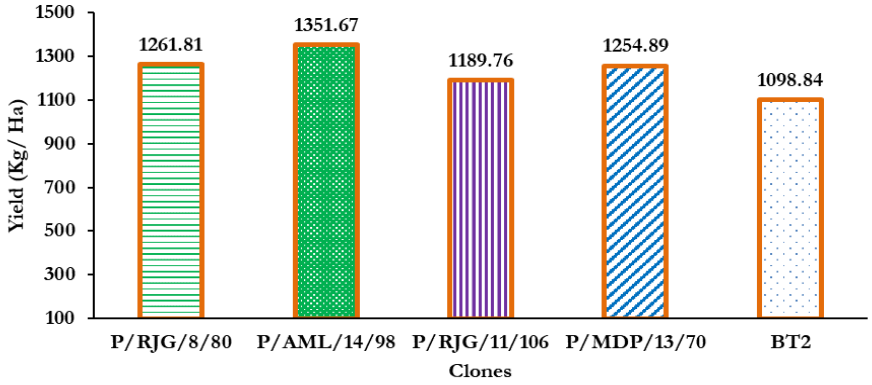


Fig. 15. Comparative yield of clones made tea (kg/ha)

Table 28. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/RJG/8/80	7.44	7.33	7.27	7.35	2.85	32.24	AA
P/AML/14/98	7.36	7.51	7.41	7.61	2.88	32.77	AA
P/RJG/11/106	7.34	7.44	7.56	7.34	2.98	32.66	AA
P/MDP/13/70	7.35	7.52	7.35	7.46	2.85	32.53	AA
BT2	7.32	7.61	7.61	7.38	3.09	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.

B2-55: 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. The experimental plants were skiffed at 50 cm. 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 29.

Table 29. Yield of green leaves

Clone	P/RJG/6/57	P/KRM/11/46	P/RJG/6/48	P/CHM/18/79	BT2
Treatment mean	369.87	334.87	355.85	377.23	314.92

Treatment difference- Significant (LSD at 5%=11.23)

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.

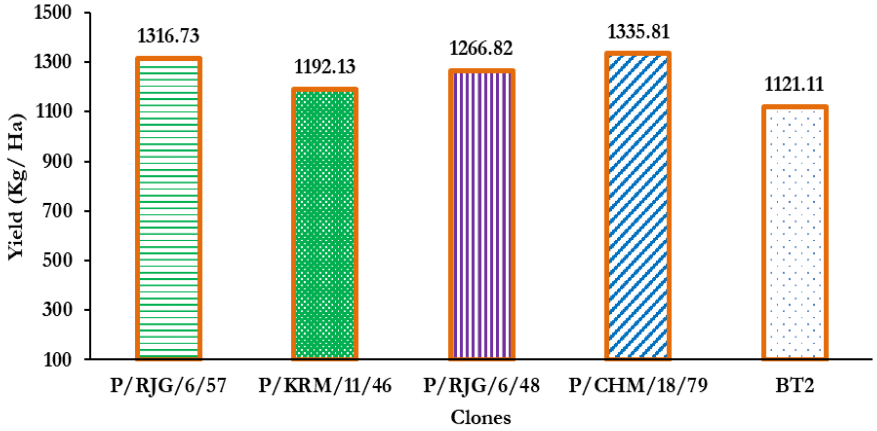


Fig. 16. Comparative yield of clones made tea (kg/ha)

Table 30. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/RJG/6/57	7.33	7.56	7.49	7.59	3.11	33.08	AA
P/KRM/11/46	7.45	7.36	7.28	7.45	3.22	32.76	AA
P/RJG/6/48	7.53	7.43	7.23	7.41	2.97	32.57	AA
P/CHM/18/79	7.46	7.55	7.42	7.29	3.15	32.87	AA
BT2	7.37	7.57	7.55	7.42	3.12	33.03	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 experimental plants were skiffed at 50 cm. 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	A/8/217	A/8/194	Sh/9/65	B/8/93	BT2
Treatment mean	445.52	476.12	421.53	398.23	374.34

Treatment difference- Significant (LSD at 5%= 18.54)

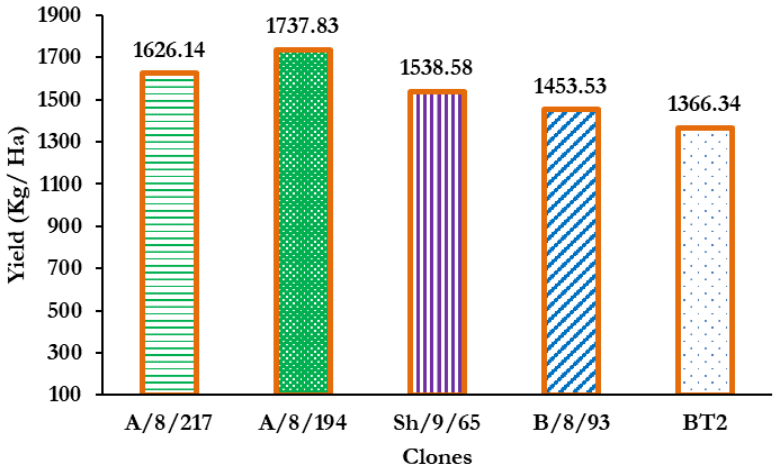


Fig. 17. Comparative yield of clones made tea (kg/ha)

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.

Table 32. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/217	7.38	7.51	7.39	7.26	3.14	32.68	AA
A/8/194	7.21	7.38	7.33	7.55	2.89	32.36	AA
Sh/9/65	7.32	7.38	7.41	7.35	3.11	32.57	AA
B/8/93	7.34	7.25	7.44	7.31	3.13	32.47	AA
BT2	7.48	7.22	7.44	7.51	2.99	32.64	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 experimental plants were skiffed at 50 cm. The yield data were analyzed and presented in Table 33.

Table 33. Yield of green leaves

Clone	B/8/97	Sh/9/71	B/8/79	Sh/9/43	BT2
Treatment mean	367.74	337.12	378.65	391.45	334.67

Treatment difference- Insignificant

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.

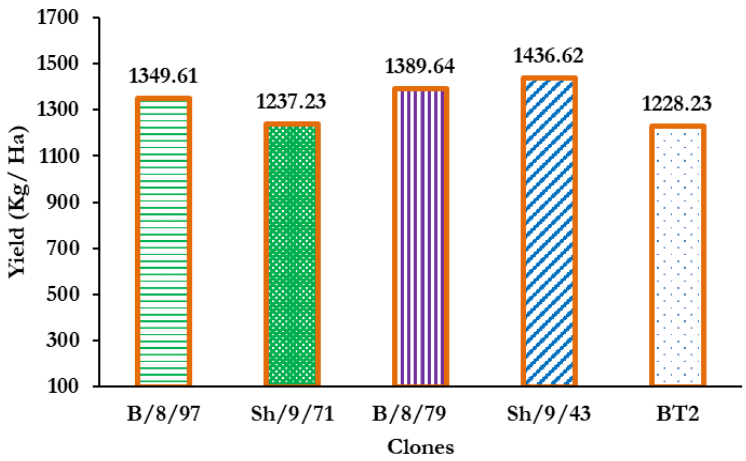


Fig. 18. Comparative yield of clones made tea (kg/ha)

Table 34. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.35	7.59	7.55	7.26	3.14	32.89	AA
Sh/9/71	7.27	7.46	7.32	7.31	2.96	32.32	AA
B/8/79	7.37	7.51	7.25	7.34	3.12	32.59	AA
Sh/9/43	7.35	7.54	7.83	7.22	2.91	32.85	AA
BT2	7.43	7.45	7.56	7.27	3.22	32.93	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 experimental plants were skiffed at 50 cm. The yield data were analyzed and presented in Table 35.

Table 35. Yield of green leaves

Clone	P/CHB/18/67	P/TLP/5/58	P/KPR/56	P/MDP/12/41	BT20
Treatment mean	337.34	374.23	393.55	353.52	366.54

Treatment difference- Insignificant

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

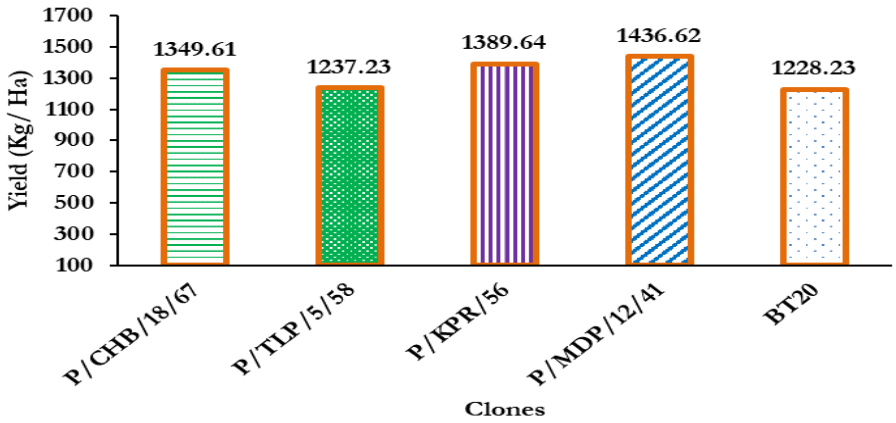


Fig. 19. Comparative yield of clones made tea (kg/ha)

Table 36. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/CHB/18/67	7.44	7.56	7.51	7.28	2.97	32.76	AA
P/TLP/5/58	7.28	7.49	7.36	7.38	2.96	32.47	AA
P/KPR/56	7.38	7.57	7.26	7.37	3.18	32.76	AA
P/MDP/12/41	7.38	7.58	7.82	7.21	2.97	32.96	AA
BT20	7.45	7.46	7.74	7.75	3.98	34.38	E

B2-59: Yield 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 experimental plants were skiffed at 50 cm. The yield data were analyzed and presented in Table 37. The estimated made tea production in kg/ha is presented in Fig. 20.

Table 37. Yield of green leaves

Clone	P/MPR/16a/99	P/AML/12/20	P/MPR/16a/78	P/RJG/6/19	BT15
Treatment mean	319.46	332.97	355.24	347.85	318.05

Treatment difference- Insignificant

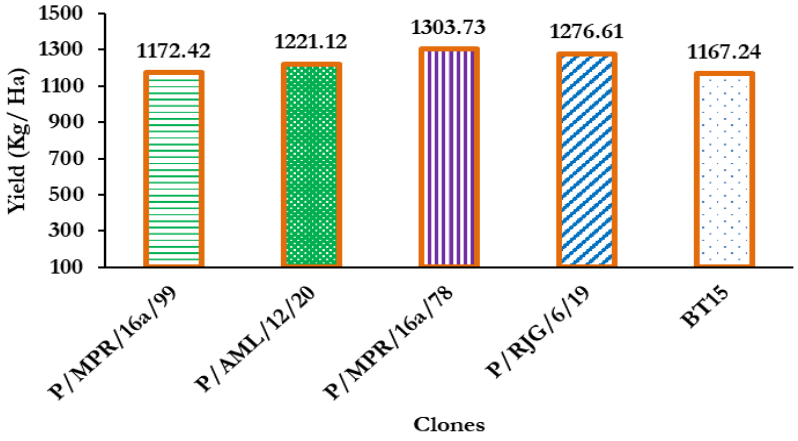


Fig. 20. Comparative yield of clones made tea (kg/ha)

The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 38.

Table 38. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/MPR/16a/99	7.24	7.64	7.31	7.15	3.2	32.54	AA
P/AML/12/20	7.38	7.37	7.32	7.33	2.83	32.23	AA
P/MPR/16a/78	7.36	7.43	7.42	7.31	2.56	32.08	AA
P/RJG/6/19	7.39	7.61	7.52	7.41	2.86	32.79	AA
BT15	7.24	7.71	7.54	7.33	4.26	34.08	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**". The experimental plants were decentered at 18 cm. The yield data were analyzed and presented in Table 39.

Table 39. Yield of green leaves

Clone	P/RU/LAI/13	P/RU/BTL/49	P/RU/LAI/53	BT19
Treatment mean	222.64	213.65	225.75	214.53

Treatment difference- Insignificant

B2-61: Yield and Quality Trial of four Test Clones; Test Clones– P1, P2, P3 and P4 against Standard BT2 (BTRI, 2021-2033).

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**". The experimental plants were decentered at 18 cm. The yield data were analyzed and presented in Table 40.

Table 40. Yield of green leaves

Clone	P1	P2	P3	P4	BT2
Treatment mean	202.88	216.11	213.64	201.54	195.24

Treatment difference- Insignificant

B2-62: Yield and Quality Trial of Three Test Clones; Test Clones– A1, A2 and A3 against Standard BT13 (BTRI, 2021-2033).

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**". The experimental plants were decentered at 18 cm. The yield data were analyzed and presented in Table 41.

Table 41. Yield of green leaves

Clone	A1	A2	A3	BT13
Treatment mean	186.34	210.43	213.65	196.43

Treatment difference- Insignificant

B3: BREEDING OF TEA (NO. OF EXPERIMENTS-8)

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 2021:

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 42: Crossing compatibilities and germination

Crossing combination		No. of pollinations	No. of fruit set	Fruit setting (%)	No. seeds germinated	Germination (%)
Receiver	Donor					
TV26 x BT10		26	13	50	6	46.15
BT4 x TV1		18	6	33.33	3	50
TV19x TV1		39	18	46.15	6	33.33
TV26 x BT6		42	17	40.47	7	41.17
TV1 x BT4		48	19	39.58	11	57.89
BT6 x TV26		22	11	50	5	45.45
BT2 x TV23		38	25	65.78	18	72
BT2 xTV19		31	19	61.29	6	31.57
TV1 x TV19		29	15	51.72	8	53.33
TV18 x BT3		38	28	73.68	25	89.28
TV23 x BT2		23	12	52.17	6	50
BT10 x TV26		31	15	48.38	7	46.66
BT2 x BT17		54	29	53.7	21	72.41
TV9 x BT2		34	22	64.7	12	54.54

Highest Percentages of fruit setting was found in TV18 x BT3 (73.68%) and Highest Percentages of germination was found in TV18 x BT3 (89.28%).

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 2022.

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 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.

B3-8: 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 different 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.

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 (2019-2022).

In 2022, two 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 (2019-2022).

In 2022, three 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 (2019-2022).

In 2022, three 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 (23 BTRI released clones, 5 test clones and 3 wild genotype) were planted in the nursery 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-13)

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.

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.

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.

B4-13: Amendment of existing of tea plantation area and standardization of new extension plantation area by using BTRI released clones for manufacturing better cup quality tea in Northern region of Bangladesh. (2022-)

This experiment will be started very soon.

B4-14. Impact of Biokad and micronutrients on productivity and sustainable tea farming (2021-).

Research activities will be continued and detailed data will be published after completion of the experiment.

B4-15. Fabrication and characterization of polymer matrix composite based on tea waste and different polymer (2021-).

Research activities will be continued and detailed data will be published after completion of the experiment.

B4-16. Estimation of simple equation for measuring Leaf Area of BTRI released individual clones and biclones (2021-).

Research activities will be continued and detailed data will be published after completion of the experiment.

B4-17. Effect of number of tea leaf pubescence and rate of fermentation on made tea quality of BTRI released clones & biclones (2021-).
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-18: Impact of blending on commercial tea cultivar on black tea quality along with price. (2021-)
This experiment will be started very soon.

B4-19: Effect of nursery-tipping on the development of stem girth in different tea saplings / seedlings.
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-20: Effect of different media on tea seed germination
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-21: Study of phenological attributes and floral morphology of some selected tea germplasm in Bangladesh
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-22: SMART tea gardening in Bangladesh.
This experiment will be started very soon.

Summary of activities of Botany Division-2022

1. No. of Experimental, Advisory and Official Visit: 25
2. Correspondence: 91
3. Tea Tasting Course/ Session: 07

Date	Type	Venue	Participants/ Number of Tea Estate
30.7.22	Central Tea Tasting	BTRI Tea Tasting Room	Participants: 80
27.09.22	Group Tea Tasting	BTRI Tea Tasting Room	Number of Tea Estates: 11
12.10.22	Balisira Valley Tea Tasting	Balisira Valley Club	Number of Tea Estates: 17
13.10.22	Luskerpore Valley Tea Tasting	Luskerpore Valley Club	Number of Tea Estates: 11
04.11.22	Juri Valley Tea Tasting	Juri Valley club	Number of Tea Estates: 12
05.11.22	Monu Doloi Valley Tea Tasting	Monu Doloi Valley club	Number of Tea Estates: 12
05.11.22	Lungla Valley Tea Tasting	Lungla Valley club	Number of Tea Estates: 11

4. Received Tea Sample Tasting: 1005
5. Quantity of planting material supplied:

Rooted cutting (nos.)	Seasonal Bi-clonal seeds (kg)
2463	134

AGRONOMY DIVISION

Dr. Toufiq Ahmed
Chief Scientific Officer
And
Dr. Mohammad Masud Rana
Principal Scientific Officer

RESEARCH

A total of nine experiments (7 ongoing and 2 new) and two field trials were approved in the RSC meeting to carry out by Agronomy division in 2022. The experiments were under two research program areas such as (i) standardization of cultural practices; and (ii) development of soil fertility. Among the 09 experiments, 8 were conducted in 2022 and 1 could not be started due to some unavoidable circumstances. Results of the experiments and field trials 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 Farm; Long term: 2010-2023)

Treatments: 05

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

Planting materials: The clones BT1, BT2, BT5, BT11, BT12 and BT13 were used in the experiment. The experiment was laid out in a Split Plot Design with three replications and total number of plots under the experiment is 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 2022, it was observed that significantly highest yield was obtained in the treatment T_1 and that was followed by T_4, T_5, and T_2; and the lowest yield was obtained in T_3 (Table 1). These differences in yields were due to the differences in the given pruning operations. However, the yields from T_4, T_5, and T_2 are statistically identical. The interaction effect between the clone and treatment was not significant (Figure 1). From overall analysis (2010-2022) it is observed that longer pruning cycles are providing higher yield of tea (Figure 2). It is noted that the 7-years long pruning cycle (T_5) gave 18.85% more yield compared to the existing BTRI recommended 4-years pruning cycle (T_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 2022

Treatments	Yield (kg/ha)
T_1 (LP–**DS**–MS)	3503 a (DS)
T_2 (LP–DS–**MS**–LS)	2877 b (MS)
T_3 (LP–LS–**DS**–MS)	2380 c (DS)
T_4 (LP–LS–DS–MS–**DS**–LS)	2955 b (DS)
T_5 (LP–DS–MS–LS–DS–MS–**LS**)	2908 b (LS)
LSD (0.01)	415.5
CV (%)	15.89

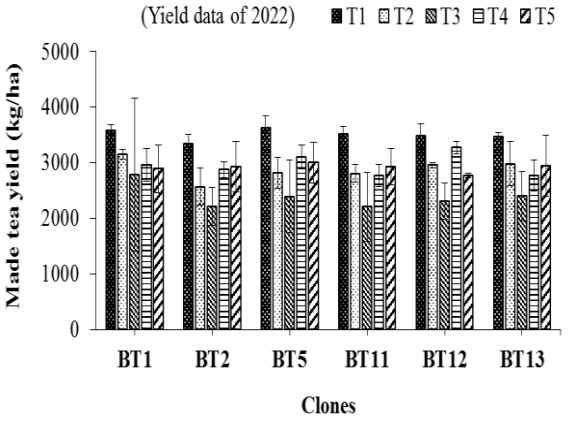


Figure 1. Interaction effect of different clones with different treatments in 2022

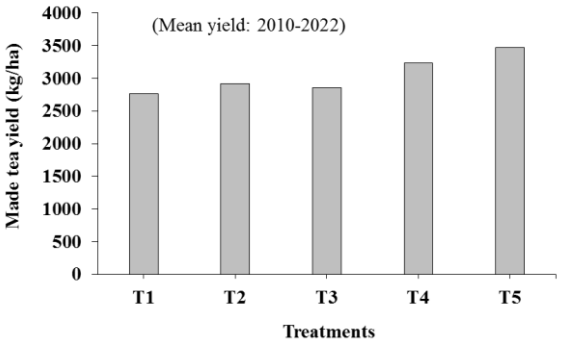


Figure 2. Average yield of made tea (kg/ ha) in different treatments from 2010-2022

Experiment 2: Effects of different types of composts on growth and development of clonal tea (BTRI Main Farm, Duration: 2017-2022)

Treatments: 04

T_1 : Applied 2 kg vermi-compost per pit during the plantation

T_2 : Applied 2 kg farm-yard compost per pit during the plantation

T_3 : Applied 2 kg decomposed water hyacinth per pit during the plantation

T_4 : Applied 2 kg decomposed cowdung per pit during the plantation (Control)

The experiment was set as a Randomized Complete Block Design (RCBD) with 04 replications. Year 2021 was the 4th year of young tea plants and pruning height of these plants were 18 inches from the ground. Data were collected on the harvested green leaf yield from each plot and number of branches per plant. For the interpretation of results, green leaf yield of each plot was converted as made tea yield (kg/ha).

Progress: After analyzing the yield data of 2022, it was observed that yield was not significantly different for treatments at p=0.05. However, among the treatments, higher yield was obtained in T_4 (1215 kg/ha) that was followed by T_1 (1210 kg/ha), T_3 (1182 kg/ha), and T_2 (1138 kg/ha)(Figure 3).

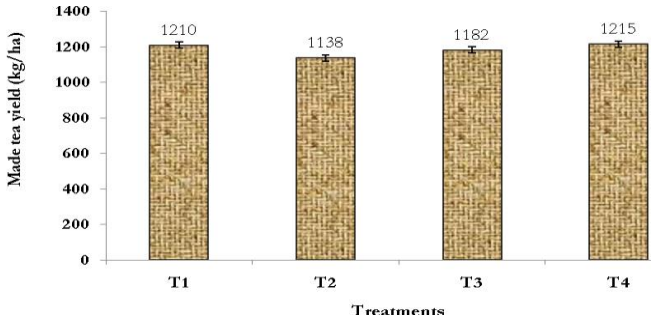


Figure 3. Variation of made tea yield due to treatments

However, after the formative pruning, number of branches per plant and base diameter of the main stem (collar zone) were observed significantly different for treatments. T_4 exhibited the highest number of branches per plant as well as the largest base diameter. This was closely trailed by T_3 and T_1, with no statistically significant differences among them (Table 2). T_2 showed the poorest performance among them.

Table 2. Effect of treatments on number of branches and base diameter at the final stage of young tea (after formative pruning at 22 inches)

Treatments	No. of branches/plant	Base diameter (mm)
T_1 (Vermicompost)	18 ab	32.5 ab
T_2 (Farm-yard compost)	16 b	28.9 b
T_3 (Water hyacinth compost)	18 ab	32.9 a
T_4 (Decomposed cowdung – Control)	21 a	33.0 a
Mean	18	31.9
LSD (P=0.05)	3	3.7
CV (%)	15	10

Experiment 3: Mechanization in pruning and its impact on the yield of tea (BTRI Main Farm; Duration: 2019-2023)

Objectives:

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

Treatments: Different pruning policies using the machine and traditional pruning knife (Figure 4) were the different treatments of the experiment. The traditional method of pruning using pruning knife was the control treatment. The study tested three distinct pruning policies across four types of pruning operations (LP, DSK, MSK, and LSK).

Figure 4. Photos of the pruning machine and the traditional pruning knife

a) Different pruning policies-

T_1 : Manual pruning using traditional pruning knife (Control)
T_2 : Machine pruning only
T_3 : Machine pruning followed by manual repairing

b) On different types of pruning-

1. Light Pruning (LP)
2. Deep Skiff (DSK)
3. Medium Skiff (MSK)
4. Light Skiff (LSK)

Data collection: During the experimentation, three distinct pruning policies were applied to various pruning types in the field. Data was collected regarding the number of bushes pruned per hour, resource inputs (such as labor and fuel) necessary for each pruning policy, and the resulting yield outcomes.

Progress: The experiment was initiated at BTRI main farm on December 2019. A mature tea field of BT2 was used 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. All the pruning operations were completed in between December 2021 to February 2022 according to the treatments. Yield data were collected during each plucking as green leaf/plot and converted to made tea/ha. From the results, it was noticed that there was no significant difference in yield between traditional manual pruning and machine pruning (Figure 5). Notably, no negative impact of machine pruning on tea yield was noticed; the yield either increased or remained almost equal compared to traditional pruning. Machine pruning expedited the task completion by 2.40-3.67 times compared to traditional manual

pruning (Table 3). Across different pruning types, the fuel consumption of the machine ranged between 0.27 and 0.37 liters per hour (Table 4). Per hectare fuel consumption was highest for LP (59.26 liter/hectare) and lowest for LSK (33.33 liter/hectare). The experiment will be continued.

Table 3. Comparison of efficiency between machine pruning and manual pruning

Pruning Type	Machine Pruning*		Manual Pruning (On the basis of tasks**)		Ratio (Machine: Manual) (on the basis of required time/ha)
	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	55	283 hrs	15	1038 hrs	1 : 3.67
DSK	110	142 hrs	31	498 hrs	1 : 3.51
MSK	113	137 hrs	44	356 hrs	1 : 2.60
LSK	119	130 hrs	50	312 hrs	1 : 2.40

** Two people was involved for each machine for taking rest and to do the work alternatively.

** 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 4. Fuel consumption in machine pruning (continuous run)

Pruning Type	Fuel consumption per hectare (Octane in liter)	Fuel consumption per hour (Octane in liter)
LP	59.26	0.27
DSK	35.19	0.34
MSK	37.04	0.37
LSK	33.33	0.34

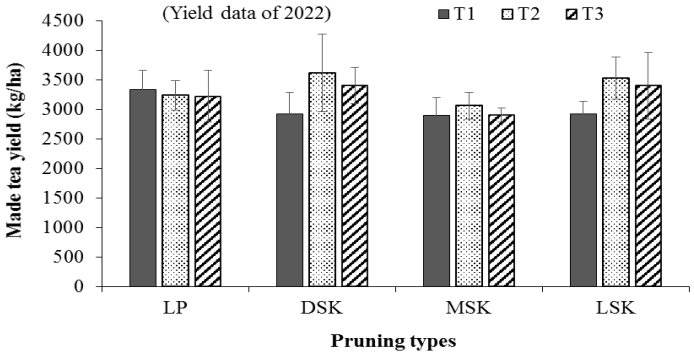


Figure 5. Yield of tea under different treatments on various pruning types in 2022.

Experiment 4: Implementation of grafting technique to produce composite tea plant in the nursery for increasing yield and drought resistance capacity of the plant (V.P Nursery, BTRI Main Farm, Duration: 2020-2022)

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

Treatments: 04

T_1 : BT2
T_2 : BT12
T_3 : BT15
T_4 : BT17

The experiment comprises 04 (Four) treatments. Scions collected from four distinct BTRI released high yielding clonal tea plants were the different treatments. Bi-clonal seedling tea plants were the 'root stocks' for all the treatments. Completely randomized block design was followed having five replications. There were 50 seedlings in each replication and the total number of seedlings used for the study was 1000.

In 2021, data were collected mainly on the sprouting percentage after completion of grafting in the nursery. Grafted tea plants were maintained in the nursery for about a year until they were ready for transplantation into the main field. In 2022, data were collected on plant height, rooting depth, and dry weight of roots of the grafted plants during the time of planting in the main field.

Results: After analyzing the collected data of 2022, it was observed that during planting in the main field, plant height significantly different for treatments (p=0.05). Maximum height was observed in T_1 (59.9 cm) which was statistically similar with T_4 (56.8 cm) and T_3 (56.5 cm) but different with T_2 (43.4 cm), presented in Figure 6. Similarly, rooting depth and root dry weight were also found significantly different for treatments and results are shown in the Table 5.

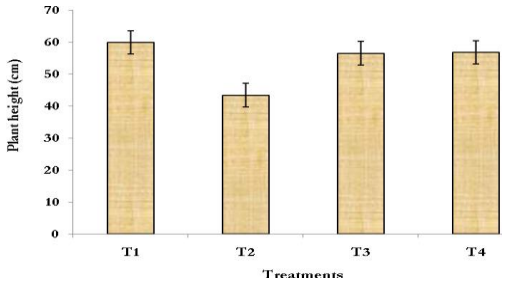


Figure 6. Height of tea plants in different treatments during the time of plantation in main field

Table 5: Root depth and dry weight of root of grafted tea plants during the time of plantation

Treatments	Root depth (cm)	Root dry weight (gm)
T_1 = BT2	14.25 a	3.47 a
T_2 = BT12	11.75 b	2.43 b
T_3 = BT15	13.25 ab	3.18 a
T_4 = BT17	12.25 ab	2.93 ab
Mean	12.87	3.0
CV (%)	12	13
LSD (p=0.05)	2.39	0.63

Experiment 5: Effect of different irrigation techniques to irrigate young tea, planted at the hot slope in tillah area (Newly plantation area of Bilashcherra Experimental Farm, BTRI, Duration: 2021-2024).

Justification: In Bangladesh, due to unevenness of seasonal rainfall often causes seasonal drought during the month of November – March. Beside this, the soil of tea gardens particularly in tillah area is thin, poor in water retention capacity and strong in permeability. Therefore, the young tea plants planted in tillah area severely suffer from drought. In order to solve the problem, several economic and water-saving irrigation techniques are used in tea gardens and sprinkler irrigation technique is widely used among them. Sprinkler irrigation system is more costly, hard to manage and time consuming.

Therefore, in the present experiment has been carried out to find the effective and economic irrigation system to irrigate young tea, especially young tea planted at the hot slope in tillah area.

Objective (s):

1. To observe the efficacy of different irrigation techniques over the control in southern part of tillah area; and
2. To find out the most effective and economic irrigation techniques for hot slope of tillah area.

Treatments: 05

T_1 : No irrigation (Control)

T_2 : Sprinkler irrigation: 2 hours at 15 days interval

T_3 : Sprinkler irrigation: 2 hours at 10 days interval

T_4 : Drip irrigation: 2 hours at 15 days interval and

T_5 : Drip irrigation: 2 hours at 10 days interval

The experiment was laid out in a Randomized Complete Block Design (RCBD) with 03 replications. Data will be collected on casualty percentage, growth parameters (Number of branches, diameter of branches and bush formation quality), and yield. Expenditure of different treatments will also be calculated.

Progress: Due to some unavoidable circumstances, the experiment could not be started during the dry period of 2022. However, attempts will be made to start the experiment at the beginning of next dry period (October 2023).

Experiment 6: Effect of different plucking rounds on yield and quality of tea at Northern Tea growing area of Bangladesh (Northern Tea Growing Area, Panchagarh, Duration: 2021-2024).

Objective: To find out the best plucking system for Northern Bangladesh to ensure the quantity as well as the quality of made tea.

Treatments: 05

T_1 : Manual plucking at 10 days interval (Control)
T_2 : Manual plucking at 15 days interval
T_3 : Knife plucking at 25 days interval
T_4 : Knife plucking at 35 days interval
T_5 : Machine plucking at 30 days interval

The experiment was set in a Randomized Complete Block Design (RCBD) with 03 replications.

Data Collection: Data were collected regularly on harvested green leaf yield and quality. Moreover, number of plucking rounds were counted in a year under each treatment.

Progress: According to the experimental design, plucking data for different treatments were collected as green leaf and converted to made tea (considering 22% recovery). After each plucking, soft leaf percentage was also recorded. From the analysis result of yield data obtained in 2022, it was observed that yield was significantly affected due to treatments. Highest yield was obtained in the treatment T_5 and that was statistically similar to T_3 and T_4 (Table 6). The lowest yield was obtained in T_1. Whereas, soft leaf (%) was also found statistically significant for treatments. Maximum soft leaf (%) was found in T_1 followed by T_2, T_5, T_3 and the lowest was in T_4.

Table 6. Made tea yield (kg/ha) and soft leaf (%) under different treatments in 2022

Treatments	Made tea (kg/ha)	Soft leaf (%)
T_1	2659.991 b	75.708 a
T_2	3021.225 b	49.889 b
T_3	3290.413 ab	43.250 c
T_4	3373.130 ab	31.933 d
T_5	4238.853 a	44.667 c
LSD $_{(0.05)}$	1021.30	2.779
CV (%)	16.35	3.01

Experiment 7: Effect of light pruning (LP) completed at different months on growth and yield of tea Bilashcherra Experimental Farm and BTRI Main farm, Duration: 2022-2024).

Justification: The general recommendation from the Bangladesh Tea Research Institute (BTRI) has traditionally been to complete light pruning (LP) of tea bushes within the month of December. This practice has been followed by tea planters to achieve higher yields and improve tea quality. However, in recent years, there has been an observed trend of active buds and shoots persisting on tea bushes even in the month of December, which may be attributed to the effects of climate change. Considering the ongoing changes in climate patterns, it is reasonable to propose a hypothesis that the timing of pruning, especially LP, may need to be reconsidered. Therefore, an experiment was conducted in the field to investigate this potential adjustment.

Objective: To find out the best time period of LP for maximizing yield of tea in the context of present climate change.

Treatments and design: 06

T_1: Light pruning completed by 15 November
T_2: Light pruning completed by 30 November
T_3: Light pruning completed by 15 December
T_4: Light pruning completed by 30 December
T_5: Light pruning completed by 15 January
T_6: Light pruning completed by 30 January

The experiment was set in a Randomized Complete Block Design (RCBD) with 04 replications.

Progress: Pruning treatments have been executed as per the predefined timetable. Intercultural operations are being carried out in accordance with the recommendations provided by BTRI. Prior to the pruning of tea bushes, an assessment of the starch reserves in the tea plant roots was conducted. Data on harvested leaf yield and yield related parameters will be collected regularly.

Experiment 8: Effect of First Frame Formation Pruning of winter planted tea at different times after planting on its growth and survivality (Luskorpore Tea Estate, Luskorpore valley, Habigonj, Duration: 2020-2024).

Objective (s): To identify the appropriate time for first frame formation pruning of young tea and to minimize the time for young tea maintenance period.

Treatments: 07

T_1 : First Frame Formation Pruning in August, 2021
T_2 : First Frame Formation Pruning in September, 2021
T_3 : First Frame Formation Pruning in October, 2021
T_4 : First Frame Formation Pruning in November, 2021
T_5 : First Frame Formation Pruning in December, 2021
T_6 : First Frame Formation Pruning in January, 2022
T_7 : First Frame Formation Pruning in February, 2022

The experiment was laid out in a Randomized Complete Block Design (RCBD) with 03 replications. Data on striking rate (survival rate), growth parameters (number of branches, base diameter and bush formation quality) and yield will be collected.

Progress: According to the experimental design and operational time frame decentering, FFP1 and skiff for all the treatments were done. Yield data were collected as green leaf and converted to made tea considering 22% recovery rate. Mortality percentage was recorded for all treatments after the skiff and from which striking rate was calculated. From the analysis result of yield data and striking rate, it was observed that there is no significant difference among the treatments. Comparatively higher yield was obtained in the treatment T_3 and that was followed by T_1, T_2, T_5, T_4 and T_6; and the lowest yield was obtained in T_7 (Table 7). Whereas, striking rate was found 95-97% for different treatments. Regular observation is going on. Following the completion of the Final Frame Formation Pruning, data pertaining to number of branch, striking rate, and yield will be gathered. Subsequently, final comments will be made.

Table 7. Made tea yield (kg/ha) of different treatments in 2022

Treatments	Yield (kg/ha)	Striking rate (%)
T_1	436.535	94.67
T_2	425.737	94.67
T_3	448.624	94.00
T_4	419.170	94.67
T_5	421.394	95.33
T_6	418.771	94.67
T_7	396.578	94.00
LSD $_{(0.05)}$	53.557	3.50
CV (%)	7.10	2.08

Experiment 9: Development of a standard young tea pruning schedule for Northern Tea Growing areas of Bangladesh (Northern Tea Growing Area, Panchagarh, Duration: 2021-2027).

Objectives: To find out the best pruning schedule for bringing young tea into bearing for Northern Tea Growing areas of Bangladesh.

Treatments: 04

Operations	**Treatment 1**	**Treatment 2**	**Treatment 3** (Control)	**Treatment 4**
Planting date	May/2022	May/2022	May/2022	May/2022
Decenter (6-9 inch)	July-August/ 2022	October-November/ 2022	January-February/ 2023	Local Practice
FFP1 (14-16 inch)	January-February/ 2023	April-May/ 2023	January-February/ 2024	
Skiff (20 inch)	May-June/ 2023	January-February/ 2024	January-February/ 2025	
FFP2 (18-20 inch)	January-February/ 2024	January-February/ 2025	January-February/ 2026	
Skiff (27-29 inch)	May-June/ 2024	May-June/ 2025	January-February/ 2027	
First LP (20-22 inch)	December/ 2024	December/ 2025	December/ 2027	

The experiment was set in a Randomized Complete Block Design (RCBD) with 03 replications.

Progress: According to the experimental design and operational time frame, planting and decentering for all the treatments were completed. Regular observation is going on. Data on harvested leaf yield and yield related parameters (number of branch, branching behavior, and base diameter) will be collected regularly. The experiment will be continued till 2027 and then it will be feasible to provide final comments.

Field Trial 1: Effect of a plant growth regulator (FLORA – Nitrobenzene) on growth and yield of mature clonal tea (BTRI Main Farm, Duration: 2021-2022).

Justification: In the literature of the product 'FLORA', supplied by the company ACI Limited, it is mentioned that its main component is Nitrobenzene (20% w/w) and widely used for increasing yield of many crops including tea. Moreover, it is stated that its application increased tea yield about 30% in Vietnam and 19% in India. Hence, the trial was conducted following proper procedure to know its effect on growth and yield of tea in Bangladesh.

Treatments: 05

T_1 : Control

T_2 : Applied 2.0 ml Flora / L H2O after every 2 plucking round

T_3 : Applied 2.0 ml Flora / L H2O after every 4 plucking round i.e. monthly interval

T_4 : Applied 3.0 ml Flora / L H2O after every 2 plucking round

T_5 : Applied 3.0 ml Flora / L H2O after every 4 plucking round i.e. monthly interval.

The experiment was set in a Randomized Complete Block Design (RCBD) with 04 replications. Altogether, there were 20 plots in the trial and each plot consists 48 mature tea bushes (BT2 clone). The trial field was under DSK pruning operation. Data on harvested green leaf yield and active shoots (%) in the harvested green leaf were collected regularly from the field throughout the plucking season of 2022.

Results: After analyzing the collected data of 2022, it was observed that yield and active shoots (%) in the harvested leaf were not significantly different for treatments at p=0.05. Similar to the previous year, in 2022, the trial treatments gave higher yields compared to the control - T1 (Figure 7). However, there was no significant increase in yield with the adjustment of dosage or application intervals.

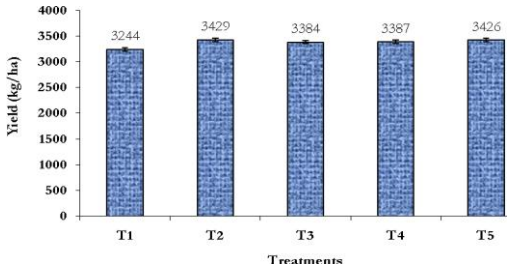


Figure 7. Variation of made tea yield due to treatments

Field Trial 2: Effect of a plant growth regulator (Clybio) on growth and yield of tea BTRI Main Farm, Duration: 2022 – 2023)

Justification: From the literature of the product supplied by the company Conpass Corporation, it is mentioned that 'Clybio' is a biotechnological product which is responsible for plant growth improvement. It is being used in many other countries as a bio-PGR on large number of crop varieties including tea. Hence, the trial is done to know the effect of 'Clybio' on growth and yield of tea in Bangladesh.

Treatments: 05

T_1 : Control

T_2 : Applied 2.0 ml Clybio / L H_2O after every 2 plucking round

T_3 : Applied 2.0 ml Clybio / L H_2O after every 4 plucking round *i.e.* monthly interval

T_4 : Applied 3.0 ml Clybio / L H_2O after every 2 plucking round

T_5 : Applied 3.0 ml Clybio / L H_2O after every 4 plucking round *i.e.* monthly interval

The experiment was set in a Randomized Complete Block Design (RCBD) with 04 replications. Altogether, there were 20 plots in the trial and each plot consists 48 mature tea bushes (BT2 clone). The field was under DSK pruning operation. Data on harvested green leaf yield and active shoots (%) in the harvested green leaf were collected regularly from the field throughout the plucking season of 2022.

Results: After analyzing the collected data of 2022, it was observed that yield was not significantly different for treatments at p=0.05. But the yield data showed a positive trend on application of the PGR (Clybio). All treatments of this trial gave higher yields than the control- T_1, presented in Figure 8. Similarly, active shoots (%) in the harvested green leaf was found non-significantly different for treatments.

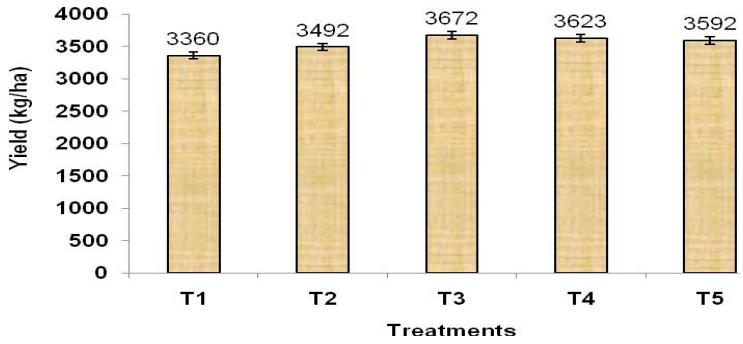


Figure 8. Variation of made tea yield due to treatments

OTHER ACTIVITIES

Visits:

Apart from divisional research activities and experimental visits, scientists of the division kept themselves busy to enrich the tea industry through different activities. During the reporting year 2022, 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 5.

Table 8. Number of visit paid by the scientific personnel of the division during the reporting year

Reporting year	No. of advisory visits	No. of other official visits	Delivered lectures at MTC, PDU (Hours)
2022	31	27	73 Hours

Workshop/ Seminar

Researchers of Agronomy division accomplished **18** workshops in different tea estates to disseminate updated technologies among tea growers and planters on pruning, tipping, plucking, drainage, drought management etc.

BTRI Main Farm

Mr. Roni Debnath is the 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 »
Total	: 11.22 ha

Other crops

1) Rehabilitation crops	: 0.16 ha
2) Nursery	: 1.09 »
3) Mixed forest, Orchard, Lemon, Guava etc.	: 5.21 »
Total	: 6.46 ha

Other uses

Office, Laboratory, Guest house, Mosque, School, Factory, Club house, labour line, roads etc.	: 17.22 ha
Grand total	: 34.90 ha

Improved planting materials supplied

Year of supply	No. of fresh cuttings	No. of rooted cuttings
2022	355400	39739

Green leaf production and earning from other farm products

Reporting year	Green leaf production in kg	Earning from other farm products in Taka
2022	75165.25	37545

Green Leaf Supplied in kg

Reporting year	Central Factory BTRI	Mini Factory BTRI	Green Tea Factory	Total Green Leaf Production
2022	74662	104.30	398.95	75165.25

Independence and Victory Day

National Independence Day, Victory Day and other national holidays were celebrated with due solemnity during the reporting year following the guidelines circulated by the Government.

ENTOMOLOGY DIVISION

Dr. Mohammad Shameem Al Mamun
Principal Scientific Officer

STAFF

Dr. Mohammad Shameem Al Mamun and Mr. Shovon Kumar Paul were promoted to Principal Scientific Officer and Senior Scientific Officer, respectively on 16 August 2022. Mr. Shovon Kumar Paul joined at Entomology Division, BTRI on 1 September 2022 after completing his PhD deputation from Malaysia. Mr. Md. Jahangir Alam, Scientific Officer was died on 19 October 2022 due to a road accident. The posts of Chief Scientific Officer (01), Scientific Officer (02), Senior Farm Assistant (01), and Laboratory Assistant (01) were lying vacant during the period under report.

RESEARCH

Four experiments under three programme areas were carried out during the year of 2022. The experiments were - Biopesticides as promising alternative to chemical pesticides for sustainable management of major insect pests of tea; Formulation of a new organic fertilizer cum pesticide (FCP) and study the efficiency of foliar spray on tea plant; Survey and monitoring of new insect pests in tea due to change in climate: Causes and Remedies; Screening of pesticides against *Helopeltis*, Red spider mite, Termites, Nematodes, Looper caterpillar, Aphid and Thrips in tea. Details of the experiments together with their findings are furnished below:

ENT 1. BIORATIONAL MANAGEMENT

Expt. 1.1 Biopesticides as promising alternative to chemical pesticides for sustainable management of thrips in tea (2022-2024)

Progress: The experiment was carried out to evaluate the efficacy of different bio-pesticides such as pheromone lure (ThripNok), yellow and blue sticky traps, Spinosad (Bio-Spinosad 2.5SC), Matrin (Bio-Action 1.5%) and Flometoquin (Gladious 10SC) as chemical pesticide against thrips under field condition at BTRI main farm during 2022. The experiment was laid out in Randomized Complete Block Design with 3 replications. Pheromone lure and yellow & blue sticky trap have been collected from Russell IPM Bangladesh Limited. Pheromone lure, Yellow and Blue Sticky traps has been set up in 10 m distance from each of trap in the mature section of C area, BTRI main farm. The pesticidal plots and control plots have been taken 50 m away from sticky trap plots. These plot size were 5 m x 5 m. Traps were fixed at a height of 5" (inch) above from the bush canopy of tea. A total of 12 traps were set up in the experimental plot. The sticky traps (yellow & blue) replaced at fortnightly interval but the pheromone lures were not changed. In case of pesticidal plots, 3 rounds of pesticides were applied at the interval of 21 days and 42 days after the first application. Data on number of thrips & other insects catched in the traps were collected at weekly interval. Identification of different insects was confirmed with the help of available literature of Triplehorn and Johnson (2005), Mani (1982) and Das (1965).

Result revealed that pheromone lure with yellow sticky traps captured the highest number of thrips at different intervals (Fig. 1). It is cleared that pheromone lure had great impact in capturing more thrips in comparison to sole use of yellow or blue sticky traps. It was also observed that different types of insects besides thrips available in tea ecosystem were also captured in traps (Fig. 2a). The highest percentages of insect captured in different traps were thrips (47%) followed by jassid (19%), aphid (12%) and white fly (9%). Hence, other harmful insects like Jassid, aphid, whitefly, leaf roller moth, flushworm moth were also controlled to some extent by different traps. Moreover, some beneficial and other non-target insects such as lady bird beetle, hober fly, rober fly, wasp, preying mantis, bees, ants, cranefly were also caught on different sticky traps (Fig 2b). However, their percentages were found very low (6%) compared to harmful insects.

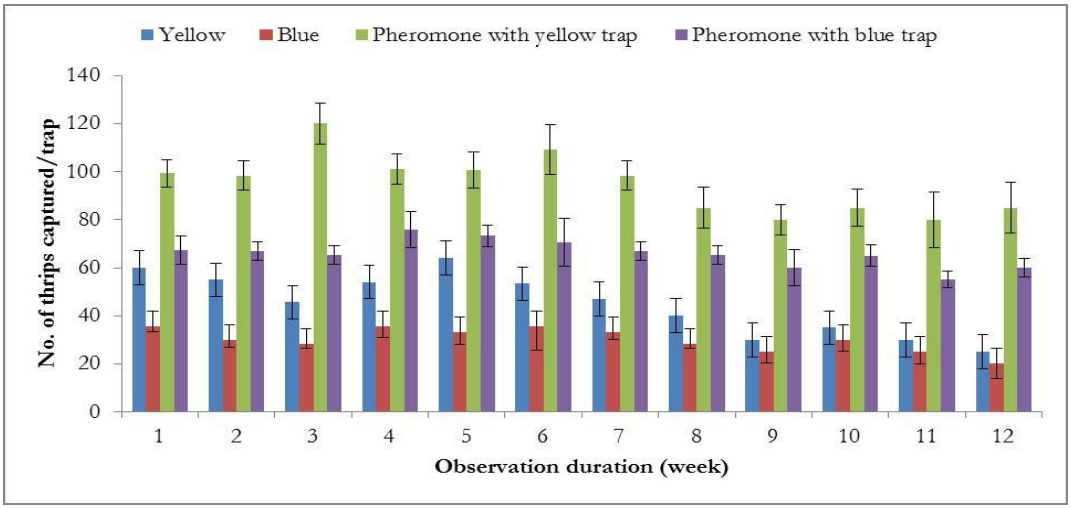


Fig. 1. Number of thrips captured per trap at different weeks.

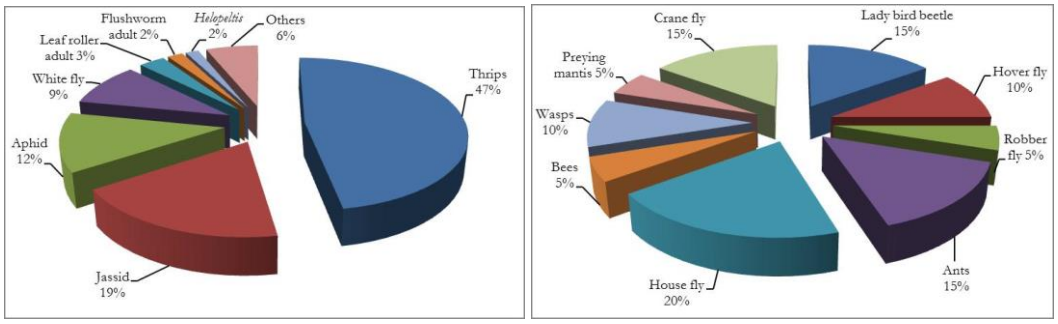


Fig. 2. Percentage of various insects captured on different traps (a) harmful insects and (b) other non-target insects.

Table 1. Percent effectiveness of different traps and insecticides for controlling thrips in tea.

Treatments	% effectiveness of different traps & insecticides after application												Overall mean effectiveness (%)
	after 1st setup		after 2nd setup		after 3rd setup		after 4th setup		after 5th setup		after 6th setup		
	1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk	7th wk	8th wk	9th wk	10th wk	11th wk	12th wk	
T_1	55.63	60.54	62.35	56.25	62.35	54.12	58.22	51.24	55.25	51.23	46.03	43.81	54.75e
T_2	50.85	58.32	53.21	50.45	55.56	48.35	53.12	47.23	51.41	46.15	49.53	41.59	50.48f
T_3	70.56	75.23	72.23	67.35	72.52	69.52	67.85	65.25	58.23	60.15	56.41	50.99	65.52c
T_4	60.25	70.56	66.52	64.48	67.24	63.41	61.53	60.53	53.74	50.85	49.23	47.15	59.62d
T_5	90.96	86.48	79.13	93.12	87.26	80.68	90.24	85.89	80.45	77.99	74.67	71.77	83.22ab
T_6	87.41	85.15	78.74	88.11	85.63	79.22	86.52	83.63	81.18	79.12	76.85	72.54	82.00b
T_7	91.25	88.26	79.45	90.05	86.43	80.78	90.19	87.25	85.23	83.52	81.15	76.56	85.01a
T_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00g

*Mean of 3 replications; Means with the same letter are not significantly different at P>0.05 using LSD.

T1= Yellow sticky trap @ 100 ha^{-1}
T2= Blue sticky trap @ 100 ha^{-1}
T3= Yellow sticky tap with Pheromone lure
T4= Blue sticky tap with Pheromone lure
T5= Spinosad 2.5% (Success 2.5SC) @ 650 ml ha^{-1}
T6= Matrin 1.5% (Bio-Action 1.5%) @ 1.5 L ha^{-1}
T7= Flometoquin 10% (Gladious 10SC) @ 500 ml ha^{-1}
T8= Control

Among the traps setup plots, the highest efficacy (65.52%) in terms of percent shoot infestation reduction was found in the plot of pheromone lure with yellow sticky traps (T3) and that of the lowest (50.48%) was found in blue sticky traps (T2). The results confirmed that the effectiveness of controlling thrips increased when pheromone lure was used rather than the sole use of yellow or blue sticky traps. On the other hand, the highest percent of effectiveness (85.01%) was observed in chemical treated plot (T7) followed by bio-pesticides treated plot T5 (83.22%) and T6 (82.00%) (Table 1). Though chemical options are better comparing with others in terms of mortality, bio control is most effective and safe for both target mortality and environment.

ENT 1. BIORATIONAL MANAGEMENT

Expt. 1.2 Formulation of a new organic fertilizer cum pesticide (FCP) and study the efficiency of foliar spray on tea plant (2022-2023)

1.2.1. Determining the toxicity effect of FCP against Helopeltis through bioassay technique

Progress: This experiment was conducted at Entomology laboratory, BTRI to determine the toxic effect of FCP against *Helopeltis*. The toxicity of FCP was done by topical application method according to the method of Talukder and Howse (1993) with slight modification. Different concentrations of FCP (2%, 4%, 6% & 8%) were prepared with water solvent. *Helopeltis* was collected from BTRI main farm. One micro-liter (µl) of prepared solution was applied to the dorsal surface of the thorax of each insect using a micropipette. Ten bugs (five males & five females) per replication were treated and each treatment was replicated thrice.

In addition, the same numbers of insects were treated with water only for control. After treatment, the insects were transferred into 9 cm diameter petridishes (10 insects/petridish) containing fresh tea shoots. Insect mortalities were recorded at 24, 48 and 72 hours after treatment (HAT). Original data were corrected by Abbott's (1987) formula.

Table 2. Effect of different concentration of FCP (A) and Time (B) on the mortality of *Helopeltis* adult in laboratory.

Treatment	Mortality (%)
Concentration of FCP (A)	
FCP 2%	41.93±1.35d
FCP 4%	47.75±1.69c
FCP 6%	55.64±2.15b
FCP 8%	60.26±1.90a
Control	0.00e
Time (B)	
24 HAT	36.71±5.14c
48 HAT	41.29±5.81b
72 HAT	45.34±6.37a
Significance level	
Treatment	**
Time	**
Treatment *Time	*
Mean	41.12
CV (%)	6.12

HAT= Hours After Treatment; * 0.05 level of significance; ** 0.01 level of significance

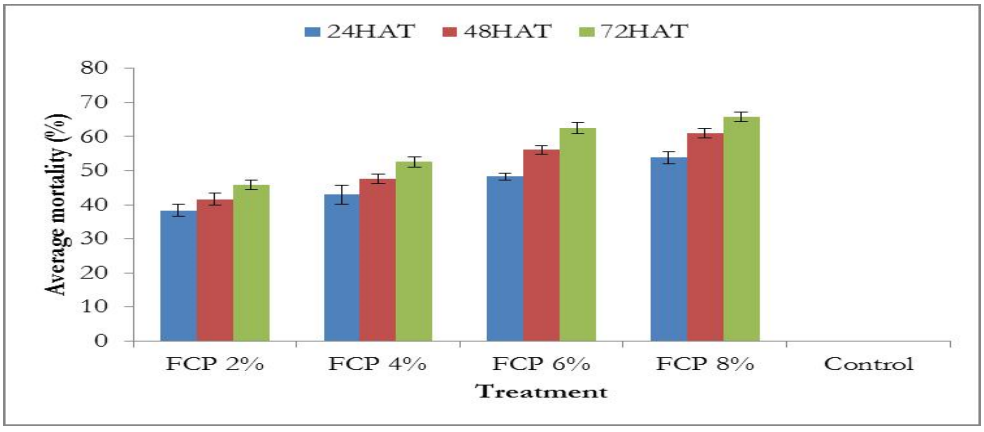


Fig. 3. Mean mortality of *Helopeltis* on concentrations of FCP in laboratory.

Results showed that both the concentration of FCP and time had significant effect on the mortality of *Helopeltis* under laboratory condition (Table 2). The highest mortality was observed in FCP 8% concentration (60.26%) and 72 HAT (45.34%). The mortality rate was increased with the increasing of FCP concentration and observation duration (Fig. 3). Field evaluation of FCT at different concentrations against *Helopeltis* is in progress.

1.2.2. Determining the efficacy of FCP against plant parasitic nematodes

Progress: The experiment was conducted in pot at Nematology Field Laboratory, Entomology Division, BTRI in Complete Randomized Design (CRD) with three replications. Plastic pots (22 cm dia) were filled with sandy loam soil and cowdung in 3:1 ratio. Then different doses of FCP were mixed with the pot soil. A chemical nematicide, Fipronil 3% (Goolee 3GR) was used as standard to compare the efficacy of FCP. A pot filled with only water has been considered as control. The pot has been kept for 2 weeks and watered regularly for decomposition of FCP. Fourteen (14) months old tea seedling has been planted in those pots after 2 weeks. Pre-treatment observations on the presence of nematodes were made. Second and third round applications were done at 60th days and 120th days, respectively. Post treatment observations were recorded at 15 days intervals and thus a total of twelve observations were recorded. The soil was collected and analyzed to find out the nematode population in 10 g soil. Nematode extraction was done by "Bayerman Funnel Method". The efficacy of different treatments was counted by using Henderson & Tilton formula. The efficacy data were analysed by SAS programme (version 9.4) and the mean values were separated by LSD test at 0.05 level of significance.

Results revealed that different doses of FCP and chemical nematicides reduced nematode population over control. The highest efficacy (84.36%) was found in chemical nematicides treated pot (T7). Among the different doses of FCP, T6 (Planting with soil + Cowdung + 16 g FCP) showed the highest efficacy (65.16%) in controlling nematodes (Table 3).

Table 3. Percent effectiveness of different doses of FCP for controlling nematodes in tea.

Treatments	% effectiveness of FCP & chemical nematicide after application												Overall mean effectiveness (%)
	after 1st application				after 2nd application				after 3rd application				
	15 days	30 days	45 days	60 days	75 days	90 days	105 days	120 days	135 days	150 days	165 days	180 days	
T_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00f
T_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00f
T_3	48.67	44.30	38.91	35.87	52.97	47.96	43.14	38.35	51.54	48.87	46.56	44.13	45.11e
T_4	56.73	53.56	50.78	46.99	58.98	52.54	49.02	45.53	57.99	54.86	52.15	48.94	52.34d
T_5	66.29	61.77	58.86	55.46	68.81	65.51	62.36	58.59	64.29	58.85	55.52	51.12	60.62c
T_6	71.55	67.88	64.81	60.83	69.03	65.74	60.41	56.30	72.84	67.10	64.33	61.11	65.16b
T_7	87.88	82.22	78.34	73.57	92.00	86.49	83.14	78.52	93.69	89.28	85.04	82.16	84.36a

*Mean of 3 replications; Means with the same letter are not significantly different at P>0.05 using LSD.

T1= Planting with only soil
T2= Planting with soil + Cowdung
T3= Planting with soil + Cowdung + 4 g FCP
T4 = Planting with soil + Cowdung + 8 g FCP
T5 = Planting with soil + Cowdung + 12 g FCP
T6 = Planting with soil + Cowdung + 16 g FCP
T7 = Fipronil 3% (Goolee 3GR) @ 165 g/m3

ENT 2. SURVEY OF NEW INSECT PESTS

Expt. 2.1 Survey and monitoring of new insect pests in tea due to change in climate: Causes and Remedies (2021-2023)

Progress: Survey and monitoring was initiated to find out the invasion of new insect due to climate change. Monitoring directly and/or collecting data from affected zone/T.E. randomly identified from sampled area (100 tea bush in a plot). Frequent data collection from same area year the round has conducted to find out the seasonal abundances and nature of damage. Monthly data collection has been continued.

The occurrence of green weevil pest has been first noticed at Monipur T.E. Recently, 20 tea garden such as Monipur T.E., Moomincherra T.E., Amtoli T.E., Dinarpur T.E., Sathgaon T.E., Clonal T.E., Saif T.E., Madhupur T.E., Rajnagar T.E., Pathrokhola T.E., Mathiura T.E., Zareen T.E., Bilashcherra Experimental Farm etc.) have reported the spot occurrences of this herbivorous pest. Adult weevils from different tea estates were collected and reared in laboratory under full controlled condition with support (suitable host). The morphological features have been done to the identified weevils and nature of damage of the weevil was also studied both in controlled and field conditions. The pest is identified as Golden/Green Weevil, *Hypomeces pulviger* (Order: Coleoptera; Family: Curculionidae). It measures about 14.00 mm in length and is covered with green or yellow metallic scales, giving the beetle a dust-like appearance. The adult beetle has an elongated snout with chewing mouthparts located at the end of the snout. The weevil, as the herbivorous pest causing sporadic and irregular damage making an irregular hole in maintenance (mostly) leaves. The pest normally attack in May-June and September in the cropping season. The experiment is continued.

Plate 1. Adult weevil pest and its damage symptom on tea leaves

ENT 4. SCREENING OF PESTICIDES

ENT 4.1. Screening of pesticides against *Helopeltis*, Red spider mites, Termites, Nematodes, Looper caterpillar, Aphids and Thrips in tea (2022-2023)

Progress: The experiment was conducted in main farm and Bilashcherra experimental farm of BTRI in RCBD with three replications. The pre-treatment observations were taken before first application on the same date along with the post-treatment observations at one week interval for *Helopeltis*, thrips, aphid and looper caterpillar. Second and third application was done after 3 weeks and 6 weeks intervals, respectively. For red spider mite, infested leaves were brushed by mite brushing machine and mites were counted under a Stereo-microscope in the laboratory. In case of termite, Second and third applications were done after 4 months

and 8 months interval, respectively. Post-treatment observations were noted at monthly intervals. For nematode, second and third round applications were done at 60th days and 120th days, respectively. Post treatment observations were recorded at 15 days intervals. Nematode extraction was done by "Bayerman Funnel Method". A total of 12 observations were recorded for all the field trials. Efficacy of pesticides was calculated by using Henderson & Tilton formula. Fifty two (52) chemical pesticides and five (05) bio-pesticides under different groups were evaluated against *Helopeltis* (22), Red spider mite (12+4), Termite (10), Thrips (2+1), Looper caterpillar (1), Aphid (4) & Nematode (1) in the field and the reports were sent to plant protection wing for their standardization. The results revealed that all the tested pesticides was found satisfactory (>80% effectiveness) for the control of pests of tea.

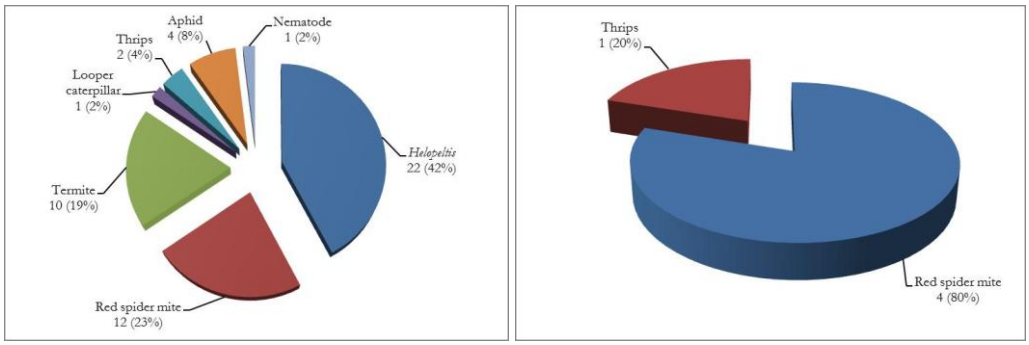


Fig. 4. Number (Percent) of chemicals trial against *Helopeltis*, Red spider mite, Termite, Thrips, Looper caterpillar, Aphid and Nematode (a) Chemical pesticides and (b) Bio-pesticides.

Table 4. Different group of new molecule of pesticides trial against major insect pests of tea.

Pests	Technical Name	Dose/ha
(a) Chemical pesticides		
Helopeltis	Imidacloprid 15%+Lambda Cyhalothrin 5%	350 ml
	Pymetrozine 60%+Nitenpyram 20%	250 g
	Thiamethoxam 20%+Emamectin Benzoate 20%	150 g
	Indoxacarb 14.5%+Thiamethoxam 10%	350 ml
	Diafenthuron 50%	500 ml
	Fipronil 20%+Acetamiprid 20%	200 g
	Cartap 92%+Acetamiprid 3%	100 g
	Indoxacarb 20%+Emamectin Benzoate 5%	250 g
	Indoxacarb 6% +Abamectin 3%	250 ml
	Azocyclotin 5%+Acetamiprid 10%	250 g
	Acephate 50%+Imidacloprid 5%	500 g
Red spider mite	Fenpropathrin Plus 15%+Pyriproxyfen 5%	500 ml
	Emamectin Benzoate 20%+Thiamethoxam 20%	150 g
	Thiocyclam-Hydrogenoxalate 50%+Abamectin 0.5%	1.50 kg
Termite	Cartap 92%+Acetamiprid 3%	500 g
	Dinotefuran 20%+Thiamethoxam 30%	500 g
	Fipronil 40%+Imidacloprid 40%	500 g
	Emamectin benzoate 5%+Hexaflumuron 25%	500 g
Thrips	Dinotefuran 20%+Pymetrozine 50%	300 g

	Flometoquin 10%	500 ml
Aphid	Chlorfenapyr 24%+Lufenuron 6%	250 ml
Nematode	Clothianidin 5%	165 g/m^3
(b) Bio-pesticides		
Red spider mite	Abamectin 1.8%	1.00 L
	Azadirectin 0.15%	2.50 L
	Abamectin 1.2%	1.00 L
Thrips	Spinosad 2.5%	650 ml

OTHER ACTIVITIES

Advisory and Experimental visits

A total of fourteen (14) advisory visits were paid to different tea estates to identify and render advice on specific pest problems and Eleven (11) 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 one hundred twenty two (122) soil samples were analyzed in the Laboratory for nematode count and reported to different tea estates. Physical test of six (06) insecticides sent from tea estates were done and reported to different tea estates.

Tours/Visits

A total of two (02) official visits were paid by the Scientists of the division to different organizations/T.E. for Official purposes.

Annual courses/MTC module

The Scientific personnel of the division delivered lectures on tea pest management at Annual Courses held at BTRI, Srimangal and BTRI Sub-Station, Fatikchari, Chittagong 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 conducted

A total of two (02) workshops were conducted at different tea estates under different valley circles on tea pest management during 2022.

Publications

1. M.S.A. Mamun. 2022. Integrated pest management (IPM) strategies for sustainable tea cultivation. Presented the paper in the conference and abstract has been published in the Proceeding of the 7th Edition of Global Conference on 'Plant Science and Molecular Biology' held on 1-2 September 2022 organized by Magnus Group at Paris, France.

2. S.K. Paul, N.A. Adam, S, Jamian and A.S. Mokhtar. 2022. Life cycle and determination of nymphal instars of *Helopeltis theivora* Waterhouse (Hemiptera: Miridae). Presented poster and abstract has been published in the proceedings of 11th International Conference on Plant Protection in the Tropics (ICPPT) held on 14-15 September 2022 organized by Malaysian Plant Protection Society (MAPPS) at Langkawi, Malaysia.

PLANT PATHOLOGY DIVISION

Mohammed Syeful Islam
Principal Scientific Officer
Plant Pathology Division

(1) STAFF

Mr. Mohammed Syeful Islam was promoted to the post of Principal Scientific Officer on 16 August 2022. Mr. Moshiur Rahman Akonda was promoted to Senior Scientific Officer of Botany division and Mr. Raihan Mujib Himel also was promoted to Senior Scientific Officer of Plant Pathology division on 16 August 2023. Mr. Aurongozeb, Laboratory attendant was attached to sale center on 16 November 2022. Mr. Shakil Ahmed, Duftry joined the division on 6 October 2022. The post of two Scientific Officers, one Field Assistant, and one Laboratory attendant of the division were remained vacant. There were no other changes in the staff position of this division during this period.

(2) RESEARCH

Five experiments (ongoing 3 and new 2) were approved to conduct during 2022. Among these four experiments were carried out under the research program of disease management and rest one was under weed management. However the progresses of the experiments are as follows:

(1) Title: Investigations on Phytotoxicity of commonly used fungicides for controlling tea diseases in Bangladesh.

Objective:

1. To assess the residue of fungicide in tea plants.
2. To determine fungicidal accumulation in the plant cells and tissues.

Activities:

- Nine different groups of fungicides along with control were sprayed with recommended doses against Black rot and Red rust diseases. The fungicides were sprayed 2 times at 7 days intervals for contact and 15 days for systemic fungicides.
- Shoot and leaf sample were taken at 7 days after last spraying.
- Extract/ solution were prepared separately.
- The absorption was analyzed by Atomic Adsorption Spectrophotometer at 400 nm by determining density (Sumardiyono, 1996). These were compared with control.
- Cells and tissues of vascular bundle of tea shoots were studied and compared with control; (Kadambari, 1968) following a scale 1 = - (No damage or blockage), 2= ++ (1- 20%), 3= ++++ (21- 40%), 4= ++++++ (41- 60%) and 5= *** (Above 60%)
- Cells and tissues of leaves were studied and compared with control; (Kazuma Sakoda, 2020)

Progress:

1. Statistically similar absorbance was found for all treatments.
2. No blockage or accumulation or damages in cells and tissues of shoots and leaves were observed (Table 1)

Conclusion:

Preliminary it can be concluded that there was no residual impact on tea plants

Table1: Showing absorbance, Cells and tissues of shoots and leaves against different fungicides

Sl No	Chemicals	Absorbance at 400 nm	Grading Cells and tissues of shoots	Grading Cells and tissues of leaves
1	Copper oxychloride 50 WP	1.169 a	1	1
2	Propineb	1.169 a	1	1
3	Copper Hydroxide 77 WP	1.171 a	1	1
4	Carbendazim 50 WP	1.169 a	1	1
5	Azoxystrobin + Tebuconazole	1.171 a	1	1
6	Mancozeb 80 WP	1.170 a	1	1
7	Mancozeb + Metalaxyl 72 WP	1.171 a	1	1
8	Carbendazim + Mancozeb	1.170 a	1	1

9	Azoxystrobin + Difenoconazole	1.171 a	1	1
10	Control	1.171 a	1	1
	CV= 0.08 and LSD 2.57			

The experiments will be continued

(2) Title: Cross Inoculation and Host Range Studies of some important tea pathogens in tea ecosystem.

Objective:

1. To specify the alternate harbor and /or succumb of tea pathogens by the sets of plants.
2. To regulate the environments of compatible and incompatible reactions and the identification of races in tea ecosystem.

Activities

1. Collection, isolation and purification of pathogen (from tea plants, shade trees and others plant species in tea plantations)
2. Performing pathogenicity test.
3. Cross inoculation studies through detached leaf inoculation method
4. Host range studies **(Tu, 1986 and Dath, 1985).**

Progress:

Fusarium oxysporum, Fusarium solani and *Rhizoctionia solani* were isolated from Seedling wilt, Stem canker and Damping-off of seedlings of *Albizia lebbeck* (Sirish). In Bangladesh tea plantations, the pathogen *Fusarium oxysporum* causes Gall disease of tea. But the isolated pathogen *Fusarium oxysporum* and *Fusarium solani* cannot produce Gall disease of tea. It might be due to host specificity by genetic coding.

Conclusion:

Preliminary it can be said that the pathogen either same genus and species or same genus different species of shade tree cannot produce tea disease in same ecology (Table 2)

Table 2: Showing Isolated pathogens from Host plants rather than tea and their inoculation impact on tea plants

Isolated pathogens from Host plants			**Inoculation impact on tea plants**
Isolated pathogens	**Disease**	**Host plant**	
Fusarium oxysporum	Seedling wilt	*Albizia lebbeck* (Sirish)	No disease symptoms were appeared in tea plants after inoculations.
Fusarium solani	Stem Canker	*Albizia lebbeck* (Sirish)	
Rhizoctionia solani	Damping-off of seedlings	*Albizia lebbeck* (Sirish)	

The experiments will be continued

(3) Title: Screening of BTRI clones against different diseases of Tea (2021-2025)

Objective:

1. To find out the tolerance level of BTRI released tea clones against some major diseases of tea in Bangladesh.

Activities

1. Survey was conducted to measure disease severity of different tea diseases.
2. Pathogens of Black rot, Blight and Dieback diseases were isolated and maintained as pure cultures for inoculations.
3. Inoculation was done by direct inoculation and wound inoculation technique.

Progress:

From Table 2(a) & Table 2(b), comparing all the clone it is revealed that in case of Red rust disease, BT 5 is susceptible to Red rust; BT 7, BT 10, BT 11 & BT 19 are moderately susceptible. BT 4 ,BT 6, BT 8, BT 9, BT 13, BT 16 , BT 18 & BTS1 are moderately tolerant while BT 1, BT 2, BT 3, BT 12, BT 14, BT 15, BT 17, BT 20 & BT 21 show tolerance to red rust disease.

In case of Leaf rust disease, BT 2 is susceptible to leaf rust; BT 5, BT 6, BT 7, BT 8, BT 9, BT 10, BT 12, BT 17, BT 18 & BT 19 are moderately susceptible. BT 1 ,BT 4, BT 11, BT 13, BT 14 , BT 15 & BT 16 are moderately tolerant while BTS1, BT 20 & BT 21 show tolerance to red rust disease.

In case of Black rot disease, BT 16 is susceptible to black rot; BT 5, BT 6, BT 10 & BTS1 are moderately susceptible. BT 4, BT 7, BT 8 & BT 9 are moderately tolerant while BT1, BT 2, BT 3, BT 11,BT 12, BT 13, BT 14, BT 15, BT 17, BT 18, BT 19, BT 20 & BT 21 show tolerance to black rot disease.
In case of Horse Hair Blight disease, BT 6 & BTS1 is susceptible to Horse Hair Blight; BT 1, BT 3, BT 4, BT 5, BT 8, BT 9, BT 10 are moderately susceptible. BT 2 , BT 11, BT 12, BT 13, BT 16 , BT 17, BT 18 & BT 20 are moderately tolerant while BT 14, BT 15, BT 19 & BT 21 show tolerance to Horse Hair Blight disease.
In case of Grey Brown Blight disease, BT 6, BT 8, BT 9, BT 11, BT 12, BT 13, BT 14, BT 15, BT 16, BT 17, BT 18 & BT21 is susceptible to Grey Brown Blight; BT 2, BT 3, BT 7, BT 19, &BTS1 are moderately susceptible. BT 1, BT 4, BT 5, BT 10 & BT 20 show tolerance to moderate tolerance to Grey Brown Blight disease.
In case of Branch canker, BT 1, BT 2 & BT 4 is susceptible to Branch canker; BT 3, BT 6, BT 7, BT 8, BT 9, BT 10, BT 15, BT 19, BT 20, BT 21 & BTS1 are moderately susceptible. BT 5, BT 11, BT 12, BT 13, BT 14, BT 16, BT 17 & BT 18 show tolerance to moderate tolerance to Branch canker disease. The experiment will be continued to the next year.
The experiment will be continued

Table 1 (a): Percent disease index of different diseases against different clones in 2022

Disease	Percent disease index											
	BT 1	BT 2	BT 3	BT 4	BT 5	BT 6	BT 7	BT 8	BT 9	BT 10	BT 11	BT 12
Red rust	34.00 c	30.00 b	30.00 b	36.00 c	50.00 b	24.00 e	34.00 d	34.00 b	36.00 b	44.00 b	36.00 a	30.00 c
Leaf Rust	45.00 a	54.00 a	40.00 a	30.00 e	56.00 a	42.00 a	52.00 a	48.00 a	42.00 a	50.00 a	30.00bc	54.00 a
Black rot	26.00 f	24.00 d	22.00 d	32.00 d	45.00 c	38.00 b	36.00 c	34.00 b	30.00 d	38.00 c	28.00 c	22.00 d
Horse hair blight	42.00 b	30.00 b	40.00 a	40.00 b	44.00 d	44.00 a	44.00 b	36.00 b	26.00 e	34.00 d	16.00 d	20.00 d
Grey brown blight	28.00 e	26.00 c	24.00 c	24.00 f	18.00 f	36.00 c	32.00 e	30.00 c	34.00 c	28.00 e	32.00 b	38.00 b
Branch canker	30.00 d	22.00 e	20.00 e	45.00 a	24.00 e	26.00 d	24.00 f	24.00 d	20.00 f	24.00 f	14.00 d	16.00 e
Lsd (0.05)	**1.59**	**1.96**	**1.36**	**1.36**	**0.74**	**1.54**	**1.59**	**2.63**	**0.74**	**0.93**	**2.67**	**2.75**

Table 1 (b): Percent disease index of different diseases against different clones in 2022

Disease	Percent disease index									
	BT 13	BT 14	BT 15	BT 16	BT 17	BT 18	BT 19	BT 20	BT 21	BTS1
Red rust	24.00 d	28.00 c	24.00 c	30.00 d	30.00 c	40.00 c	32.00 b	30.00 a	24.00 c	30.00 c
Leaf Rust	30.00 b	40.00 a	38.00 a	40.00 b	50.00 a	52.00 a	48.00 b	26.00 b	34.00 a	22.00 e
Black rot	28.00 c	30.00 b	22.00 d	44.00 a	32.00 c	26.00 d	20.00 d	24.00 c	24.00 c	42.00 b
Horse hair blight	20.00 e	16.00 e	16.00 f	24.00 e	18.00 d	24.00 e	10.00 e	18.00 e	18.00 e	54.00 a
Grey brown blight	34.00 a	40.00 a	34.00 b	34.00 c	38.00 b	42.00 b	28.00 c	24.00 c	30.00 b	30.00 c
Branch canker	18.00 f	20.00 d	20.00 e	20.00 f	18.00 d	20.00 f	20.00 d	16.00 f	20.00 d	24.00 d
Lsd (0.05)	**0.93**	**1.78**	**1.36**	**1.62**	**2.12**	**1.28**	**2.37**	**0.93**	**1.28**	**0.93**

Table 2 (a): Average of percent disease index of different diseases against different clones

Disease	Percent disease index											
	BT 1	BT 2	BT 3	BT 4	BT 5	BT 6	BT 7	BT 8	BT 9	BT 10	BT 11	BT 12
Red rust	30.00 c	27.00 c	29.00 b	33.00 c	52.00 a	26.00 d	36.00 c	32.00 b	33.00 c	42.00 b	38.00 a	27.00 c
Leaf Rust	40.00 a	56.00 a	37.00 a	32.00 e	50.00 b	45.00 a	50.00 a	44.00 a	44.00 a	49.00 a	32.00 bc	51.00 a
Black rot	25.00 d	23.00 d	24.00 d	31.00 d	35.00 d	41.00 b	34.00 d	34.00 b	30.00 d	40.00 c	26.00 c	23.00 d
Horse hair blight	39.00 b	26.00 d	38.00 a	37.00 b	41.00 c	46.00 a	46.00 b	33.00 b	28.00 e	32.00 d	18.00 d	22.00 d
Grey brown blight	26.00 d	28.00 b	27.00 c	22.00 e	20.00 f	37.00 c	31.00 e	31.00 c	35.00 b	26.00 e	34.00 b	36.00 b
Branch canker	31.00 c	26.00 d	22.00 e	42.00 a	22.00 e	26.00 d	25.00 f	23.00 d	22.00 f	24.00 f	15.00 d	17.00 e
Lsd (0.05)	**1.16**	**1.90**	**1.15**	**1.15**	**1.47**	**2.11**	**1.29**	**2.11**	**0.86**	**0.96**	**2.73**	**1.84**

Table 2 (b): Average percent disease index of different diseases against different clones

Disease	Percent disease index									
	BT 13	BT 14	BT 15	BT 16	BT 17	BT 18	BT 19	BT 20	BT 21	BTS1
Red rust	26.00 d	26.00 c	25.00 c	31.00 d	27.00 c	37.00 c	36.00 b	29.00 a	25.00 c	31.00 c
Leaf Rust	32.00 b	39.00 a	35.00 a	38.00 b	45.00 a	48.00 a	46.00 b	26.00 b	31.00 a	21.00 e
Black rot	27.00 c	28.00 b	24.00 d	47.00 a	29.00 c	24.00 d	22.00 d	23.00 c	23.00 c	43.00 b
Horse hair blight	22.00 e	17.00 e	15.00 f	23.00 e	19.00 d	23.00 e	12.00 e	19.00 e	18.00 e	52.00 a
Grey brown blight	36.00 a	39.00 a	33.00 b	33.00 c	36.00 b	40.00 b	29.00 c	24.00 c	31.00 b	29.00 c
Branch canker	19.00 f	18.00 d	22.00 e	18.00 f	17.00 d	18.00 f	22.00 d	19.00 f	21.00 d	25.00 d
Lsd (0.05)	**0.93**	**2.16**	**1.14**	**1.27**	**1.55**	**1.13**	**1.68**	**1.65**	**1.45**	**2.15**

Table 3: Susceptibility and Tolerance level of BTRI released clones against different tea diseases.

Diseases	**Susceptible**	**Moderately susceptible**	**Moderately tolerant**	**Tolerance**
Red rust disease	BT5	BT7, BT10, BT11 & BT19	BT4, BT6, BT8, BT9, BT13, BT16, BT18 & BTS1	BT1, BT2, BT3, BT12, BT14, BT15, BT17, BT20 & BT21
Black rot	BT16	BT 5, BT 6, BT 10 & BTS1	BT 4, BT 7, BT 8 & BT 9	BT1, BT 2, BT 3, BT 11,BT 12, BT 13, BT 14, BT 15, BT 17, BT 18, BT 19, BT 20 & BT 21
Blight disease	BT 6, BT 8, BT 9, BT 11, BT 12, BT 13, BT 14, BT 15, BT 16, BT 17, BT 18 & BT21	BT 2, BT 3, BT 7, BT 19, & BTS1	BT 1, BT 4, BT 5, BT 10 & BT 20	

Branch canker	BT 1, BT 2 & BT 4	BT 3, BT 6, BT 7, BT 8, BT 9, BT 10, BT 15, BT 19, BT 20, BT 21 & BTS1	BT 5, BT 11, BT 12, BT 13, BT 14, BT 16, BT 17 & BT 18	
Horse Hair Blight disease	BT 6 & BTS1	BT 1, BT 3, BT 4, BT 5, BT 8, BT 9, BT 10	BT 2 , BT 11, BT 12, BT 13, BT 16 , BT 17, BT 18 & BT 20	BT 14, BT 15, BT 19 & BT 21

(4) Title: Effect of different group of herbicides on tea soil environment.

Objective:

1. To reveal the impact of different herbicides used in tea cultivation on tea soil environment

Activities:

1. Glyphosate, Paraquat, Glufosinate ammonium, 2, 4- D amine salt and Diquat were applied in the field.
2. Soil micro-organisms of treated soils were studied by serial dilution agar plating technique.
3. Soil nutrient status were measured by collecting soil samples of 0-9 inch depth from treated plots
4. Retention of herbicide in soil was measured by extract collection from soil sample after 7, 14, 21 and 28 days of herbicide application.

Progress:

***Presence of Mycoflora*:**

Five different groups of herbicides were applied on weeds in tea fields. Soils of each plot collected. In the laboratory Soil microorganisms were isolated from collected soil samples. Paraquat, Glufosinate ammonium & Glyphosate herbicide have less effect on mycoflora growth in soil compare to control where no herbicide was applied. 28 days after spraying, about 80% mycofloral growth was found in contrast to control. Whether, 2, 4-D has more inhibitory effect on soil microorganisms rather than other herbicides (Table 1).

Table 1: Mycoflora found in tea soil at different interval after application of different group of herbicides

Treatment	7 DAS	14 DAS	21 DAS	28 DAS
T1 = Paraquat	2 (40%)	3 (60%)	4(80%)	4(80%)
T2= 2,4-D	1(20%)	2 (40%)	3 (60%)	3 (60%)
T3= Glufosinate ammonium	2(40%)	3(60%)	4(80%)	4 (80%)
T4= Diquat	2(40%)	3 (60%)	3 (60%)	4 (80%)
T5= Glyphosate	2 (40%)	3 (60%)	5 (100%)	4 (80%)
Control=	3 (60%)	4 (80%)	5 (100%)	5 (100%)

* DAS = Days after spray.

***Phytotoxic Effect*:**

For determining retention level of herbicide in soil, soil solution was prepared from treated plot after 03, 05 & 07 days of herbicide application. Soil solution was applied on the plants. Observations were taken on yellowing, wilting and dying of tea shoots. after 03, 05 & 07 days of herbicide application. No phytotoxic effect (Yellowing of Leaf, leaf curling, leaf burn) was found in tea foliage after 03, 05 & 07 days of soil solution application (Table 2). It is revealed that generally used herbicides such as glyphosate, Paraquat, 2,4-D, Glufosinate ammonium & Diquat have no residual effect on soil environment that hamper growth of tea plants.

Table 2: Showing the grade of impact of herbicidal treated soil extracts on tea plants

Treatment	3 DAS	5 DAS	7 DAS
T1 = Paraquat	0	0	0
T2= 2,4-D	0	0	0
T3= Glufosinate ammonium	0	0	0
T4= Diquat	0	0	0
T5= Glyphosate	0	0	0
Control=	0	0	0

Note: 0= no phytotoxic effect, 1= 1- 20%, 2= 21- 40%, 3= 41- 60%, 4= 61- 80% and 5= 81- 100% phytotoxic effect.

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

Objective (s):

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

Activities:

- Application of fungicides against tea diseases and herbicides on mixt stand weeds following RCBD design.
- Data collection on disease severity and mortality of weeds in tea fields.

Progress

A total of twenty three fungicides and twenty nine herbicides (Pre and post emergence) 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 four (24) advisory visits were paid to different tea estates to identify and render advice on specific disease and weeds problem and twenty five (25) correspondences issued to different tea estates in respect of identification of various diseases and their control measures during the reporting year. Thirty (30) experimental visits were made with particular preference to experimental data collection in tea estates.

A total of three (03) official visits were paid by the scientists of the division to different organizations for official purposes.

There are four (04) workshops were carried out during the reporting year. The scientific personnel of the division delivered a total of eighteen (18) hours lectures on tea disease and weeds management in Professional Diploma Course arranged by Project Development Unit, Bangladesh Tea Board, Srimangal.

There is one scientific research article was published during the reporting year. There are twenty nine different groups of fungicides and herbicides were standardized also in same year.

STATISTICS & ECONOMICS DIVISION

Dr. Shefali Boonerjee
Principal Scientific Officer

STAFF

Dr. Shefali Boonerjee promoted as Principal Scientific Officer on 16th August 2022 in this Division. The post of Senior Scientific Officer (PSO) was lying vacant during the period under report. Md. Shahadat Hossen has joined as Statistical Assistant on 28th February 2021. 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 experimental plots namely Bot-40 and Bot-43 of BTRI farm were taken to data collection. 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 has been collected and tabulated. The secondary data collection of production and approximate expenditure of last 10 years is also going on. For the year 2022 the collected data were summarized and presented in the Table 1, 2, 3 & 4.

Table1. The expenditure of labor wages and different cultural practices in experiment Bot-43

Operation	No of application	Wage (Taka)	Material Cost (Taka)	Total cost (Taka)	Green leaf production (kg)
Plucking	20 (round)	3120.0	-	3120.0	245750
Insecticide	8(time)	330.48	505.57	836.05	
Fungicide & weedicide	3 (time)	217.2	176.63	393.83	

Pruning	2 (days)	720	-	720	
Other Works	8 (days)	300	-	300	
				5369.88	

Table2. The expenditure of labor wages and different cultural practices in experiment Bot-40

Cultural Operation	No of application	Wage (Taka)	Material cost (Taka)	Total Cost (Taka)	Green leaf production (kg)
Plucking	23 (round)	2876.4	-	2876.4	431910
Insecticide	8 (time)	413.10	631.96	1045.06	
Fungicide & weedicide	3 (time)	230.52	245.28	475.8	
Pruning	2 (days)	816	-	816.00	
Other works	9 (days)	265.20	-	265.20	
				5478.46	

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

Table 3. Estimation of benefit cost ratio (BCR) of experiment Bot-40

Clones/Test clones	Green Leaf Production	Made Tea Production	COP	Total cost	Total Benefit	BCR
T2	73750	16962.5	191.36	3245944	92445.63	1.03
T3	65130	14979.9		2866554	81640.45	1.03
T4	77680	17866.4		3418914	97371.88	1.03
T5	71700	16491		3155718	89875.95	1.03
T6	62800	14444		2764004	78719.8	1.03
T7	80850	18595.5		3558435	101345.5	1.03

Table 4. Estimation of benefit cost ratio (BCR) of experiment Bot-43

Clones/Test clones	Green Leaf Production	Made Tea Production	COP	Total cost	Total Benefit	BCR
T1	50900	11707	191.36	2240252	63803.15	1.03
T2	32950	7578.5		1450222	41302.82	1.03
T3	55450	12753.5		2440510	69506.57	1.03
T4	56600	13018		2491124	70948.1	1.03
T5	49850	11465.5		2194038	62486.98	1.03

SE 2: Evaluation of technologies.

SE 2.1 Adoption of BTRI matured technologies and its extension to Bangladesh Tea Industry.

The study conducted to examine the overall feature of implementation and its efficiency of the BTRI technologies to the tea estates. BTRI has so far released 23 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. This database regarding the disseminated technologies will be helpful to find out the adoption efficiency in the field and to find out the limitations of dissemination of the BTRI technologies.

During the study, Adoption of BT clones in different tea estates was revealed (Fig 1). Among the 144, about 54 gardens could not mention the specific name and area coverage of the BT clones available in their clone areas. Among the tea estates that have specifically mentioned the name of BT clones, 90 and 49 tea estates were found to have BT2 clones (100%) and BT1 clone (54%) respectively. BT5 (21%), BT6 (21%) and BT4 (20%) followed by BT3 (12%), BT8 (6.6%), BT11 (4.4%) and BT18 (4%) were observed to be planted in different tea gardens. Other BT clones (1-3%) were also found to be planted in the clone areas of different tea gardens (Fig. 1). Most of the tea estates have different BT clones as mother bush in their nucleus clone plot (NCP) besides the plantation areas.

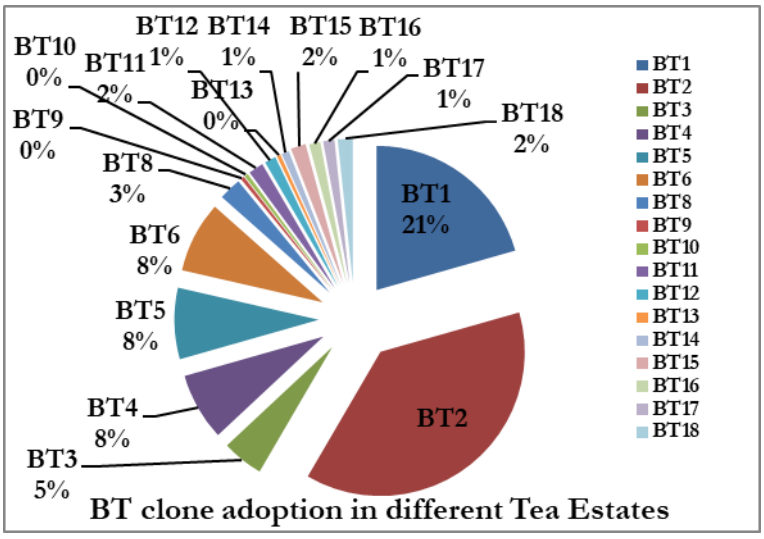


Figure 1: Different BT clones in different tea estates.

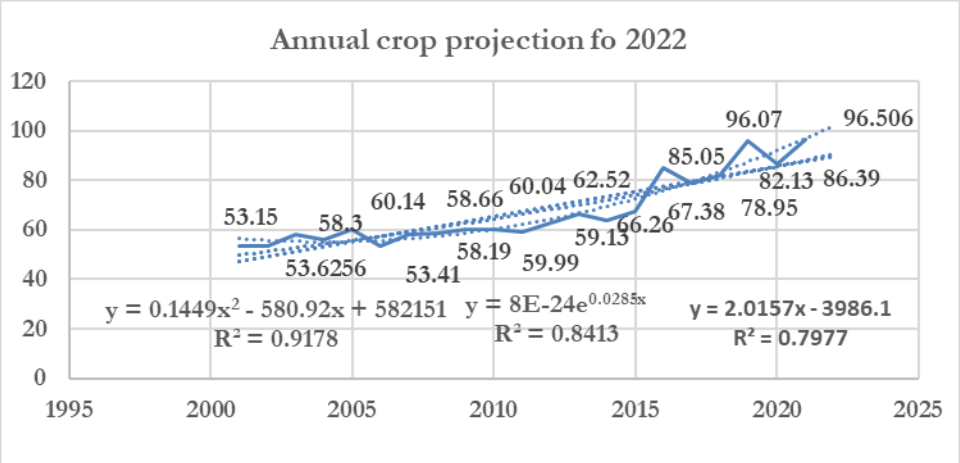
STATISTICS

1. Estimation of Annual Crop for 2022:

Annual crop forecasting (2022) using time series data (last 21 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



Graph 1: Yield trend in correlation regression analysis using last 21 years data for forecasting the tea crop of 2022.

Table5. Correlation regression analysis using last 21 years data for forecasting the tea crop of 2022

Year	Production (Mkg)	linear (0.797)	Polynomial (0.917)	exponential (.834)
2001	53.15	51.46	56.52	52.24
2002	53.62	52.73	55.77	53.29
2003	58.3	54.00	55.30	54.35
2004	56	55.27	55.13	55.44
2005	60.14	56.54	55.24	56.55
2006	53.41	57.81	55.64	57.68
2007	58.19	59.08	56.33	58.83
2008	58.66	60.35	57.31	60.01

2009	59.99	61.62	58.58	61.21
2010	60.04	62.89	60.14	62.43
2011	59.13	64.16	61.99	63.68
2012	62.52	65.43	64.13	64.95
2013	66.26	66.70	66.55	66.25
2014	63.88	67.97	69.27	67.58
2015	67.38	69.23	72.27	68.93
2016	85.05	70.50	75.56	70.31
2017	78.95	71.77	79.15	71.71
2018	82.13	73.04	83.02	73.15
2019	96.07	74.31	87.18	74.61
2020	86.39	75.58	91.63	76.10
2021	96.506	76.85	96.36	77.62
2022		78.12	101.39	79.18
SD	14.00352716	8.24	14.86	8.32
Mean	67.417	63.52	65.84	63.46

Three observations were found in linear (78.12), Exponential (79.18) and Polynomial (101.39) model for the estimation of annual crop of 2022. In Polynomial model the estimated data was found more relevant to last 21 years examined production data along with the closer SD value of time series data. So, the estimated crop for 2022 will may be 101.39 million kg. (NB. The analysis was done depending only on the yield parameter of the last 21 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.

Item	BEF	BTRI	Kality	Total
Produced Green Leave (Kg)	750650	74662	42135	867447
Produced made Tea (Kg)	172649	17172	9691	186579*
Field Cost/Kg (Tk)	29.10	47.00	35.9	31.03(weighted Avg.)
Others Cost/Kg (Tk)	3.34	-	3.85	
Factory Cost/Kg (Tk)				56.65
Cost of made tea/ Kg (Tk) [GL Cost * 4.25 + F Cost + Others Cost]	183.67	256.40	213.07	191.36(weighted Avg.)

*

Conclusion: Correlation analysis using time series data showed estimated production of 101.39 M.kg teas for the year 2022. If any difference will come in actual production it would be due to the influences of environmental and other related factors over the production of crop in 2022.

Table 6. 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
2021	96.506	95.24	0.68	0.74
2022	93.829		.78	0.72

Source: BTB

Table7. Month wise tea production (Mkg) of last five years in Bangladesh

Month	Production (Mkg)				
	2018	2019	2020	2021	2022
January	0.331	0.495	0.175	0.268	0.507
February	0.038	0.114	0.026	0.019	0.033
March	1.556	1.917	1.625	1.681	1.585
April	3.505	6.110	2.365	3.932	4.934
May	6.334	7.645	8.655	6.151	7.420
June	7.634	11.667	8.963	13.354	12.585
July	10.985	11.104	12.178	12.338	11.267
August	12.477	13.505	11.321	14.387	10.762
September	12.008	13.382	12.144	12.607	14.740
October	11.863	13.407	11.486	14.578	11.377
November	9.147	10.300	10.495	10.241	10.840
December	6.256	6.423	6.961	6.932	7.779
Total	82.134	96.069	86.394	96.506	93.829

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 2022 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 2022 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 57th Annual Course of BTRI held at BTRI Main Station, Sreemangal.

Advisory visits

In 2022, a total of four (4) conjoined (with other divisions) advisory visits were paid by the scientific personnel of the department to different tea estates and rendered advice as per the estate's requirements. Four (4) advisory correspond letters were issued according to the visit.

BILASHCHERRA EXPERIMENTAL FARM (BEF)

BTRI, SREEMANGAL

In-Charge: Rayhan- Ur- Rahman, Scientific Officer, Botany Division

After sudden demise of Mr. Rayhanur Rahman, Bnagladesh Tea Board appointed Dr. Ismail Hossain, Director (In-charge), BTRI as in-charge of BEF and Mr. Raihan Mujib Himel as attached officer of BEF.

STAFF

Mr. Mehedi Hasan, Farm Supervisor was transferred to BTB Project, Lalmonirhat and Mr. Abul Kalam Azad Senior Farm Assistant joined at BEF from BTRI. There was no other change in the staff position during the reporting year.

FARM

Table 1. Land Distribution

Sl. No.	Description	Area (ha)	
(a)	Tea cultivated area		128.33
	I. Plucking Area		
	1. Immature Tea (under 5 years)	16.29	
	2. Tea bushes 6 to 10 years	08.02	121.33
	3. Tea bushes 11 to 40 years	32.56	
	4. Tea bushes 41 to 60 years	64.46	
	II. Seed Bari		6.00
	II. Seed Nursery		0.50
	III. Clone Nursery		0.50
(b)	Under Subsidiary Crops		32.17
	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		25.30
(d)	Cultivable, Fallow and Waste Land		42.56
Total Area of the Farm			**228.36**

Table 2. Crop Production 2022

Black Tea	Green Tea	Orthodox Tea	Total Green Leaf (kg)	Tea cultivated area (Excluding Immature Tea)
Green Leaf (kg)	Green Leaf (kg)	Green Leaf (kg)		
740150	2963	10500	753613	112.04

Table 3. Green leaf Production of the Farm in the Year 2022

Name of the Month	Month-wise crop production in 2022 (kg)			
	Green Leaf for Black Tea	Green Leaf for Orthodox tea	Green Leaf for Green Tea	Grand Total
January	0	0	0	0
February	0	0	0	0
March	1300	0	0	1300
April	27798	0	144	27942
May	21746	0	0	21746
June	73522	0	0	73522
July	112548	0	0	112548
August	134360	1779	1162	137301
September	145732	1087	408	147227
October	126370	5901	0	132271
November	63785	1733	1097	66615
December	32989	0	152	33141
Total	740150	10500	2963	753613

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)
721	Collected 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. 1160 tea saplings were infilled in section no 5 and 6780 tea saplings were infilled in section no 12 in the year 2022. Experiments of different research 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. Moshiur Rahman Akonda (Senior Scientific Officer, Botany Division) performed his duties as Officer-In-Charge during the reporting year. Mr. Shuva Das (Soil Science) and Mr. Ajit Chandra Chowdhury (Senior Farm Assistant) carried out their responsibilities as in before, consecutively.

Production of green leaves
During the year, about 53, 534 Kg of green leaves were plucked from the existing tea plantation and sold to Kaiyacherra Dolu Tea Estate @ Tk. 34 per Kg.

Distribution of improved planting materials
About 7,55,000 no. of fresh cuttings were collected from the mother bush area and 355 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 16,863 tea saplings were planted to fill the vacancies in the existing young tea plantation during the reporting year.

Soil sample analysis
About 264 soil samples from 14 tea gardens of Chattogam were analyzed and reported during the reporting year.

KALITI SUB-STATION

Kulaura, Moulvibazar

STAFF

During the reporting year 2022, 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.)
2022	42,135*	1,25,000	5,000**

*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 & 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 387, No. of small grower under tea cultivation 130, total land under tea cultivation 686 Acre in the year 2022. 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 252 N0s.
2. Tea sapling raised 12.55 lac.
3. Land lease for tea sapling production 2.63 Acre.
4. Training of different topics such as tea plantation, land preparation, pruning, plucking, disease and pest management, Total no. of farmer 1525 under 61 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 7284 kg in 2022.

BTRI SUB STATION, PANCHAGARH

Md. Amir Hossain
Development Officer
&
Officer in-charge

STAFF

Dr. Mohammed Shameem Al Mamun, Principal Sceientific Officer transferred from BTRI Sub Station, Panchagarh to BTRI main Office Sreemongal on 31 december 2022. There was no other change in the personnel position of the BTRI Sub Station, Panchagarh during the period ended of 2022.

Statistical Information

A total of 30 tea gardens (9 registered and 21 unregistered) and 8,355 small holding tea gardens in the plains of North Bengal (Panchagarh, Thakurgaon, Lalmonirhat, Dinajpur and Nilphamari) produced a total of 17.78 million kg of made tea in 2022. In other words, 19 percent tea has been added to the national production from the tea plantations in the northern plains and ranked 2nd in respect of region wise production. In 2022, tea has been cultivated on a total of 12079.06 acres of land in five districts of Northern Bangladesh. A total of 9,02,74,632 kg of green tea leaves have been produced from those tea gardens, which is 17.78 million kg of made tea has been produced in 25 running tea factories of Panchagarh, Thakurgaon and Lalmonirhat which is the highest record of tea industry in North Bengal. In 2022, the area under tea cultivation in North Bengal was 11,433.94 acres and the amount of tea production was 14.54 million kg. Compared with previous year of tea cultivation area has increased by 645.12 acres (5.64%) and 32.42 lakh kg (22.33%) more tea has been produced in 2022. A total of 50 tea factories have been approved from Bangladesh Tea Board in Panchagarh, Thakurgaon and Lalmonirhat districts up to December 2022.

Advisory visit & Monitoring

A total of 130 advisory visits were made to the different tea gardens and small tea growers' gardens in northern Bangladesh under BTRI, PDU, Northern Project and rendered advice on tea cultivation in scientific way during 2022. Twenty five (25) samples of tea plants/plant parts were received from the different small tea growers' garden due to identification of various pests, diseases, other nutrient deficiencies, and suggested their remedies during the reporting year.

Research activities

Two research programs on tea have been started at Panchagarh sub station BTRI during the reporting year.

01.Development of a standard young tea pruning schedule for Northern tea growing areas of Bangladesh.

02.Effect of different pluking rounds on yield and quality of tea at Northern tea growing areas of Bangladesh.

Official visit

A total of eight (08) official visits were made to the different organizations including Rangpur, Mithapukur, BARC, Dhaka; BTRI/PDU, Srimanagal, and Ministry of Commerce, Dhaka during 2022.

Training/Workshop

A total of twelve (12) training workshops were conducted by the 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 2022.

Miscellaneous

"Clonal demonstration plots of improved varieties of tea" was established and inaugurated at BTRI Sub Station, Panchagarh by the Honorable Chairman, Bangladesh Tea Board Major General Md. Ashraful Islam, ndc, psc. Presently the work is going on.

A view exchange meeting held on 3rd January ,2022 at Rangpur divisional Comissioner Office conference hall in presence of Hon'ble chairman Bangladesh Tea Board Major General Md. Ashraful Islam, ndc, psc and Divisional Commissioner of Rangpur Digvission in order to open 3rd Tea auction in the Country with all stake holder of Tea planters and owner association including representatives of the Chamber of commerce.

Major General Md. Ashraful Islam, ndc, psc, Chairman, Bangladesh Tea Board was visited to the BTB Regional Station, Small scale tea gardens, Bought leaf tea factories and attended in a meeting to exchange of views with stakeholders of tea industry, Panchagarh on 28 July 2022.

A view exchange meeting held on 25th December ,2022 at Rangpur circuit house conference hall in presence of Hon'ble chairman Bangladesh Tea Board Major General Md. Ashraful Islam, ndc, psc due to open 3rd Tea auction in the Country with all stake holders of tea planters and owner association including the representative of the Chamber of commerce panchagarh.

Other activities of the divisions during 2022

Sl.	Item	Soil Science	Botany	Agronomy	Entomology	Plant Pathology	St. & Eco.	Bio-Chemistry
01	No. of experiments	07	46	09	04	05	2	03
02	No. of experimental, advisory and official visits	19	25	43	16	57	12	1
03	No. of advisory correspondence	166	91	-	11	25	4	1
04	No. of soil, fertilizer & dolomite samples analyzed	1819			-			
05	No. of nursery soil, water & cowdung samples analyzed for nematodes	-	-	-	122	-	-	-
06	No. of pesticide residue analysis (commercial)	-	-	-	-	-	-	-
07	No. of pesticide residue analysis (Experimental)	-	-	-	-	-	-	-
08	Physical test of pesticides in Lab.	-	-	-	-	-	-	-
09	No. of pesticides/ Weedicides tested in tea fields	-	-	-	52	29	-	-
10	No. of circulars/pamphlets/leaflets issued to T. E.	-	0	2	-	-	-	-
11	No. of workshop/seminar conducted	-	8	17	02	4	-	-
12	MTC module conducted (Hours/year)	-	76	72	-	18	-	3
13	Attended national seminar, conference, symposium & workshop	-	-	9	-	-	-	-
14	Attended international seminar, conference & symposium	-	-	-	2	-	-	-
15	Attended Training/Course		-	7	-	-	-	5
16	No. of research paper published		-	3	02	01	-	-
17	No. of Fresh cutting supplied	-	-	355400	-	-	-	-
18	No. of Rotted cutting supplied	-	2463	39739	-	-	-	-
19	Biclonal seed supply to T. E.	-	134	-	-	-	-	-
20	Tea tasting session/ course	-	07	-	-	-	-	-
21	Received Tea Sample Tasting	-	1005	-	-	-	-	-
22	Biochemical analysis of tea sample		-	-	-	-	-	72