ANNUAL REPORT 2023

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

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DIRECTOR'S REPORT
STAFF

The report of the technical staff shows the position as on 31 December 2023

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

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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	:	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)

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)

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	:	Dr. Toufiq Ahmed Chief Scientific Officer B.Sc.Ag. (Hons) M.S. (BAU), Ph.D. (Sri Lanka) 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 2023 starts from 1st January to 31rd December.

During the year under report, numerous 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.

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.

TEA TASTING SESSIONS

As a regular annual feature, eight 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 2022' and 'Tea Journal of Bangladesh- volume 49' was published in 2023.

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

Mrs. Farhana Jahan Chowdhury, Scientific Officer left her job on 03rd November, 2023. Two (02) Scientific Officer, One (01) Senior Laboratory Assistant and One (01) Laboratory Assistant posts were lying vacant during the period. There was no other change in the personnel position of the division during the period under report.

RESEARCH

A total of six experiments were conducted during the year 2023 by Soil Science Division. Progress of the experiments is given below.

SS 1: COMPARATIVE STUDY OF CONSERVATION AND CONVENTIONAL AGRICULTURE PRACTICE IN SMALL HOLDING TEA CULTIVATION IN RESPONSE TO CLIMATE CHANGE.

Objectives:

1. To efficient use of external and natural resources.
2. To economic profitable and viable for small holders.
3. To reduce the mortality rate of new plantation in dry season.

Duration: 2020-2023

Location: Bilashcherra Experimental Farm

Methodology:

1. Land preparation was different in separate area i.e. follow conservation agriculture management system and another was conventional agriculture management system.

2. Two new tea plantation in Bilashcherra Experimental Farm was done by conservation agriculture management system and another was done by conventional agriculture management system.

3. Comparative data collection i.e. mortality of sapling, growth of tea plant, soil properties, etc. were started from the zero year of the new planting areas.

Progress 2023:

In the conventional and conservation method about 90 young tea plants were grown in each treatment plots in Bilashcherra Experimental Farm. (Section: Near Coffee Tillah)

Table 1. Initial soil properties

Treatment	Texture	pH	OC%	Total N%	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
Conventional method	SCL	4.5	1.4	0.13	2.49	29.41	112.95	13.54
Conservation method	SCL	4.9	1.09	0.10	6.76	21.02	88.3	14.38

Table 2. Changes of soil properties after completion of the experiment

Treatment	Texture	pH	OC%	Total N%	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
Conventional Method	SCL	5.0	0.85	0.085	4.79	21.99	147.95	21.04
Conservation Method	SCL	5.2	1.26	0.12	6.76	41.69	143.3	24.38

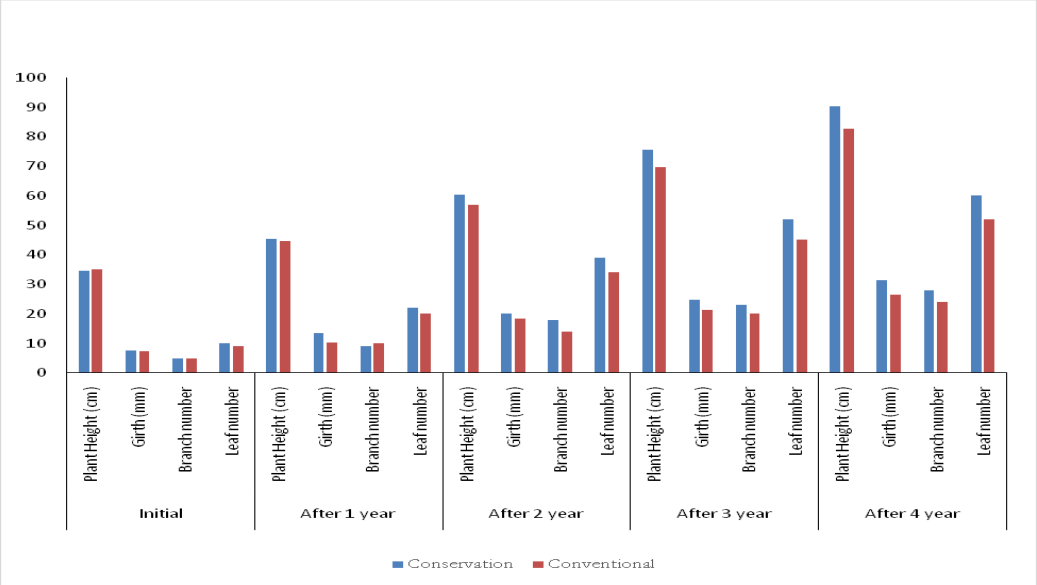


Figure 1. Changes of plant growth parameters

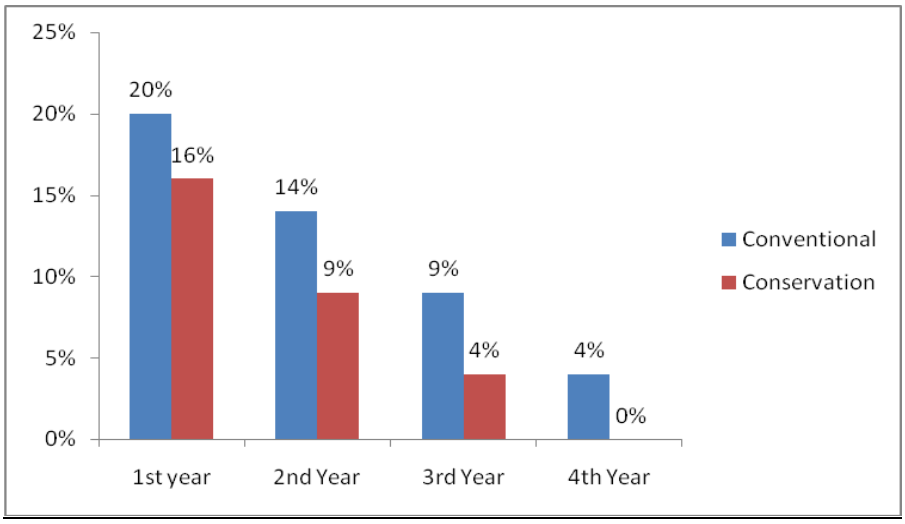


Figure 2. Changes of mortality rate

Comments:

The Plant growth was higher and mortality rate was lower in the conservation practice than conventional practices. This experiment was finished in the year 2023.

SS 2: EFFECT OF DIFFERENT PRUNING OPERATION ON TEA SOIL PROPERTIES AND NUTRIENT UPTAKE BY TEA PLANTS VIS A VIS STARCH RESERVATION.

Objectives:

1. To know the properties of tea soil (Physical, chemical and some microbial) before and after pruning operations.
2. To know the status of nutrient uptake by tea plants.
3. To know the status of starch reservation due to pruning operations.

Location: BTRI Farm, BTRI Fatikchhari Substation, Jagcherra Tea Estate and Ghazipore Tea estate.

Duration: 2023 - 2024

Progress, 2023:

Table 3. Soil properties before and after pruning

Sample Name	Texture	pH	O.C %	Total N %	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)
BTRI LP Before	SCL	3.9	0.69	0.070	13.12	49.66	364.93	39.97
BTRI LP After	SCL	4.3	1.2	0.115	23.54	88.96	198.23	42.32
BTRI LSK Before	SCL	4.1	0.85	0.090	36.32	59.3	190.60	33.51
BTRI LSK After	SCL	4.9	1.21	0.12	54.21	87.69	203.21	41.65
BTRI DSK Before	SCL	4.1	0.81	0.080	68.36	50.87	150.03	15.95
BTRI DSK After	SCL	3.9	0.96	0.092	79.68	70.02	183.23	21.03
BTRI MSK Before	SCL	4.3	0.72	0.077	69	54.33	149.93	14.79
BTRI MSK After	SCL	4.8	1.2	0.118	110.52	80.25	163.15	23.18
BTRI Fatikchhari Lp before	SL	4.8	0.92	0.090	26.16	67.91	279.97	25.10
BTRI Fatikchhari Lp After	SL	4.6	1.02	0.10	25.23	73.21	216.98	18.26
BTRI Fatikchhari DSK Before	SL	4.9	0.86	0.090	24.12	75.21	97.45	20.06
BTRI Fatikchhari DSK After	SL	4.7	0.36	0.042	18.32	31.98	58.21	11.32
Ghazipore Lp Before	SCL	4.5	0.37	0.045	34.07	77.88	144.00	28.23
Ghazipore LP After	SCL	5	1.62	0.15	142.81	90.02	399.65	75.03
Ghazipore LSK Before	SCL	4.4	0.76	0.080	125.49	137.70	320.70	53.49
Ghazipore LSK After	SCL	4.8	1.17	0.12	84.56	84.49	233.95	42.74
Ghazipore DSK Before	SCL	4.3	0.87	0.090	168.67	79.75	189.40	16.04
Ghazipore DSK After	SCL	5.1	1.67	0.16	103.34	134.05	309.70	35.38
Ghazipore MSK Before	SCL	4.6	1.45	0.140	174.4	66.44	279.30	57.91
Ghazipore MSK After	SCL	4.7	1.17	0.12	118.52	85.25	153.15	23.18
Jagcherra Unprunned Before	SCL	4.4	0.97	0.095	33.51	83.99	91.99	10.07
Jagcherra Unprunned After	SCL	4	1.39	0.14	35.87	128.50	87.52	10.17
Jagcherra LP Before	SCL	4.4	1.19	0.12	201.72	236.20	86.04	12.32
Jagcherra LP After	SCL	4	0.8	0.075	132.01	255.90	124.80	12.79
Jagcherra DSK Before	SCL	4.3	1.08	0.11	220.5	124.10	52.76	8.57
Jagcherra DSK After	SCL	4	1.5	0.14	71.29	108.10	94.34	12.74

Table 4. Nitrogen content (%) in the leaf samples

Garden name	Pruning time	LP	LSK	DSK	MSK	Unprunned
BTRI	Before	2.7	2.01	2.15	3.96	-
	After	3.32	2.73	2.9	2.69	-
BTRI Substation Fatikchhari	Before	3.06	-	2.54	-	-
	After	3.17	-	2.37	-	-
Ghazipore Tea estate	Before	3.01	3.15	3.41	3.21	-
	After	3.42	3.3	2.52	3.37	-
Jagcherra Tea Estate	Before	3.72	-	3.5	-	3.41
	After	4.3	-	3.85	-	4.54

Table 5. Nitrogen content (%) in the root samples

Garden name	Pruning time	LP	LSK	DSK	MSK	Unprunned
BTRI	Before	0.56	1.23	0.68	0.84	-
	After	0.62	0.77	0.54	0.76	-
BTRI Substation Fatikchhari	Before	0.85	-	0.85	-	-
	After	0.76	-	0.85	-	-
Ghazipore Tea estate	Before	0.67	0.52	0.6	0.5	-
	After	0.26	0.48	0.38	0.31	-
Jagcherra Tea Estate	Before	0.98	-	0.43	-	0.63
	After	0.63	-	0.73	-	0.41

Progress:

1. Soil chemical properties were increased after pruning may be due to dolomite application in soil.
2. Nitrogen content (%) of all collected Leaf samples were ranged 2.01% (BTRI: Before LSK) to 4.54% (Jagcherra: After Unprunned). The leaf samples which N% is below 3.0% may will be affected by nitrogen deficiency in future if proper nutrient management will not done.
3. Nitrogen content (%) of all collected Root samples were ranged 0.26% (Ghazipore After LP) to 1.23% (BTRI Before LSK).

Comments: This experiment will be continued till 2024.

SS 3: POTENTIALITY OF DIFFERENT OIL CAKES AS A SOIL AMENDMENT FOR IMPROVING SOIL PROPERTIES AND YIELD OF TEA.

Objectives:

1. To find out the optimum dose and proper time different oil cakes.
2. To compare the efficacy of two oil cakes Musterd oil cake and Neem cake as soil amendments.
3. To improve soil heath and yield of tea.

Methodology:

Design: RBD

Location: BTRI

Duration: 2023-2025

Treatment: 8

Replication: 03

T_1 = Control
T_2 = Recommended dose of chemical fertilizer 100%
T_3 = Musterd oil cake 0.5 ton/ha + 80% Recommended dose of chemical fertilizer
T_4 = Neem cake 0.5 ton/ha + 80% Recommended dose of chemical fertilizer
T_5 =Musterd oil cake 1.0 ton/ha + 60% Recommended dose of chemical fertilizer
T_6 = Neem cake 1.0 ton/ha + 60% Recommended dose of chemical fertilizer
T_7 = Musterd oil cake 1.5 ton/ha + 40% Recommended dose of chemical fertilizer
T_8 = Neem cake 1.5 ton/ha + 40% Recommended dose of chemical fertilizer

Table 6. Initial soil properties

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	5.0	0.94	0.091	135.16	88.46	168.50	44.22
T_2	SCL	5.2	1.21	0.13	132.79	129.8	173.6	41.16
T_3	SCL	5.7	1.12	0.10	114.75	83.06	370.9	81.37
T_4	SCL	5.2	1.32	0.12	79.34	56.52	383.6	53.32
T_5	SCL	5.2	1.55	0.15	57.38	45.16	238.1	47.38
T_6	SCL	5.2	1.46	0.13	61.15	70.52	209.1	78.88
T_7	SCL	4.9	1.46	0.14	85.00	62.63	188.1	34.73
T_8	SCL	5.7	0.87	0.090	65.08	53.27	313.5	69.07

Table 7. Yield of tea in the year 2023

Treatment	Green leaf Kg/plot	Green leaf Kg/ha	Made tea kg/ha	Rate of increase over control (%)
T_1	11.98	10174.45	2340	0.00
T_2	12.41	10541.21	2424	3.60
T_3	13.04	11078.45	2548	8.88
T_4	13.10	11133.67	2561	9.43
T_5	13.42	11404.7	2623	12.09
T_6	14.02	11915.6	2741	17.11
T_7	13.60	11550.55	2657	13.53
T_8	13.67	11615.69	2672	14.17

Comments: In case of the treatment T_6= Neem cake 1.0 ton/ha + 60% Recommended dose of chemical fertilizer was given the highest yield (2741 kg/ha) which was 17.11% higher than the control. Moreover, treatment T_2 = Recommended dose of chemical fertilizer 100% has given the lowest yield 2424 kg/ha (3.60%). The mean difference was statistically not significant. This experiment will be continued till 2024.

SS 4: COMPARATIVE STUDIES OF SOIL PROPERTIES UNDER DIFFERENT VEGETATION IN THE TEA ESTATES OF CHATTOGRAM REGION.

Objectives:

1. To assess and compare physical and chemical properties of soil under different land vegetation in the tea garden of Chattogram valley.
2. To provide suggestion about the land in the tea gardens under other type of vegetation and fallow land to bring them under tea plantations.

Progress:
Location: Andharmanik T.E., Oodaleah T.E., Tintohori T.E. (03)

Soil Sample: 48

Soil Texture: Sandy Clay Loam (SCL)

Table 8. Soil Chemical Properties of Different Vegetation Types in Tea Estates of Chittagong Region

Depth (cm)	Chemical Properties	Vegetation Type							
		Mature Tea*	Young Tea*	Malta *	Orange	Vegetable	Cashew Nut	Cassava	Fallow Land
0-23	pH	4.6	4.3	4.0	3.6	4.5	4.4	4.5	4.6
	O. C (%)	1.10	0.90	0.95	0.97	0.78	0.66	0.75	1.09
	Total N (%)	0.116	0.094	0.098	0.101	0.081	0.069	0.079	0.112
	Av. P (mg/kg)	38.3	5.39	22.20	78.93	2.26	5.36	3.85	8.87
	Av. K (mg/kg)	77.0	54.99	82.78	85.36	115.19	74.44	76.3	85.56
23-46	pH	4.3	4.4	4.0	3.5	4.6	4.4	4.5	4.5
	O. C (%)	0.68	0.66	0.82	0.76	0.66	0.54	0.76	0.84
	Total N (%)	0.070	0.072	0.084	0.079	0.069	0.057	0.080	0.087
	Av. P (mg/kg)	1.64	2.46	8.69	11.52	1.92	1.92	4.60	4.18
	Av. K (mg/kg)	25.64	52.41	89.26	59.63	159.63	74.44	74.44	91.11
46-92	pH	4.2	4.4	4.1	3.6	4.5	4.4	4.5	4.5
	O. C (%)	0.69	0.75	0.75	0.64	0.58	0.53	0.72	0.82
	Total N (%)	0.07	0.078	0.078	0.067	0.061	0.056	0.076	0.085
	Av. P (mg/kg)	1.58	2.15	5.62	4.46	2.51	2.43	2.76	3.35
	Av. K (mg/kg)	19.26	42.33	81.86	52.02	172.59	74.44	72.59	92.96

*****mean values of chemical properties

Comments: This experiment will be continued till 2024.

SS 5: 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

Table 9. FCP doses for foliar, broadcasting, pot experiment and nursery polytube

1st Phase – Foliar Spray (2022-2023) **(Treatment = 8, Replication= 3)** T_1 =Control T_2 = BTRI recommended fertilizer application on soil T_3 = FCP 2% foliar spray + T_2 T_4 = FCP 4% foliar spray + T_2 T_5 = FCP 6% foliar spray + T_2 T_6 = FCP 8% foliar spray + T_2 T_7 = Zinc 2% foliar spray + T_2 T_8 = Boron 2% foliar spray + T_2	**2nd Phase – Broadcasting (2023)** **(Treatment = 8, Replication =3)** T_1= Control T_2= 100% BTRI recommended fertilizer application on soil T_3= FCP 1.0 ton/ha T_4 = FCP 1.0 ton/ha + 80% T_2 T_5 = FCP 1.5 ton/ha T_6 = FCP 1.5 ton/ha + 60% T_2 T_7 = FCP 2.0 ton/ha T_8 = FCP 2.0 ton/ha + 40% T_2
3rd Phase (2022-2023) Pot Experiment (Treatment = 6, Replication =5) T_1= Planting with only soil T_2= Planting with soil + Cowdung T_3= Planting with soil + Cowdung + 24 gm FCP T_4 = Planting with soil + Cowdung + 48 gm FCP T_5 = Planting with soil + Cowdung + 72 gm FCP T_6 = Planting with soil + Cowdung + 96 gm FCP	**4th Phase: Secondery polytube in Nursery (Treatment = 10, Replication =5)** T_1= Control T_2= General polytube filling practice T_3= 4 gm FCP T_4 = 4 gm FCP + Nematicide + TSP T_5 = 8 gm FCP T_6 = 8 gm FCP + Nematicide + TSP T_7 = 12 gm FCP T_8 = 12 gm FCP + Nematicide + TSP T_9 = 16 gm FCP T_{10} = 16 gm FCP + Nematicide + TSP

Table 10. Physico-chemical properties of FCP

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

Progress:

1st Phase: Foliar application of FCP

Table 11. Effect of Foliar application of FCP on the yield of mature tea

Treatment	Green leaf Kg/plot	Green leaf Kg/ha	Made tea kg/ha	Rate of increase over control (%)
T_1	3.93	8440.860	1941	0.00
T_2	3.96	8505.376	1956	0.76
T_3	4.19	9012.903	2073	6.78
T_4	4.23	9105.376	2094	7.87
T_5	4.37	9387.814	2159	11.22
T_6	4.58	9850.179	2266	16.70
T_7	4.10	8825.090	2030	4.55
T_8	4.22	9073.835	2087	7.50

Comments: In case of the treatment T_6= FCP 8% foliar spray had given the highest yield (2266 kg/ha) which was 16.70% higher than the control. Moreover, treatment T_2 = Recommended dose of chemical fertilizer 100% had given the lowest yield 1956 kg/ha (0.76%). The Treatment difference was statistically significant (F=3.132) at 0.05% level.

2nd Phase – Broadcasting Application in Mature tea

Table 12. Initial soil properties

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	4.8	1.64	0.160	131.72	57.38	167.1	29.91
T_2	SCL	4.6	1.28	0.123	71.15	62.38	71.82	28.29
T_3	SCL	4.7	1.23	0.120	86.23	30.40	63.38	34.59
T_4	SCL	4.7	1.53	0.145	91.80	49.75	154.3	37.98
T_5	SCL	4.8	1.25	0.120	58.52	55.39	116.5	38.48
T_6	SCL	5.8	1.14	0.115	42.05	37.74	300.6	68.75
T_7	SCL	4.9	1.55	0.145	119.26	79.92	162.9	33.03
T_8	SCL	4.9	1.35	0.130	128.26	103.3	206.3	28.85

Table 13. Effect of broadcast application of FCP on the yield of mature tea

Treatment	Green Leaf Kg/plot	Green Leaf Kg/ha	Made tea kg/ha	Rate of increase over control (%)
T1	10.80	9175.870858	2110	0.00
T2	11.15	9473.237043	2179	3.24
T3	11.95	10152.93118	2335	10.65
T4	12.18	10348.34325	2380	12.78
T5	12.50	10620.2209	2443	15.74
T6	12.75	10832.62532	2492	18.06
T7	12.87	10934.57944	2515	19.17
T8	12.95	11002.54885	2531	19.91

Table 14. Partial economic analysis for broadcasting of FCP

Treatment	Made tea (kg/ ha)	Total Variable cost (Tk)	Gross Return (Tk)	Net Return (Tk)
T1	2110	10710	422090	411380
T2	2179	23644	435769	412125
T3	2335	55220	467035	411815
T4	2380	65363.2	476024	410661
T5	2443	77220	488530	411310
T6	2492	85082.4	498301	413218
T7	2515	99220	502991	403771
T8	2531	104801.6	506117	401316

Comments: In case of the treatment T_8= FCP 2.0 ton/ha + 40% T_2 had given the highest yield (2531 kg/ha) which was 19.91% higher than the control. Moreover, treatment T_2 = Recommended dose of chemical fertilizer 100% had given the lowest yield 2179 kg/ha (3.24%). From partial economic analysis it was concluded that though T_8= FCP 2.0 ton/ha + 40% T_2 had given the highest yield (2531 kg/ha, 19.91%) but the Net Return was highest at the treatment T_6 = FCP 1.5 ton/ha + 60% T_2 which was most economical viable dose of the fertilizer for broadcasting application. The Treatment difference was statistically significant (F=11.045) at 0.05% level.

3rd Phase: Pot Experiment

Table 15. Initial soil properties

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 16. Changes of soil properties after completion 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	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	5.1	1.19	0.120	52.66	81.08	122.20	54.38

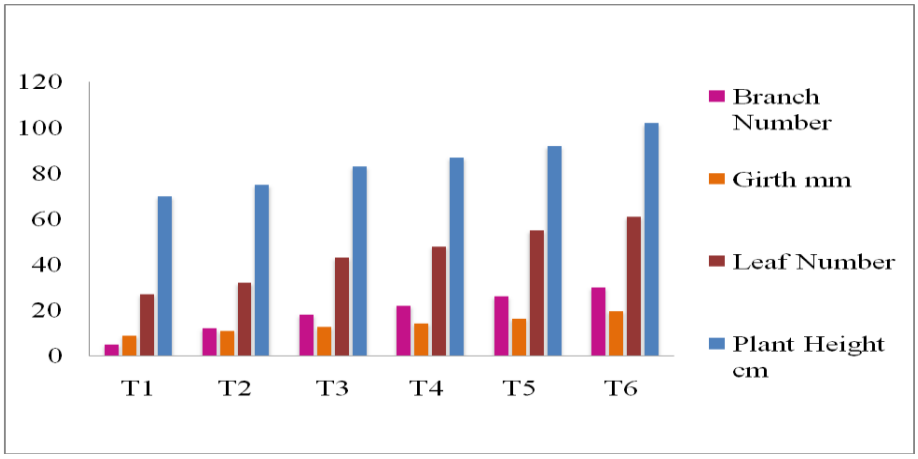
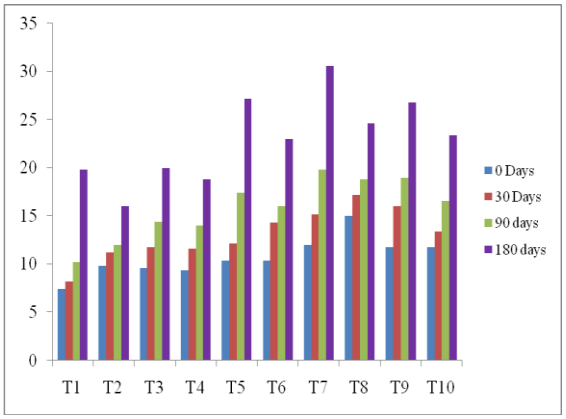
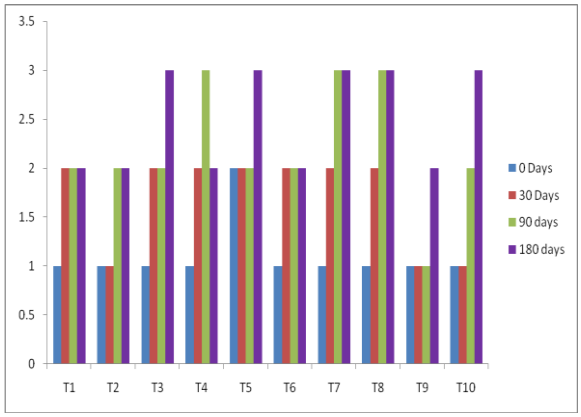


Figure 3. Effect of FCP on the growth of tea Plants

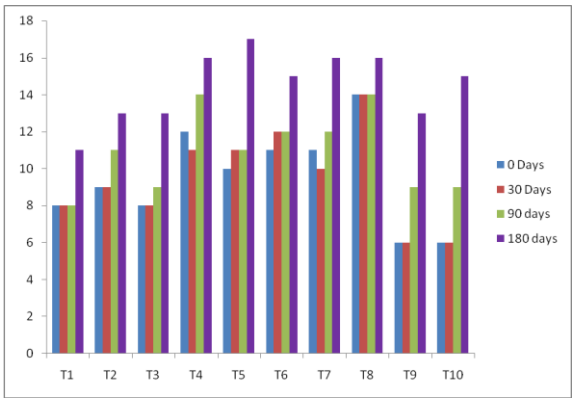
4th phase Nursery secondary Polytube



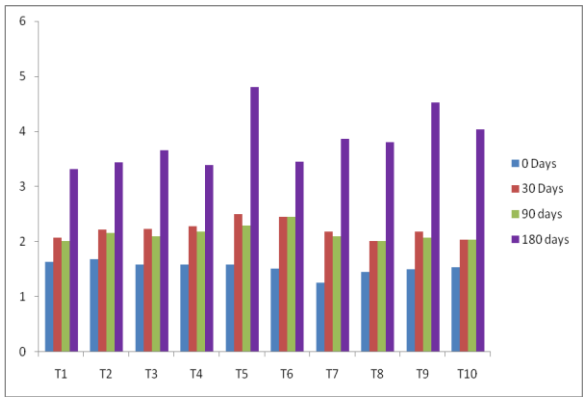
(a) Height of tea plants (cm)



(b) Branch number of tea plants



(c) Leaf number of tea plants



(d) Girth of tea plants (mm)

Figure (a, b, c, d). Effect of FCP on the height, branch number, leaf number and girth of tea plants in the secondary polytube

Comments: Growth of tea plants in nursery polytube had increased with T_5 = 8 gm FCP (Leaf and Girth of tea plants) and T_7 = 12 gm FCP (Height and Branch number of tea plants). The mortality rate of tea plant in nursery polytube was zero.

The effect of this fertilizer as pesticide on nematode population

An pot experiment was conducted to evaluate the toxicity of FCP with different doses against plant parasitic nematode in tea at Nematology Field Laboratory, Entomology Division, BTRI in Complete Randomized Design (CRD) with three replications. Plastic pots (22 cm dia) were filled with sandy loom soil and cowdung in 3:1 ratio. Then different doses of FCP were mixed with the pot soil. The pots were kept for 2 weeks and watered regularly. Fourteen (14) months old tea seedling had been planted in those pots after 2 weeks. Pre-treatment observations on the presence of nematodes were done. Second and third round applications were done at 60th days and 120th days, respectively. Post treatment observations were recorded at 15 days intervals.

The soil samples were collected and analyzed to find out the nematode population. Nematode extraction was done by "Bayerman Funnel Method". The efficacy of different treatments was counted by using Henderson & Tilton formula. The efficacy data were analyzed 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 reduced nematode population over control. Among the different doses of FCP, T_6 (Planting with soil + Cowdung + 16 g FCP/kg soil) showed the highest efficacy (70.86%) in controlling nematodes in soil.

The effect of this fertilizer as pesticide in Helopetis

Different concentrations of FCP (2%, 4%, 6% & 8%) were prepared with water. *Helopeltis* were 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. The experimental was arranged in Completely Randomized Design (CRD) with three replications. The data on mortality percentage with the observation time were analysed by 2-way ANOVA using SAS programme (version 9.4).

The mean values were separated with LSD test at 0.05 level of significance. Results showed that the highest mortality was observed in FCP 8% concentration (48.28%) at 72 HAT in the laboratory condition. The highest percent effectiveness of FCP was found to be 40.34% at 8% concentration in field condition.

The experiment was finished in December 2023.

SS 6: STATUS OF BORON IN THE TEA GARDEN SOILS AND ITS EFFECTS ON THE YIELD OF MATURE TEA

Objectives:

1. To determine the status of boron in the tea garden soils.
2. To identify the effects of boron on the yield of tea.
3. To estimate the optimum dose of boron for mature tea plantation.

Methodology:

Locations: BTRI Farm

Experimental Design: Randomized Block Design

Duration: 2023-2024

Treatments:

T1 = RFD (Control)
T2 = RFD + 1 kg/ha Boron
T3 = RFD + 2 kg/ha Boron
T4 = RFD + 3 kg/ha Boron
RFD = Recommended Fertilizer Doses (1^{st} split: $Urea_{187}$, TSP_{59} and MOP_{102})
(2^{nd} split: $Urea_{132}$ and MOP_{60})
* Boron was applied as a single split with the 1st application of Urea, TSP and MOP in the growing season.

Progress:

Table 17. Initial soil status of the experimental plot

Section	Texture	pH	O.C (%)	Total N (%)	Av. P (mg/kg)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)	B (mg/kg)
A-2 (BTRI Farm)	SCL	5.10	1.13	0.098	24.16	53.80	92.35	28.67	0.39

Table 18. Yield of tea in the year 2023

Treatments	Average GL Yield (kg/plot)	GL Yield (kg/ha)	MT Yield (kg/ha)	Rate of increase (%)
T-1	85.204	8073.18	1856.83	…….
T-2	91.082	8630.12	1984.93	6.90
T-3	94.940	8995.64	2069.00	11.43
T-4	94.643	8967.50	2062.53	11.08

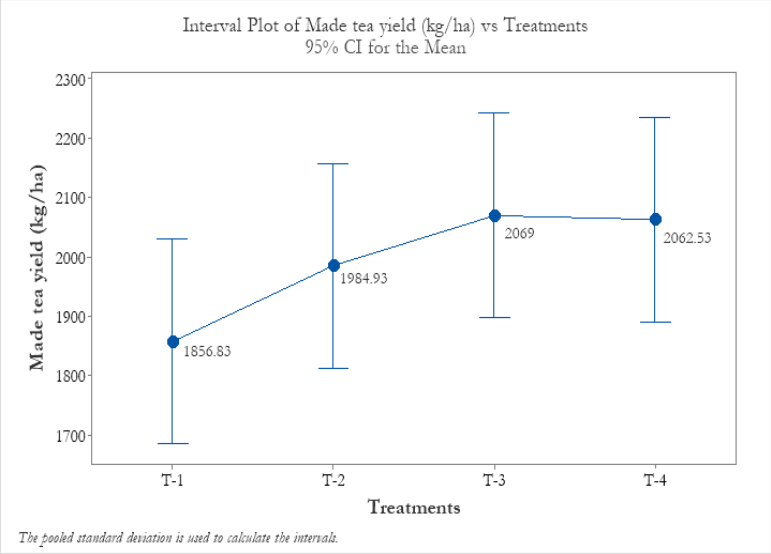


Figure 5. Effect of boron on the yield of tea

Comments:

In the year 2023, treatment T3 = RFD + 2 kg/ha Boron had given the highest yield (2069.00 kg/ha) and the rate of increase of yield over control was 11.43%. There was no significant difference was found in the yield of tea among treatments. This experiment will be continued in the year 2024.

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 1730 soil samples (210 advisory and 1520 paid) and 106 other samples from 102 tea estates were analyzed for different purposes, the breakup of which is presented in table 19 & 20.

Table 19. Number of samples analyzed

Year	Advisory Soil	Soil	Fertilizer	Lime/ Dolomite	Leaf	Water	Compost	Total (Fertilizers & others)	Total (Soils & others)
2023	210	1520	68	16	06	02	14	106	1836

Table 20. List of Tea Estates from where soil and other samples were received or collected and analyzed during the year 2023

Ameenabad	Dildarpur	Kazi & Kazi	Parkul
Amo	Dinarpur	Khadim	Patrokhola
Amtali	Eminence chem. Ind. ltd.	Khan	Phulbari
Annapurna Agro Services	Etah	Kurmah	Phulcherra
Atiabagh	Farah Agro	Lackatoorah	Premnagar
Bahadurpur	Fatehbagh	Lalchand	Rahamania
Balisera	Fyzabad	Lungla	Rajghat
Baraoora	Ghazipore	Madhabpur	Rampore
Bejoya	Golden Tea Syndicate	Madhupur	Rashidpur
Bidyabheel	Habibnagar	Madanmohanpur	Saif
Bilashcherra	Hajinagar	Ma-moni Agro services	Sathgao
Boban	Halda Velley	Marina	Shumshernugger
Burjan	Hatimara	Mazdehee	Silloah
Champarai	Horincherra	Meghalaya	Sonarupa
Chandbagh	Imam and Bawani	Mertinga	Sreebari
Chandpore	Imam	Mirzapore	Srigobindpur
Chatlapore	Islamia Trading Corp.	Monipur	Srimangal
Chaundeecherra	Jagcherra	Moulvi	Star
Clevedon	Jagadispur	M R Khan	Surma
Climate Change Project	JBCS Corporation	Nalua	Sylhet Agri. University
Clonal	Jagcherra	Neptune	Teliapara
Consolidated Tea & land Co.	Kalikabari	Nahar	Tetulia Te Co. Ltd.
Daragaon	Kality	Nandarani	Udnacherra
Deanston	Kalighat	New Samanbagh	Zarreen
Deundi	Kaiyacherra Dalu	Ootterbhag & Indanugger	
Dhamai	Kasipur	Paragon Agro	

OTHER ACTIVITIES

Advisory correspondence

A total of 184 advisory letters to different tea estates on soil, fertilizers, dolomite, compost and other soil related aspects were sent during the year 2023.

Tours

During the year under report officers of the division paid a total 15 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 2023. 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 2023, the Biochemistry division carried out a total of two experiments, which were ongoing experiment. 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 determine 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.

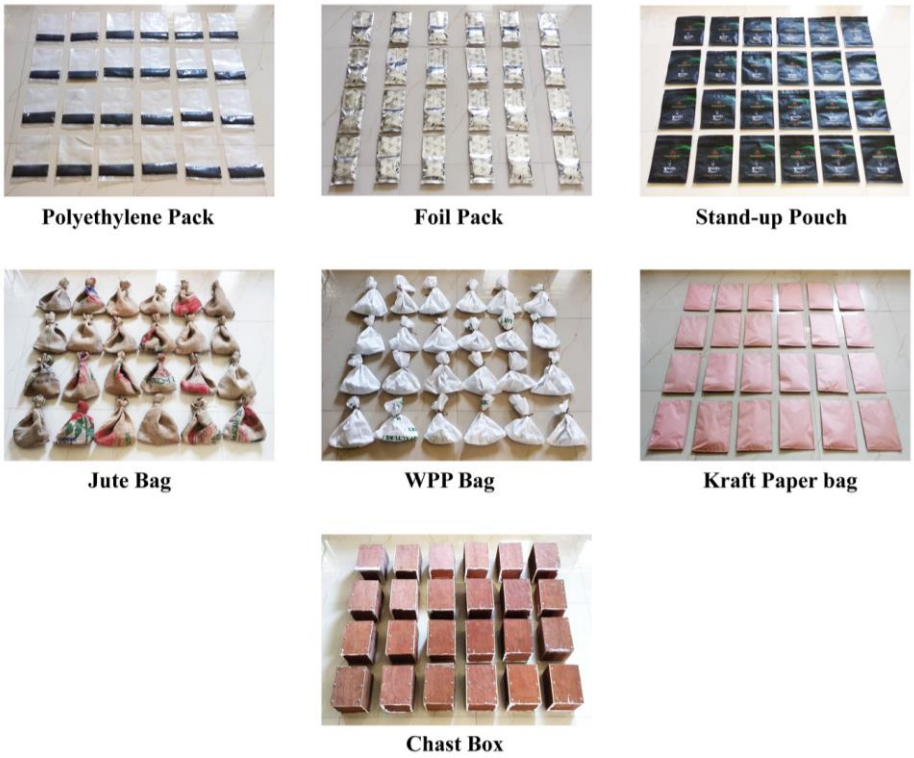


Figure 1. Prepared containers/bags/sacs with different types of packaging material for storing tea.

Moisture content

Results showed that before storage, the moisture content of the black tea samples under different treatments was 4.5%; which increased gradually and reached to 7.23-10.00% after 16 months of storage period (Figure 2). Stand-up pouch performed better and chest box performed worse than the others in terms of moisture content.

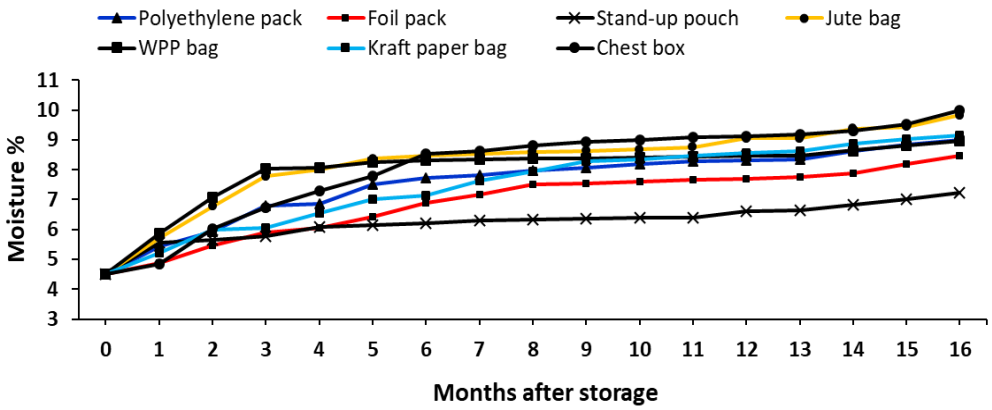


Figure 2. Moisture contents of black tea samples after different periods of storage within different packaging materials.

Polyphenols content

Results showed that initially the total polyphenols contents of the black tea samples was 19.7%; which decreased gradually and reduced to 5.80-10.73% after 6 months of storage period and then increased gradually (Figure 3). The total polyphenols contents after 16 months of storage was found between 15.63-20.99%. Stand-up pouch performed better and kraft paper bag performed worse than the others in terms of polyphenols content.

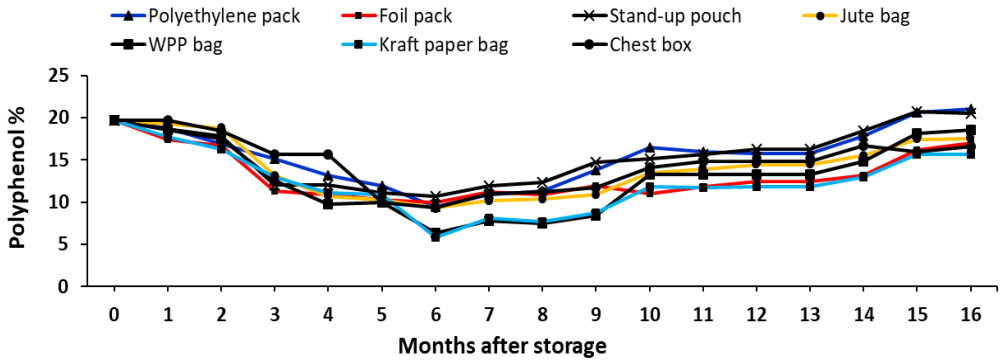


Figure 3. Polyphenols contents of black tea samples after different periods of storage within different packaging materials.

Caffeine content

Results showed that initially the caffeine contents of the black tea samples under different treatments was 4.4%; which decreased gradually and reduced to 1.98-2.83% after 16 months of storage period (Figure 4). Stand-up pouch performed better and chest box performed worse than the others in terms of caffeine content.

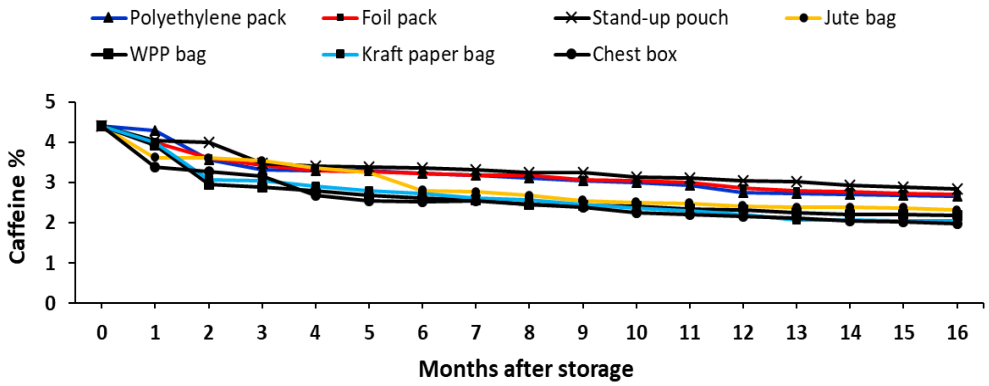


Figure 4. Caffeine contents of black tea samples after different periods of storage within different packaging materials.

Theaflavins content

Results showed that before storage, the theaflavins contents of the black tea samples under different treatments was 0.97% and then the contents found increased sharply after two months of storage (1.05-1.25%). Thereafter, the theaflavins contents decreased gradually and reduced to 0.27-0.32% after 16 months of storage period (Figure 5). All the packaging materials performed almost similarly after about 10 months of storage in terms of theaflavins content.

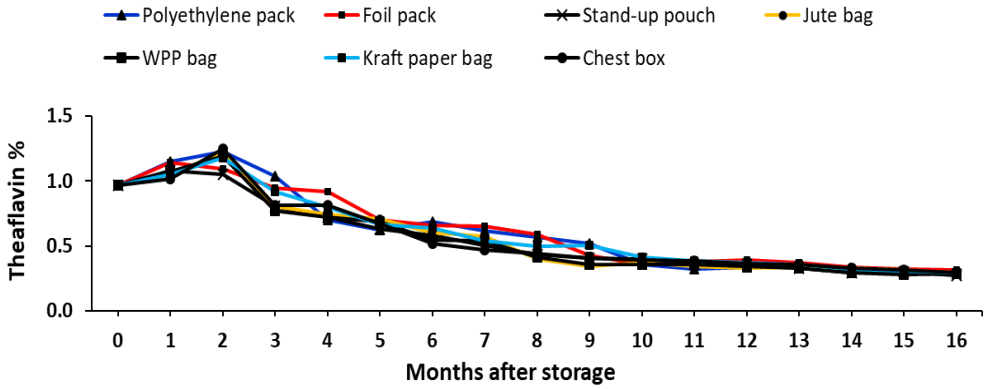


Figure 5. Theaflavins contents of black tea samples after different periods of storage within different packaging materials.

Thearubigins content

Thearubigins contents followed similar trend with theaflavins contents. Results showed that initially the thearubigins contents of the black tea samples under different treatments was 9.5% and then the contents found increased sharply after two months of storage (11.04-12.86%). Thereafter, the thearubigins contents decreased gradually and reduced to 5.42-7.30% after 16 months of storage period (Figure 6). Polyethylene pack and foil pack

performed better and kraft paper bag performed worse than the others in terms of thearubigins content.

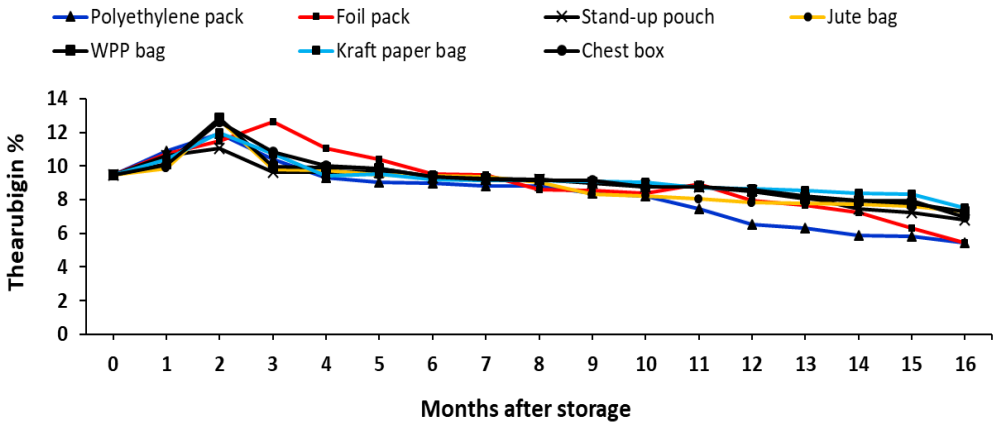


Figure 6. Thearubigins contents of black tea samples after different periods of storage within different packaging materials.

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)

Duration: 2022-2023
Location: BTRI Farm
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, mid-season, and late season. Results obtained in 2023 are summarized below.

Effect on yield
Results showed that there was a negative effect of Brassinosteroids on the yield of tea in the early-season and late-season; but significantly positive effect on yield was obtained in the mid-season (Figure 7). In the mid-season, yield was increased with increasing the doses and highest was obtained in the treatment T4 (0.50 ppm). However, treatments T1, T2 and T3 are comparable to each other statistically.

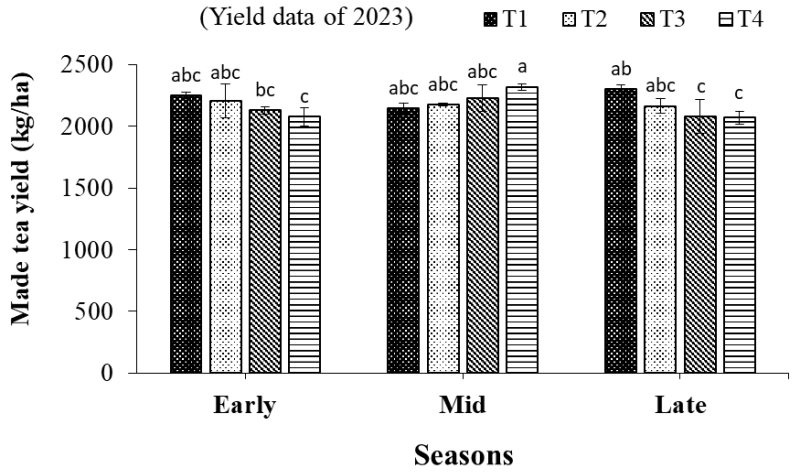


Figure 7. Interaction effect of different doses of Brassinosteroids and different seasons on the yield of tea.

Effect on quality

Total polyphenols, caffeine and amino acid contents of the harvested green leaves were demined biochemically.

Polyphenol content

It was observed that Brassinosteroids had some positive impact on total polyphenols content in the early-season and mid-season and somewhat negative effect in the late-season, though not significantly (Figure 8).

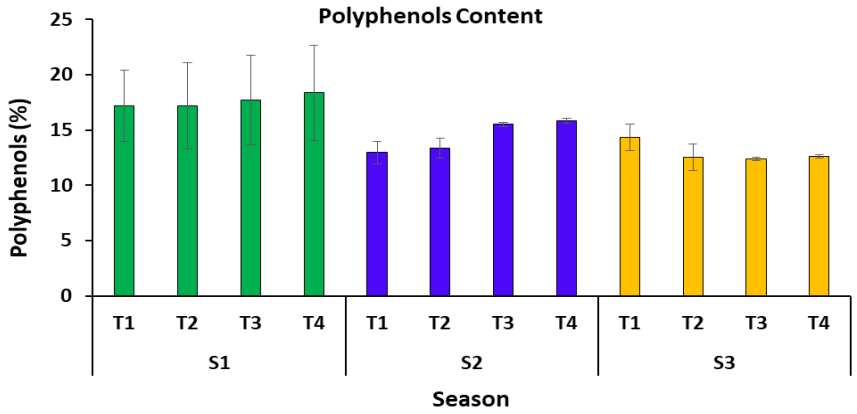


Figure 8. Interaction effect of different doses of Brassinosteroids and different seasons on total polyphenols content of green leaf.

Caffeine content

Caffeine content significantly varied due to the interaction of different doses of Brassinosteroids and different seasons (Figure 9). The effect was positive only in the mid-season and negative in the other two seasons. In the mid-season, caffeine content was increased with increasing the doses of Brassinosteroids and highest was obtained in the treatment T4 (0.50 ppm).

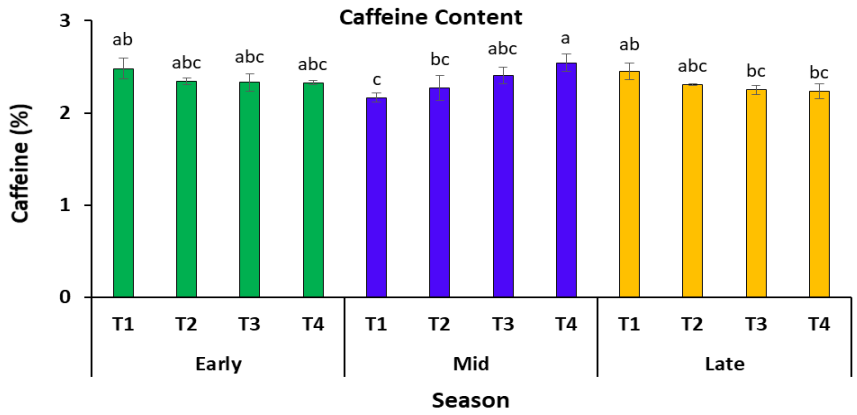


Figure 9. Interaction effect of different doses of Brassinosteroids and different seasons on total polyphenols content of green leaf.

Amino acid content

The interaction of different doses of Brassinosteroids and different seasons was insignificant. However, the amino acid content in the green leaves increased with increasing the doses of Brassinosteroids in all the three seasons (Figure 10).

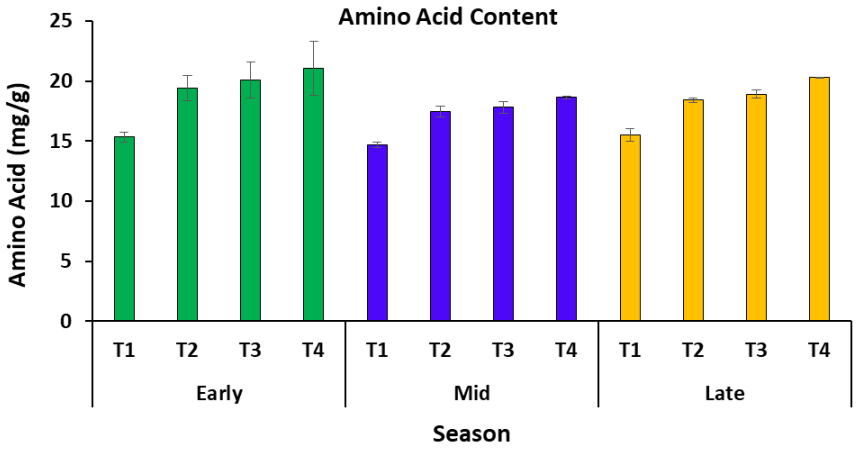


Figure 10. Interaction effect of different doses of Brassinosteroids and different seasons on total polyphenols content of green leaf.

BOTANY DIVISION

Dr. Md. Ismail Hossain
Director (in-charge) and
Dr. Md. Abdul Aziz
Chief Scientific Officer

Forty two experiments in four programme areas were conducted in 2023, 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.

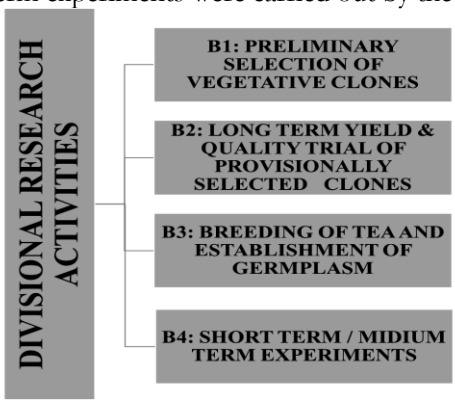


Fig 1. Divisional Activities of Boatny Division (2023)

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 (1993-2024)

11 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 1654 cuttings from 9 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 (1993-2024)

Thirty-two new bushes have been selected during the period under report. The selected bushes have been pruned for collecting cuttings for rooting trial. A total of 3148 cuttings from previously selected 28 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 (2007-2024)

06 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 957 cuttings from 5 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 deep skiffed at 67 cm in 2023. There were 27 plucking rounds in 2023. 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	1042.35	1011.275	985.37	989.47	1067.46	1031.48

Treatment difference- Significant (LSD value at 5% level of significance= 102.12)

The analytical results reveal that yield difference was highly significant (at 5% level of significance) in 2023. Test clones SDL/1 and E/4 were significantly higher in terms of yield with the control BT2 while the test clone E/4, 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.

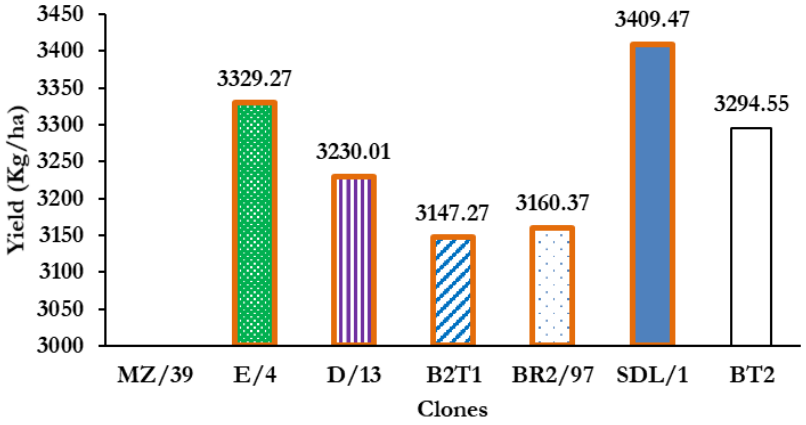


Fig. 2. Comparative yield of clones made tea (kg/ha)

Table 2. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
MZ/39	7.45	7.43	7.61	7.51	2.86	32.86	AA
E/4	7.65	7.58	7.43	7.38	2.79	32.83	AA
D/13	7.41	7.51	7.44	7.45	2.73	32.54	AA
B2T1	7.47	7.37	7.41	7.41	2.79	32.45	AA
BR2/97	7.52	7.44	7.45	7.54	2.78	32.73	AA
SDL/1	7.33	7.47	7.51	7.65	2.78	32.74	AA
BT2	7.43	7.65	7.56	7.43	2.61	32.68	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 deep skiffed at 67 cm and 27 plucking rounds in 2023. 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	1016.36	1103.12	978.55	963.81	955.94

Treatment difference- Significant (LSD value at 5% level of significance= 48.45)

The analytical results reveal that yield difference was insignificant during the cropping year. The analytical results revealed that all test clones 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	7.43	7.53	7.56	7.31	2.78	32.61	AA
A/8/55	7.28	7.41	7.51	7.43	2.69	32.32	AA
A/8/62	7.38	7.38	7.51	7.37	2.79	32.43	AA
A/8/66	7.53	7.44	7.44	7.58	2.82	32.81	AA
BT2	7.57	7.48	7.39	7.65	2.73	32.82	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.

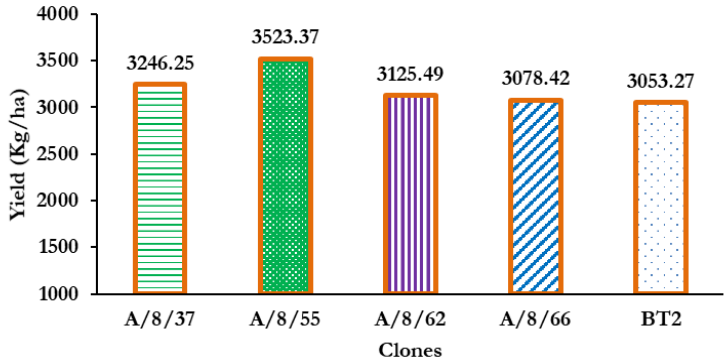


Fig. 3. Comparative yield of clones made tea (kg/ha)

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 pruned at 68 cm and there were 23 plucking rounds in 2023. 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	942.49	918.1	946.59	990	939.95

Significant (LSD value at 5% level of significance= 11.32)

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.

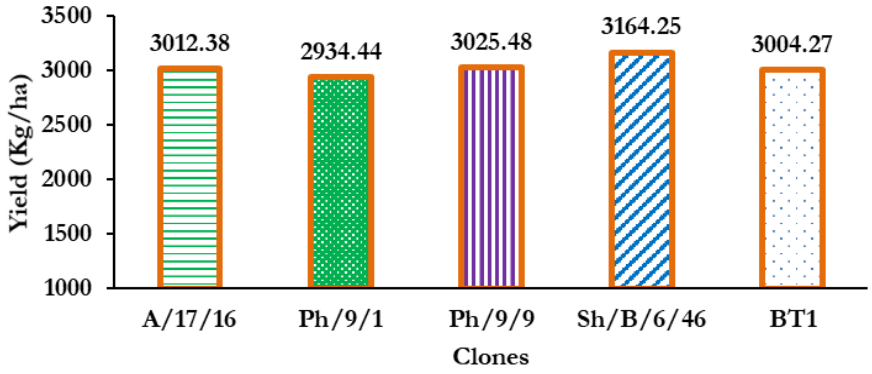


Fig. 4. Comparative yield of clones made tea (kg/ha)

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	7.35	7.54	7.46	2.75	32.63	AA
Ph/9/1	7.37	7.48	7.37	7.46	2.68	32.36	AA
Ph/9/9	7.48	7.49	7.58	7.42	2.72	32.69	AA
Sh/B/6/46	7.39	7.41	7.54	7.46	2.67	32.47	AA
BT1	7.23	7.35	7.44	7.42	2.74	32.18	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 pruned at 68 cm and there were 23 plucking rounds in 2023. 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	942.74	918.17	933.96	959.93	922.14

Significant (LSD value at 5% level of significance= 23.22)
The statistical results reveal that yield difference was significant in 2023. 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.

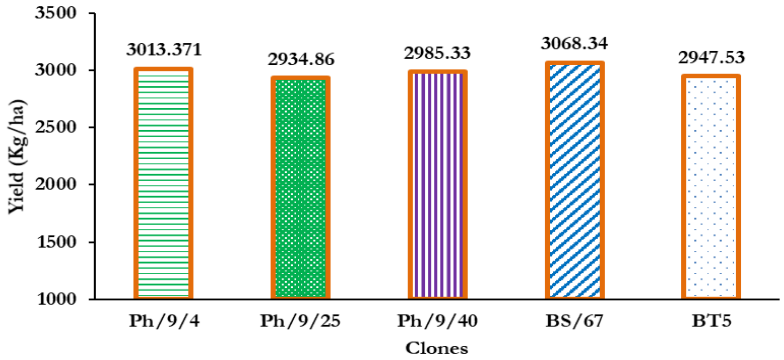


Fig. 5. Comparative yield of clones made tea (kg/ha)

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	7.52	7.45	7.49	2.68	32.52	AA
Ph/9/25	7.43	7.35	7.43	7.41	2.67	32.29	AA
Ph/9/40	7.35	7.37	7.37	7.43	2.71	32.23	AA
BS/67	7.54	7.55	7.53	7.47	2.65	32.74	AA
BT5	7.47	7.51	7.54	7.44	2.75	32.71	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 medium skiffed at 73 cm in 2023. There were 25 plucking rounds in 2023. 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	1128.18	1286.44	1117.63	1086.13

Treatment difference- Significant (LSD value at 5% level of significance= 92.48)
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.

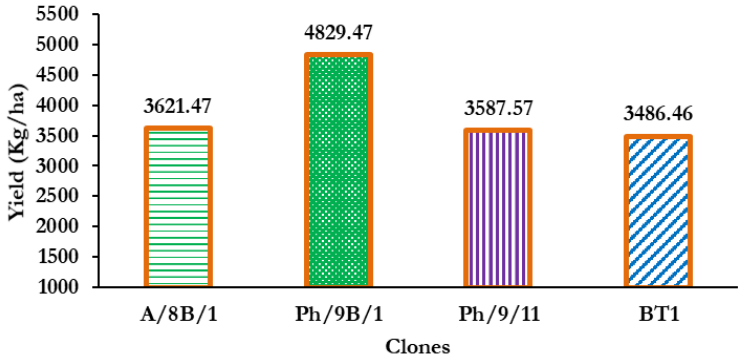


Fig. 6. Comparative yield of clones made tea (kg/ha)

Table 10. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8B/1	7.45	7.63	7.46	7.45	2.61	32.6	AA
Ph/9B/1	7.41	7.43	7.47	7.54	2.83	32.68	AA
Ph/9/11	7.48	7.52	7.45	7.34	2.78	32.57	AA
BT1	7.46	7.43	7.41	7.38	2.81	32.49	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-).

The plants of this trial were light pruned at 63 cm and there were 24 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	1018.36	1008.93	948.97	989.63	942.22

Treatment difference- Significant (LSD value at 5% level of significance=32.47)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2023. 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.

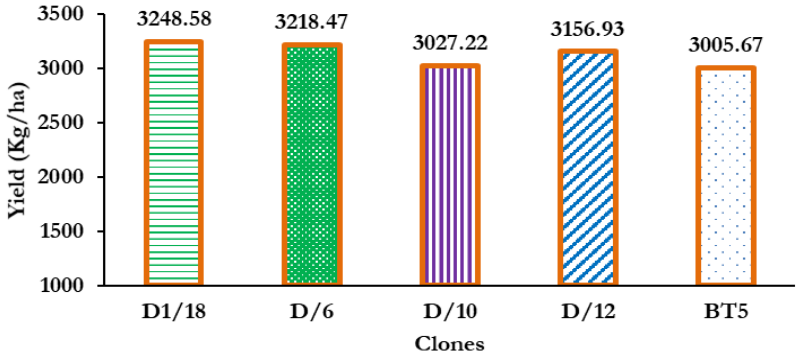


Fig. 7. Comparative yield of clones made tea (kg/ha)

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	7.47	7.44	7.43	2.85	32.84	AA
D/6	7.26	7.53	7.34	7.75	2.89	32.77	AA
D/10	7.28	7.52	7.33	7.43	2.96	32.52	AA
D/12	7.46	7.67	7.33	7.38	2.77	32.61	AA
BT5	7.32	7.72	7.36	7.35	2.91	32.66	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 light skiffed at 76 cm in 2023. There were 29 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	1237.07	1205.93	1186.7	1195.73	1174.17

Treatment difference- Significant (LSD value at 5% level of significance= 48.39)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2023. 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.

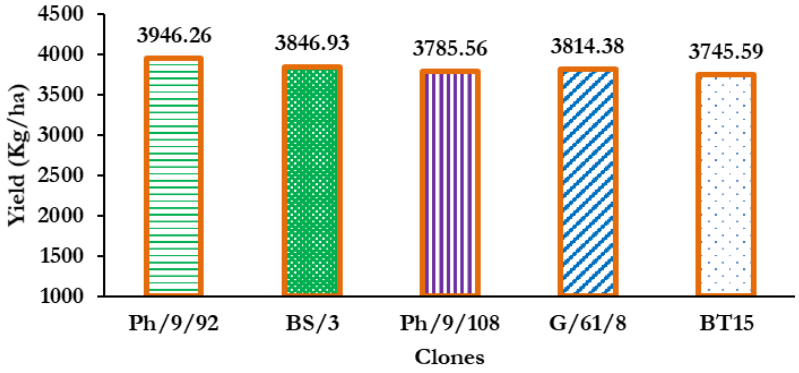


Fig. 8. Comparative yield of clones made tea (kg/ha)

Table 14. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Ph/9/92	7.26	7.44	7.54	7.52	2.83	32.59	AA
BS/3	7.37	7.52	7.19	7.35	2.68	32.11	AA
Ph/9/108	7.21	7.73	7.45	7.33	2.86	32.58	AA
G/61/5	7.12	7.54	7.65	7.27	2.84	32.42	AA
BT15	7.24	7.33	7.21	7.33	5.54	34.65	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 deep skiffed at 68 cm and there were 25 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	1137.74	1110.85	1167.55	1124.63	1069.9

Treatment difference- Significant (LSD value at 5% level of significance= 46.39)

The statistical results reveal that yield difference was significant (at 5% level of significance) in 2023. 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.

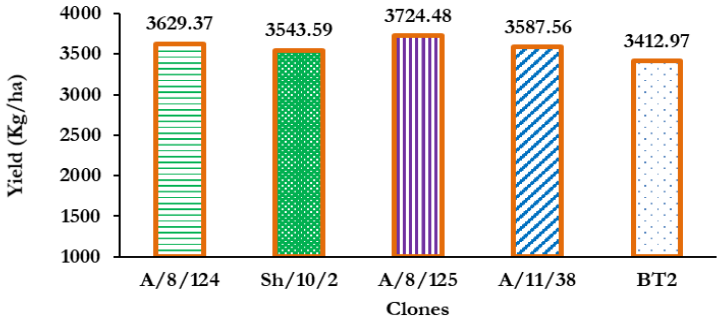


Fig. 9. Comparative yield of clones made tea (kg/ha

Table 16. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
A/8/124	7.55	7.53	7.44	7.41	2.85	32.78	AA
Sh/10/2	7.43	7.41	7.58	7.41	2.82	32.65	AA
A/8/125	7.27	7.34	7.71	7.54	2.65	32.51	AA
A/11/38	7.38	7.42	7.32	7.54	2.85	32.51	AA
BT2	7.33	7.59	7.43	7.62	2.69	32.66	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 deep skiffed at 68 cm there were 23 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	1120.96	1074.12	1038.36	983.88	959.2

Treatment difference- Significant (LSD value at 5% level of significance= 67.43)

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.

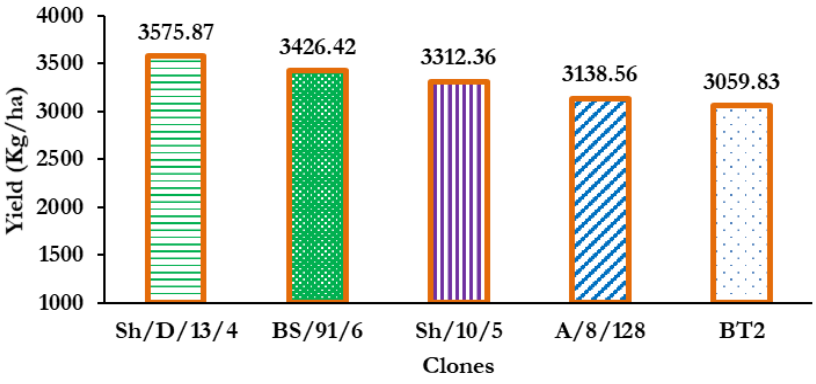


Fig. 10. Comparative yield of clones made tea (kg/ha)

Table 18. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
Sh/D/13/4	7.45	7.27	7.56	7.39	2.84	32.51	AA
BS/91/6	7.51	7.39	7.31	7.49	2.82	32.52	AA
Sh/10/5	7.38	7.64	7.43	7.51	2.78	32.74	AA
A/8/128	7.48	7.51	7.57	7.52	2.71	32.79	AA
BT2	7.27	7.48	7.39	7.43	2.86	32.43	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 light pruned at 58 cm and there were 23 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	907.95	901.74	891.92	924.32	860.81

Treatment difference- Significant (LSD value at 5% level of significance= 13.28)

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.

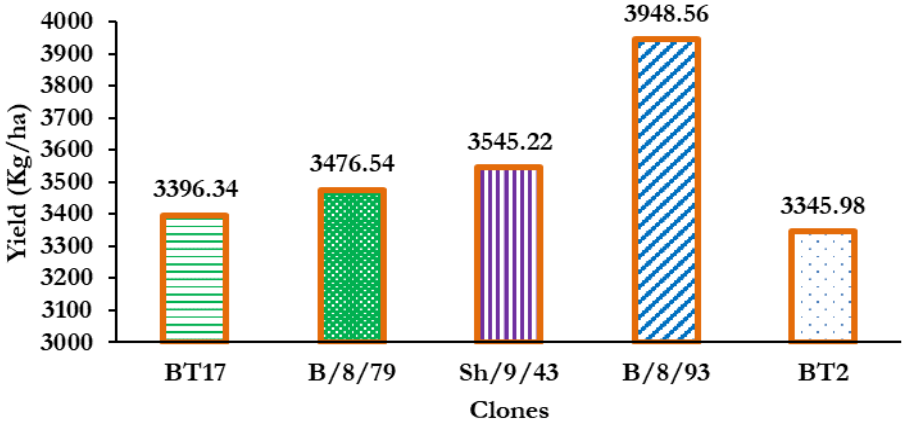


Fig. 11. Comparative yield of clones made tea (kg/ha)

Table 20. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BT17	7.25	7.43	7.44	7.43	2.72	32.27	AA
B/8/79	7.41	7.23	7.59	7.41	2.83	32.47	AA
Sh/9/43	7.44	7.34	7.63	7.29	2.62	32.32	AA
B/8/93	7.53	7.53	7.47	7.41	2.35	32.29	AA
BT2	7.55	7.52	7.47	7.52	2.68	32.74	AA

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

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

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

The plants were light skiffed at 66 cm and there were 30 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	927.36	990.55	977.75	917.48	895.77

Treatment difference- Significant (LSD value at 5% level of significance= 34.75)

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.

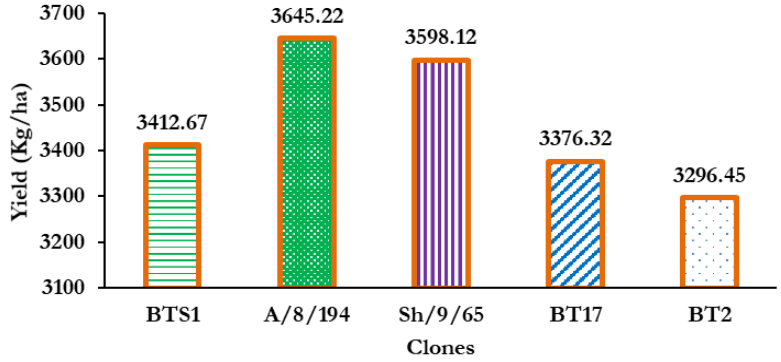


Fig. 12. Comparative yield of clones made tea (kg/ha)

Table 22. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
BTS1	7.25	7.42	7.46	7.41	2.72	32.26	AA
A/8/194	7.44	7.27	7.52	7.45	2.78	32.46	AA
Sh/9/65	7.47	7.32	7.65	7.31	2.59	32.34	AA
BT17	7.32	7.31	7.44	7.44	2.64	32.15	AA
BT2	7.46	7.64	7.36	7.37	2.84	32.67	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 deep skiffed pruned at 66 cm and the yield data were analyzed and presented in Table 23.

Table 23. Yield of green leaves

Clone	B/8/97	Sh/9/71	A/8/217	B/8/101	BT2
Treatment mean	405.07	374.48	423.66	371.86	327.78

Treatment difference- Significant (LSD value at 5% level of significance= 18.56)

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. 13. The cup quality of made tea for all the test clones were assessed organoleptically and average scores are presented in Table 24.

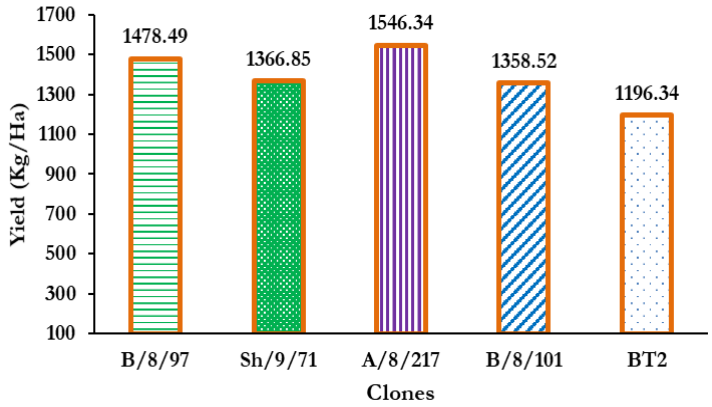


Fig. 13. Comparative yield of clones made tea (kg/ha)

Table 24. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.25	7.61	7.32	7.16	3.13	32.47	AA
Sh/9/71	7.28	7.52	7.46	7.31	2.84	32.41	AA
A/8/217	7.54	7.46	7.45	7.52	2.52	32.49	AA
B/8/101	7.31	7.54	7.53	7.41	2.89	32.68	AA
BT2	7.28	7.51	7.55	7.32	3.21	32.87	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 plants were deep skiffed pruned at 66 in 2023. 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	420.34	400.81	397.92	451.67	368.1

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.

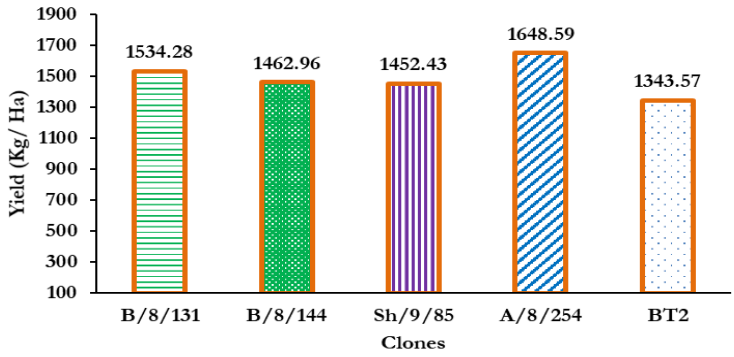


Fig. 14. Comparative yield of clones made tea (kg/ha)

Table 26. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/131	7.33	7.76	7.35	7.44	2.95	32.83	AA
B/8/144	7.24	7.73	7.44	7.51	2.85	32.77	AA
Sh/9/85	7.21	7.51	7.61	7.43	2.93	32.69	AA
A/8/254	7.35	7.43	7.31	7.25	2.98	32.32	AA
BT2	7.32	7.47	7.34	7.37	2.96	32.46	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).

The experimental plants were pruned at 51 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	295.46	308.92	295.46	303.75	270.98

Treatment difference- Significant (LSD at 5%=13.28)

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.

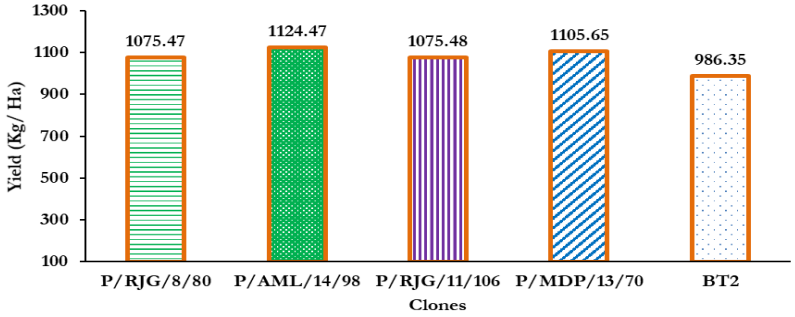


Fig. 15. Comparative yield of clones made tea (kg/ha)

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	7.36	7.27	7.35	2.85	32.27	AA
P/AML/14/98	7.31	7.52	7.41	7.61	2.88	32.73	AA
P/RJG/11/106	7.38	7.44	7.55	7.23	2.98	32.58	AA
P/MDP/13/70	7.31	7.56	7.33	7.46	2.85	32.51	AA
BT2	7.33	7.38	7.65	7.38	3.09	32.83	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).

The experimental plants were pruned at 51 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	327.32	297.36	308.53	335.03	296.56

Treatment difference- Insignificant

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.

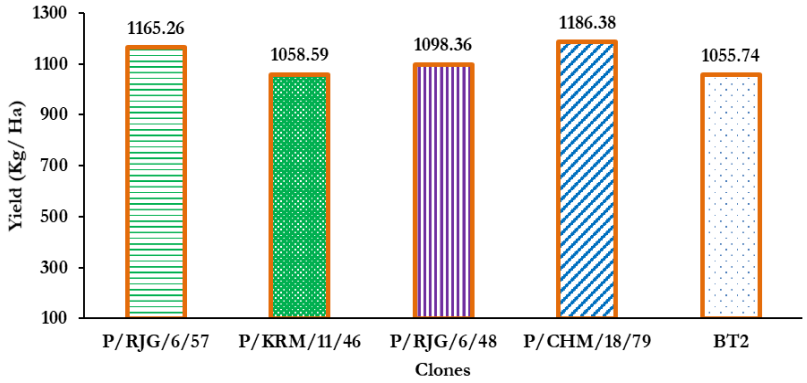


Fig. 16. Comparative yield of clones made tea (kg/ha)

Table 30. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/RJG/6/57	7.34	7.38	7.49	7.57	3.11	32.89	AA
P/KRM/11/46	7.46	7.36	7.21	7.47	3.22	32.72	AA
P/RJG/6/48	7.51	7.41	7.29	7.41	2.97	32.59	AA
P/CHM/18/79	7.49	7.34	7.44	7.29	3.15	32.71	AA
BT2	7.34	7.37	7.51	7.42	3.12	32.76	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 pruned at 51 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	371.6	393.94	362.42	352.76	320.12

Treatment difference- Significant (LSD at 5%= 11.76)

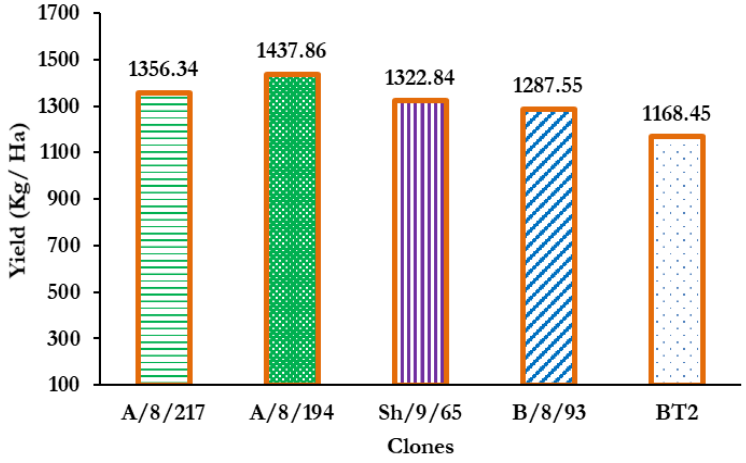


Fig. 17. Comparative yield of clones made tea (kg/ha)

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	7.32	7.54	7.39	7.26	3.14	32.65	AA
A/8/194	7.23	7.34	7.31	7.55	2.89	32.32	AA
Sh/9/65	7.21	7.37	7.44	7.35	3.11	32.48	AA
B/8/93	7.34	7.26	7.42	7.32	3.11	32.45	AA
BT2	7.31	7.43	7.54	7.51	2.99	32.78	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 pruned at 51 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	341.36	326.25	327.34	361.71	286.24

Treatment difference- Significant (LSD at 5%= 10.55)

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.

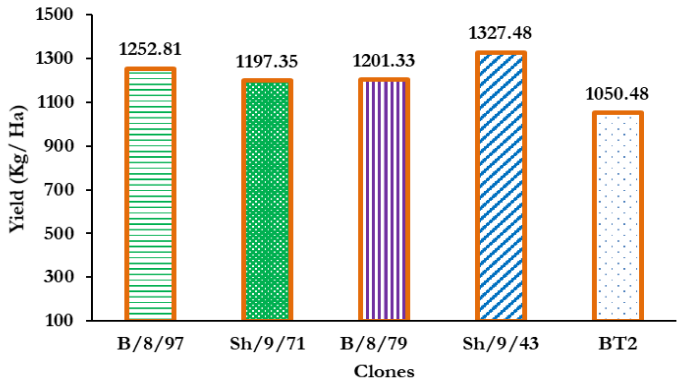


Fig. 18. Comparative yield of clones made tea (kg/ha)

Table 34. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
B/8/97	7.31	7.51	7.55	7.26	3.14	32.77	AA
Sh/9/71	7.22	7.43	7.32	7.31	2.96	32.24	AA
B/8/79	7.33	7.56	7.25	7.34	3.12	32.6	AA
Sh/9/43	7.34	7.52	7.83	7.22	2.91	32.82	AA
BT2	7.41	7.55	7.57	7.27	3.22	33.02	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).

The experimental plants were pruned at 51 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 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	344.07	333.72	310.49	309.69	313.33

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.

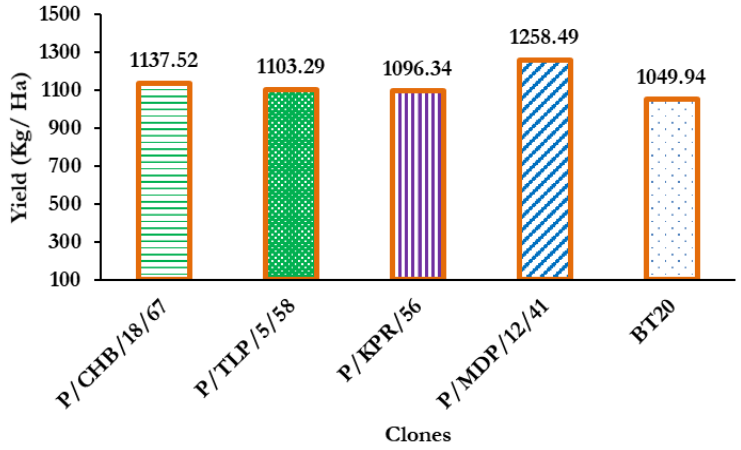


Fig. 19. Comparative yield of clones made tea (kg/ha)

Table 36. Quality scores

Clone	Infusion	Liquor colour	Briskness	Strength	Creaming down	Total	Remarks
	10	10	10	10	10	50	
P/CHB/18/67	7.34	7.11	7.35	7.26	3.22	32.28	AA
P/TLP/5/58	7.36	7.24	7.22	7.39	3.21	32.42	AA
P/KPR/56	7.53	7.33	7.53	7.33	3.23	32.95	AA
P/MDP/12/41	7.34	7.36	7.62	7.38	3.25	32.95	AA
BT20	7.37	7.39	7.62	7.43	4.28	34.09	E

All the test clones were 'Above Average' quality while control BT20 was 'Excellent' quality.

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).

The experimental plants were pruned at 51 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 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	312.35	326.49	339.9	319.95	288.82

Treatment difference- Insignificant

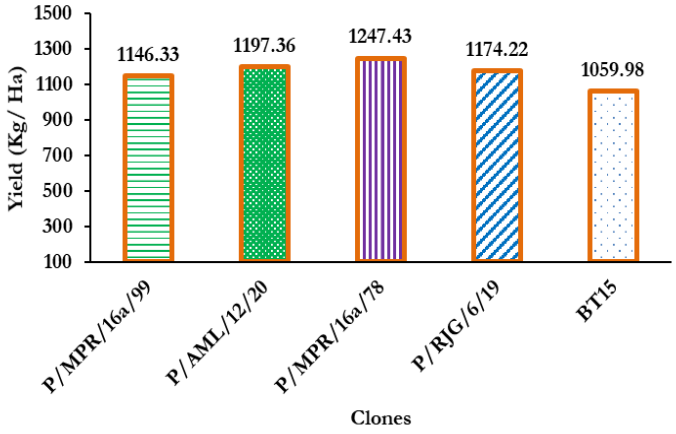


Fig. 20. Comparative yield of clones made tea (kg/ha)

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	7.22	7.64	7.33	7.15	3.12	32.46	AA
P/AML/12/20	7.51	7.37	7.32	7.33	2.83	32.36	AA
P/MPR/16a/78	7.62	7.43	7.44	7.31	2.56	32.36	AA
P/RJG/6/19	7.45	7.61	7.56	7.41	2.86	32.89	AA
BT15	7.28	7.73	7.55	7.32	4.26	34.14	E

All the test clones were 'Above Average' quality while control BT15 was 'Excellent' quality.

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).

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 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	378.43	398.43	365.75	349.29

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).

The experimental plants were pruned at 35 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 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	229.39	249.21	257.93	243.86	209.98

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).

The experimental plants were pruned at 35 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 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	214.21	239.49	227.43	210.32

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 during December 2022- January 2023:

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**					
BT4 x TV1		32	18	56.25	6	33.33
TV9 x BT2		34	14	41.18	7	50
BT2 xTV19		45	15	33.33	5	33.33
BT2 x BT17		21	17	80.95	6	35.29
BT10 x TV26		36	15	41.67	5	33.33
BT2 x TV23		33	17	51.52	7	41.18
TV26 x BT10		38	15	39.47	6	40
BS35 X TV1		27	16	59.26	5	31.25
BT6 x TV26		25	11	44	4	36.36
TV1 x BT4		31	17	54.84	5	29.41
TV18 x BT3		22	19	86.36	17	89.47
TV1 x TV19		28	11	39.29	4	36.36
TV26 x BT6		31	14	45.16	5	35.71
TV19x TV1		28	12	42.86	7	58.33
BT21 x BT1		32	12	37.5	8	66.67

Highest Percentages of fruit setting was found in TV18 x BT3 (86.36%) and Highest Percentages of germination was found in TV18 x BT3 (89.47%).

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 2023.

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-).

In 2023, one 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 T. E. Seed Barie (2019-).

In 2023, two 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 T. E. Seed Barie (2019-).

In 2023, one 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 (2023-).

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-09)

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 'Golden Tea' were optimized and standardized. Details 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 (2023-).
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 (2023-).
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-19: Effect of nursery-tipping on the development of stem girth in different tea saplings / seedlings (2023-).
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 (2023-).
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 (2023-).
Research activities will be continued and detailed data will be published after completion of the experiment**.**

B4-23: Screening and characterization of waterlog tolerant tea germplasm.
Research activities will be continued and detailed data will be published after completion of the experiment**.**

Summary of activities of Botany Division-2023

1. No. of Experimental, Advisory and Official Visit: 29
2. Correspondence: 95
3. Tea Tasting Course/ Session: 07

Date	Type	Venue	Participants
18.8.23	Valley Tea Tasting	Balisera Valley Club	19
19.8.23	Valley Tea Tasting	Chandbag Tea Factory	21
24.8.23	Valley Tea Tasting	Luskerpore Valley Club	24
25.8.23	Valley Tea Tasting	Monu Doloi Valley Club	20
26.8.23	Valley Tea Tasting	North Sylhet Valley Club	21
30.9.23	Central Tea Tasting	Tea Tasting Room, BTRI	75
05.10.23	Tea Tasting Session	BTRI Substation, Panchgarh	53
18.10.23	Valley Tea Tasting	Juri Valley	21

4. Received Tea Sample Tasting: 1195
5. Quantity of planting material supplied:

Rooted cutting (nos.)	Seasonal Bi-clonal seeds (kg)
250	907

AGRONOMY DIVISION

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

RESEARCH

Including one trial, a total of ten experiments were approved in the 78th RSC meeting of BTRI to carry out by Agronomy division in 2023. The experiments were under two research program areas such as (i) standardization of cultural practices; and (ii) development of soil fertility. Among 10 experiments, four were completed in 2023 and the others will be continued in 2024. Results of the experiments including one field trial 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: 2012-2025)

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 2023, it was observed that significantly highest yield was obtained in the treatment T_1 and that was followed by T_2, T_4, and T_5; 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 between T_2 and T_4 and between T_4 and T_5 are statistically identical. Similarly, the yields between T_3 and T_5 are also statistically identical.

Table 1. Made tea yield (kg/ha) of different treatments in 2023

Treatments	Yield (kg/ha)
T_1 (LP–DS–**MS**)	3644 a (MS)
T_2 (LP–DS–MS–**LS**)	2880 b (LS)
T_3 (LP–LS–DS–**MS**)	2312 d (MS)
T_4 (LP–LS–DS–MS–DS–**LS**)	2622 bc (LS)
T_5 (LP–DS–MS–LS–**DS**–MS–LS)	2428 cd (DS)
LSD (0.01)	295.4
CV (%)	11.90

The interaction effect between the clone and treatment was not significant (Figure 1). From overall analysis (2012-2023) 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 18.44% more yield compared to the existing

BTRI recommended 4-years pruning cycle (T_2). The experiment will be continued till 2025. Final comments will be made thereafter.

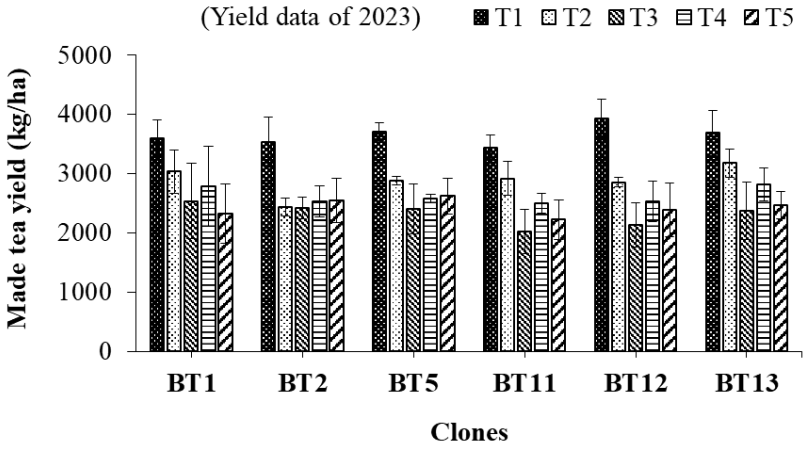


Figure 1. Interaction effect of different clones with different treatments in 2023.

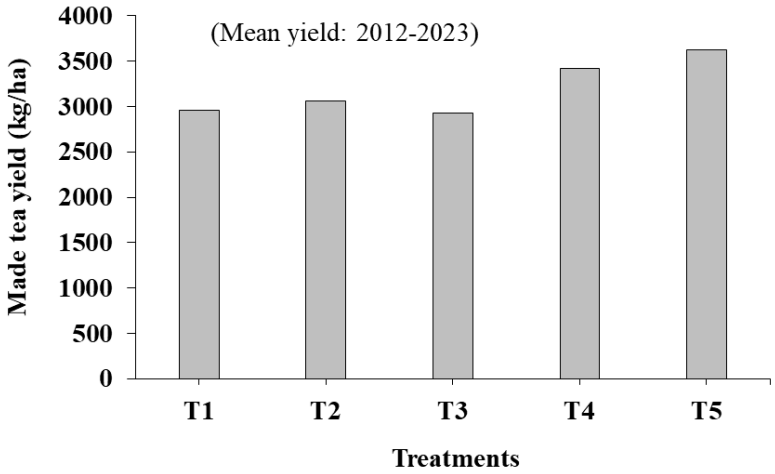


Figure 2. Average yield of made tea (kg/ha) in different treatments from 2012-2023.

Experiment 2: Implementation of grafting technique to produce composite tea plant in the nursery for increasing yield and drought resistance capacity of the plant (BTRI Farm, 2020-2023)

Treatments and design: The experiment was consisted with 04 (Four) treatments. Scions collected from BTRI released high yielding clonal tea plants as fresh cuttings were used as treatments e.g. T_1 = BT2, T_2 = BT12, T_3 = BT15 and T_4 = BT17. Bi-clonal seedling tea plants were the 'root stocks' for all treatments. With four treatments, randomized complete block design was followed having five replications. In each replication, there were 50 seedlings and all together there were 1000 seedlings for this study.

In 2021 and 2022, the study was concentrated mainly to raise grafted tea plants in the nursery and to collect required data from the plants. However in April 2023, some grafted tea plants were planted in the main field to observe their field performances relevant to the study. Following RCBD design, plants were planted in the field. There were also 04 replications and number of plants for each treatment was 10. Data

collected in the main field were on plant height, number of branches during decentering, weight of pruning litter etc.

Results:

After analyzing the collected data of 2023, it was observed that plant height during the time of decentering in the main field was significantly different for treatments (p=0.05). Maximum height observed in T_1 (74.25 cm) which was statistically similar with T_4 (69.75 cm) but different with T_3 (64.5 cm) and T_2 (62.5 cm respectively), presented in Figure 3. Similarly, number of branches per plant at the time of decentering and fresh weight of pruning litter after decentering were observed significantly different for treatments (Table 2).

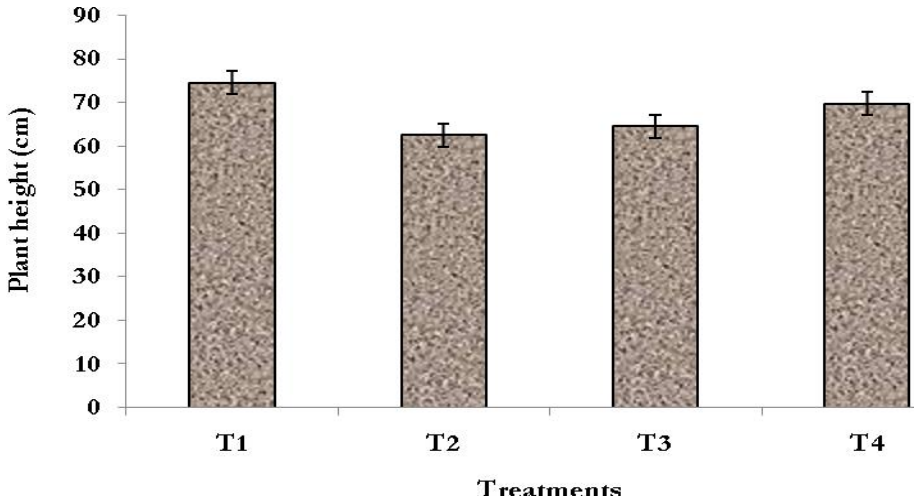


Figure 3. Average height of tea plant for different treatments at the time of decentering in main field

Table 2: Number of branches and fresh weight of pruning litter per plant during the time of decentering

Treatments	Number of branches/ plant	Pruning litter fresh weight (gm)
T_1 = BT2	3.75 a	32.13 b
T_2 = BT12	3.00 ab	34.12 b
T_3 = BT15	3.00 ab	34.83 b
T_4 = BT17	2.50 b	47.18 a
Mean	3.06	37.25
CV (%)	18	16
LSD (p=0.05)	1.24	8.57

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. Three pruning policies were tested on four different types of pruning operations (LP, DSK, MSK and LSK).

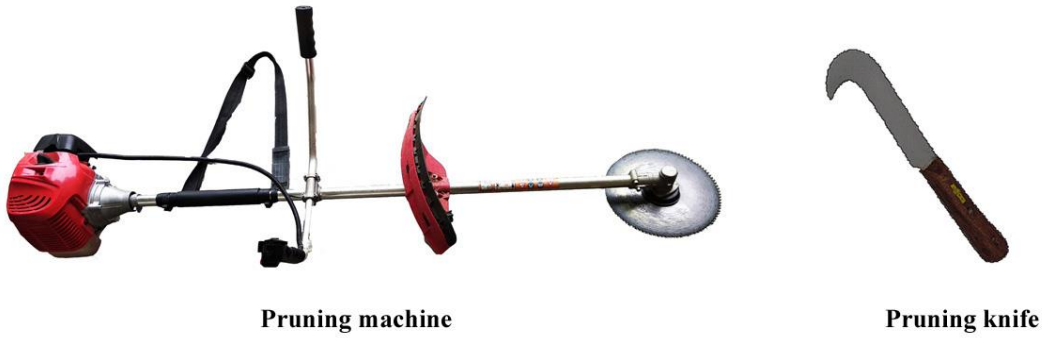


Figure 4. Photos of the pruning machine and the traditional pruning knife

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. Medium Skiff (MSK)
3. Deep Skiff (DSK) 4. Light Skiff (LSK)

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 2022 to February 2023 according to the treatments. Data were collected for comparing the efficiency between machine and manual pruning (Table 3 and Table 4). Yield data were also collected to evaluate the yield variations due to different pruning policies employed, which is shown in the Figure 5. From the result it was noticed that there was no significant difference in yield between traditional manual pruning and machine pruning. Yield slightly reduced in machine pruning in case of LP but difference is insignificant. For other treatments, yield either increased or remained almost equal in machine pruning compared to the traditional pruning. According to pruning types, fuel consumption of the machine varied from 0.27 to 0.37 liter/hour. Per hectare fuel consumption was highest for LP (59.26 liter/hectare) and lowest for LSK (33.33 liter/hectare). Compared to traditional manual pruning, machine pruning helped to complete the task 2.40-3.67 times quicker. The experiment is closed.

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 peoples were 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 (liter)	Fuel consumption per hour (liter)
LP	59.26	0.27
DSK	35.19	0.34
MSK	37.04	0.37
LSK	33.33	0.34

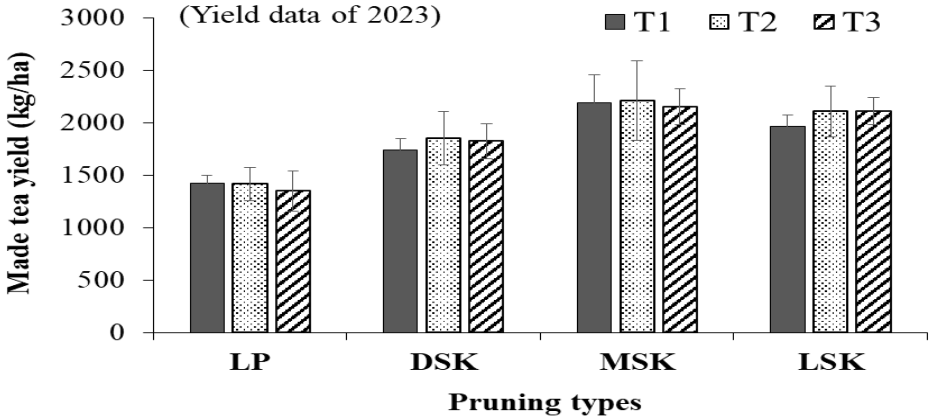


Figure 5. Yield of tea under different treatments on various pruning types in 2023.

Experiment 4: Effect of light pruning (L.P) completed at different months on growth and yield of tea (BEF, November 2022 – December 2024)

Treatments and design: 06 (six)

(a)Light pruning completed by 15 November (T_1), (b) Light pruning completed by 30 November (T_2), (c) Light pruning completed by 15 December (T_3), (d) Light pruning completed by 30 December (T_4), (e) Light pruning completed by 15 January (T_5) and (f) Light pruning completed by 30 January (T_6).

The experiment was laid out in a randomized complete block design (RCBD) with 4 (four) replications.

Progress:
Before imposing the treatments of the experiment, starch reserve of roots were estimated in 2022. Then the data on harvested leaf yield and yield related parameters were collected regularly throughout the plucking season of 2023 (April-December). After analyzing the collected data on yield, it was observed that yield was not significantly different for treatments at p=0.05 which is presented in Figure 6.

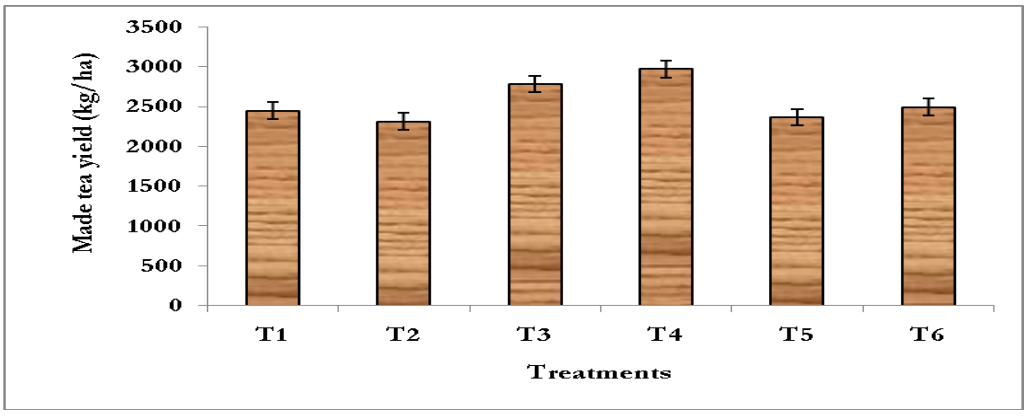


Figure 6. Effect of different time of light pruning on the yield of tea 2023.

Experiment 5: Effect of different irrigation techniques to irrigate young tea, planted at the hot slope in tillah area (BEF, 2023-2025)

Treatments: 05 (five)

T_1 = Control (irrigation applied at 10-12 days interval)
T_2 = Sprinkler irrigation: 2 hours at 7 days interval
T_3 = Drip irrigation by pvc pipe: 2 hours at 7 days interval
T_4 = Drip irrigation: By 1 liter plastic bottle at 7 days interval and
T_5 = Hand irrigation: Using ¾" normal plastic watering pipe at 7 days interval

Design: RCBD**, Replication:** 03,

Data Collection: Data will be collected on casualty percentage, growth parameters (Number of branches, diameter of branches and bush formation quality), yield etc. Expenditure of different treatments will be calculated.

Progress: With the existing facilities of irrigation, the experiment is initiated at the beginning of dry period of 2023 (November 2023) and continued. Following BTRI recommendation, intercultural operations are going on.

Experiment 6: Effect of different plucking rounds and plucking systems on yield and quality of tea at Northern Tea growing area of Bangladesh (Panchagarh, 2022-2024)

Treatments: 05 (Five)

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

Design: RCBD**, Replication:** 03

Data Collection: Data 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 23% recovery). After each plucking, soft leaf percentage was also recorded. From the analysis result of yield data obtained in 2023, it was observed that highest made tea was obtained in the treatment T_4 followed by T_2, T_5 and T_3 and the lowest was obtained in the treatment T_1. (Table 5). However, the yield differences among the treatments were not statistically significant. On the other hand highest percentage of soft leaf was obtained in the treatment T_1 followed by T_2, T_4, T_5 and T_3. However, statistically they all are comparable to each other.

Table 5. Made tea yield (kg/ha) and soft leaf (%) under different treatments in 2023

Treatments	Made tea (kg/ha)	Plucking Round	Soft leaf (%)
T_1	2835	20	62.70
T_2	3538	15	54.27
T_3	3183	11	41.91
T_4	3641	8	51.50
T_5	3301	8	48.75
LSD $_{(0.05)}$	1021	2.8	11.02
CV (%)	18	5	15

Experiment 7: Effect of First Frame Formation Pruning of winter planted tea at different times after planting on its growth and survivality (Luskorpore Tea Estate, 2021-2023)

Treatments: 07 (Seven)

T1 : First Frame Formation Pruning in August, 2021
T2 : First Frame Formation Pruning in September, 2021
T3 : First Frame Formation Pruning in October, 2021
T4 : First Frame Formation Pruning in November, 2021
T5 : First Frame Formation Pruning in December, 2021
T6 : First Frame Formation Pruning in January, 2022
T7 : First Frame Formation Pruning in February, 2022

Time frame and operations:

Time	**Operations**
Jan-Feb/ 21	Planting
Mid May/ 21	Centering
August, 2021	FFP1 for T1
September, 2021	FFP1 for T2
October, 2021	FFP1 for T3

November, 2021	FFP1 for T4
December, 2021	FFP1 for T5
January, 2022	FFP1 for T6
February, 2022	FFP1 for T7
May - June, 2022	Skiff for all treatments
January - February, 2023	Final Frame Formation Pruning for all treatments

Progress: According to the experimental design and operational time frame decentering, FFP1, skiff and final frame formation pruning for all the treatments were done. Data were collected on the mortality percentage and number of branches per plant after the final frame forming prune. However, yield data could not be collected due to some unavoidable circumstances. From the data on mortality percentage, it was observed that all the treatments had some mortality percentage which varied from 5.9 to 13.53 percent and the difference was insignificant (Figure 7). Number of branches per plant also did not vary significantly due to different treatments. However, higher number of branches per plant was observed in the treatment T3 (18.70) followed by T1 (17.90) and T7 (16.80). Comparatively less number of branches per plant were observed in the treatments T5 (13.9) and T4 (14.73), as shown in Figure 8.

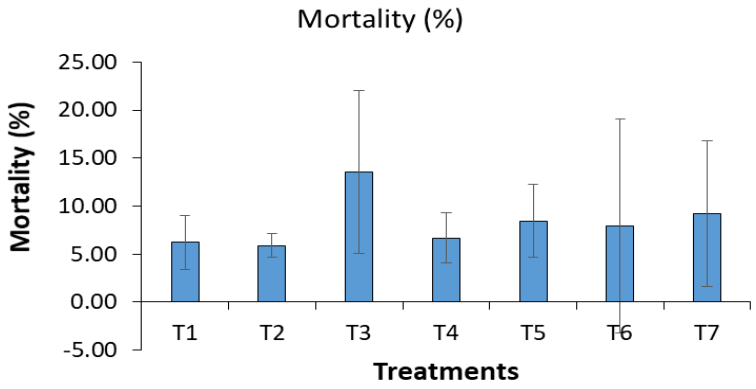


Figure 7. Mortality percentage under different treatments

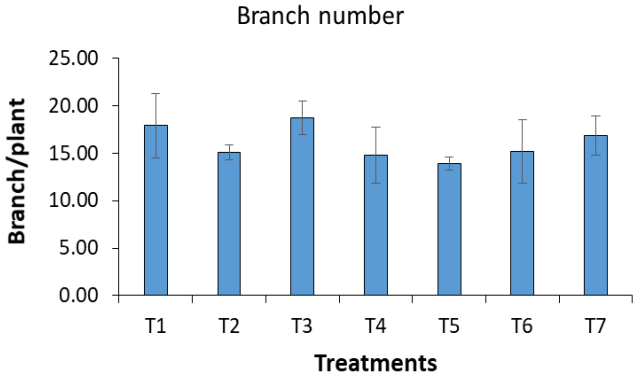


Figure 8. Number of branches per plant under different treatments

Experiment 8: Development of a standard young tea pruning schedule for Northern Tea Growing areas of Bangladesh (Panchagarh, 2022-2027)

Treatments:

There were 4 treatments. The schedule will be followed in each treatment is summarized below.

Sl. No.	Operations	Treatment 1	Treatment 2	Treatment 3 (Control)	Treatment 4
01	Planting date	May/2022	May/2022	May/2022	May/2022
02	Decenter (6-9 inch)	July-August/ 2022	October-November/ 2022	January-February/ 2023	Local Practice
03	FFP1 (14-16 inch)	January-February/ 2023	April-May/ 2023	January-February/ 2024	
04	Skiff (20 inch)	May-June/ 2023	January-February/ 2024	January-February/ 2025	
05	FFP2 (18-20 inch)	January-February/ 2024	January-February/ 2025	January-February/ 2026	
06	Skiff (27-29 inch)	May-June/ 2024	May-June/ 2025	January-February/ 2027	
07	First LP (20-22 inch)	December/ 2024	December/ 2025	December/ 2027	

Planting materials: The clones BT2 and TV26 were used in the experiment. The experiment was laid out in a Split Plot Design with 4 replications. Total number of plots under the experiment is 32.

Progress:

According to the experimental design and operational time frame, planting, decentering and FFP1 for all the treatments were completed. Regular observation is going on. Data were collected on number of branches per plant and harvested leaf yield which were presented in Table 6 and Figure 9 below. The experiment will be continued till 2027.

Table 6. Number of branches per plant under different treatments

Treatment	Number of branch/Bush	
	BT 2	**TV 26**
T1	4.350	4.000
T2	4.075	4.150
T3	4.075	3.875
T4	4.050	4.325
CV	8.010	8.480

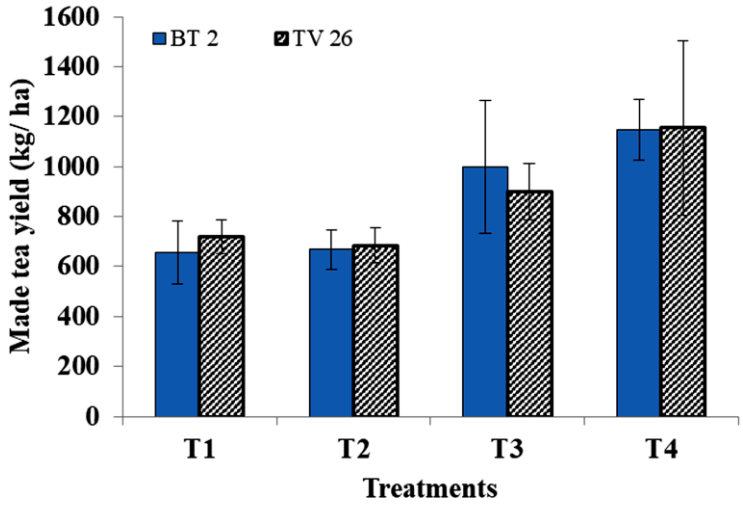


Figure 9. Yield of clone BT2 and TV26 under different treatments

Experiment 9: Yield performances of some selected tea clones in the northern tea growing area of Bangladesh (Panchagarh, 2023-2029)

Experimental details:

A) Treatments: 5 clones

T1 : BT1
T2 : BT2
T3 : BT13
T4 : BT17
T5 : TV1

B) Replication: 4 (R1, R2, R3 & R4)

Design: Randomized Complete Block Design (RCBD)
Total plots = 5×4 = 20

Progress:

The experiment is just started in 2023. Decentering/ breaking of the tea saplings were done at 6-9 inches. Regular monitoring and maintenance of the experimental field is going on.

Trial 01: Effect of a plant growth regulator (Clybio) on growth and yield of tea

Treatments and design: The trial was consisted with 05 (five) treatments-

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

Having 05 treatments, RCBD was followed with 03 replications. All together there were 15 plots in the trial and each plot was with 20 mature tea bushes (BT2 clone). The trial plot was under light pruned (L.P)

area. Data on harvested green leaf and active shoots (%) in the harvested green leaf from each plot were collected regularly throughout the plucking season of 2023.

Results:
After analyzing the collected data of 2023, it was observed that yield was not significantly different for treatments at p=0.05. However the yield data showed a positive trend on application of the PGR (Clybio) like the previous year. All treatments of this experiment gave higher yield than the control- T_1, presented in Table 7.

Table 7: Effect of different treatments of PGR (Clybio) on yield of tea yield in 2023

Treatment	Yield (kg/ha)	Yield increased compared with Control (as kg/ha)	Yield increased compared with Control (as %)
T_1 (Control)	2485	-	-
T_2	2679	194	7.8
T_3	2614	129	5.2
T_4	2738	253	10.2
T_5	2685	200	8.0

After analyzing the data, maximum average percentage of active shoots observed in T_4 (52.9%) and the lowest was in T_1 - Control (46.9%), presented in Table 8.

Table 8: Variation of active shoots (%) in the harvested green leaves due to the application of PGR (Clybio) under different treatments

Treatment	Active shoots (%)	Percentage of active shoots (%) increased in comparison with Control
T_1 (Control)	47	-
T_2	52	10.6
T_3	50	6.4
T_4	53	12.7
T_5	51	8.5

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 2023, 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 8.

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)
2023	15	08	66 Hours

Workshop/ Seminar

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

BTRI Main Farm

Farm Supervisor of BTRI Main Farm Mr. Roni Debnath resigned his job at the end of June 2023. Then Mr. Ajit Kumar Sarker (Field Assistant) was transferred from Bilashcherra Experimental Farm to BTRI Main Farm on mid of August 2023. 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
2023	351500	46257

Green leaf production and earning from other farm products

Reporting year	Green leaf production in kg	Earning from other farm products in Taka
2023	78675.25	26245

Green Leaf Supplied in kg

Reporting year	Central Factory BTRI	Mini Factory BTRI	Green Tea Factory	Total Green Leaf Production
2023	77856.00	82.85	736.40	78675.25

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.

Meteorological data for the year 2023

Month	No. rainy days	Rainfall (mm)	Evaporation (mm)	Temperature (^{O}C)		Dew point (^{O}C)	Sunshine hrs.	R.H. (%)
				Max.	Min.			
January	0	0.00	64.40	26.67	10.50	13.11	6.53	69.25
February	1	1.00	87.90	29.43	13.10	13.88	6.96	61.79
March	6	90.00	112.80	31.27	17.46	17.01	6.34	63.50
April	7	100.00	148.80	34.88	21.02	20.17	8.46	62.69
May	12	224.00	143.90	34.40	23.11	22.04	6.79	66.55
June	22	622.00	67.50	33.37	25.06	25.07	3.65	80.23
July	15	306.00	126.10	34.42	26.22	25.66	5.20	75.56
August	21	379.00	90.60	32.59	26.27	25.79	3.33	82.79
September	17	193.00	119.10	34.64	26.56	25.89	6.24	78.31
October	10	104.00	93.50	32.39	23.20	24.06	5.85	79.97
November	2	114.00	75.10	29.92	19.09	20.10	7.68	75.34
December	3	39.00	51.00	27.12	15.15	18.14	5.94	76.85
Total/ Average	116	2172.00	1180.70	31.76	20.56	20.91	6.08	72.74
	Total	**Total**	**Total**	**Average**	**Average**	**Average**	**Average**	**Average**

ENTOMOLOGY DIVISION

Dr. Mohammad Shameem Al Mamun
Principal Scientific Officer

STAFF

Dr. Mohammad Shameem Al Mamun, Principal Scientific Officer joined at Entomology Division, BTRI on 8 January 2023 as Head of the Division. Mr. Md. Shamim Hossain, Field Assistant transferred to Regional Tea Research Farm of BTRI, Banshkhali, Chattogram on 25 September 2023. 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. There was no other change in personnel position of the division.

RESEARCH

Four experiments under three programme areas were carried out during the year of 2023. 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; Isolation, mass culture and application of entomopathogens against major insect pests of tea; Survey and monitoring of new insect pests in tea due to change in climate: Causes and Remedies; Screening of pesticides against major pests of 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 (2022-2023)

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 (Success 2.5SC), Matrin (Bio-Action 1.5%) and Flometoquin (Gladious 10SC) as chemical pesticide against thrips under field condition at Bilashcherra Experimental Farm (BEF) of BTRI during 2023. 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 no. 09 of BEF. 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 caught in the traps were collected. Five plants were selected randomly from each plot to count the total number of shoots, healthy shoots and infested shoots to determine the efficacy of different treatments. Data were collected at weekly interval. The efficacy of different treatments was calculated by Henderson & Tilton formula. Identification of different insects was confirmed with the help of available literature of Triplehorn and Johnson (2005), Mani (1982) and Das (1965). The data on number of captured thrips by different traps in respective week as well as the

efficacy of different treatment were analysed by two way and one way ANOVA, respectively using SAS programme (version 9.4). Means were separated with the LSD test at 0.05 level of significance.

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 (51.21%) followed by jassid (20.42%), aphid (15.03%), looper caterpillar moth (5.01%), *Helopeltis* (2.61%), leaf roller moth (1.72%) and others (4.0%). Hence, other harmful insects like Jassid, aphid, looper caterpillar moth, *Helopeltis,* and leaf roller moth were also controlled to some extent by different traps. Moreover, some beneficial and other non-target insects such as lady bird beetle, robber fly, wasp, preying mantis, bees, ants etc. were also captured on different sticky traps (Fig 2b). However, their percentages were found very low (4.0%) compared to harmful insects.

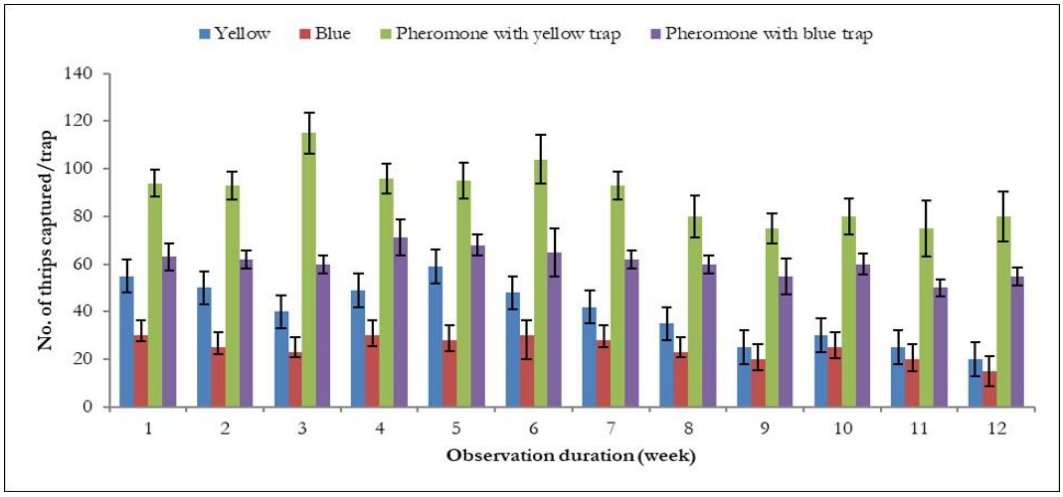


Fig. 1. Number of thrips captured per trap at different weeks.

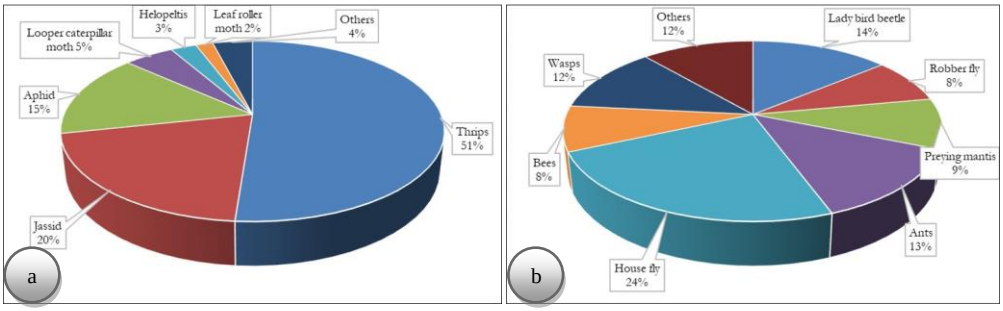


Fig. 2. Percentage of various insects captured on different traps (a) harmful insects and (b) other non-target insects.

Among the traps setup plots, the highest efficacy (66.36%) 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 (49.97%) 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 (86.13%) was observed in chemical treated plot (T7) followed by bio-pesticides treated plot T5 (82.84%) and T6 (81.66%) (Fig. 3). Though chemical options are better comparing with others in terms of mortality, bio control is also effective and safe for both target mortality and environment.

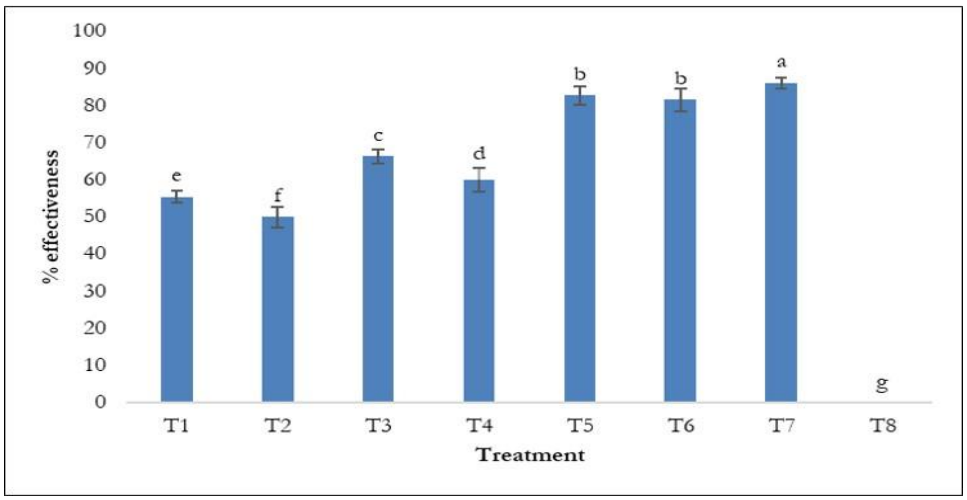


Fig. 3. Percent effectiveness of different traps and insecticides for controlling thrips in tea.

T1= Yellow sticky trap @ 100 ha^{-1}; T2=Blue sticky trap @ 100 ha^{-1}; T3= Yellow sticky trap with Pheromone lure; T4= Blue sticky trap 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

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)

This experiment was jointly implemented with Soil Science Division. The newly developed organic fertilizer cum pesticides (FCP) consisted of vermicompost, tricho-compost, neem leaves, bashok leaves, onion peel, banana peel, egg shell, rice husk ash, bone meal and horn meal. All these materials are good source of organic fertilizer. However, some components of FCP especially tricho-compost, neem leaves, bashok leaves, onion peel and rice husk, ash have pesticidal values which make a hypothesis that it can be used to control foliar and soil pests infesting tea. Hence, the efficacy of FCP was evaluated against *Helopeltis* and plant parasitic nematodes during the reporting period.

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. Chemical insecticide, Warrior 70WDG (Dinotefuran+Pymetrozine) @ 0.5 g/L of water was used as the standard to compare the efficacy of FCP. *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 wooden cage (10 insects/cage) 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. The experimental was arranged in Completely Randomized Design (CRD) with three replications. The data on mortality percentage with the observation time were analysed by 2-way ANOVA using SAS programme (version 9.4). The mean values were separated with LSD test at 0.05 level of significance.

Determining the efficacy of FCP against Helopeltis under field condition

Progress: Chemical insecticide, Warrior 70WDG (Dinotefuran+Pymetrozine) @ 0.5 g/L of water was used as the standard to compare the efficacy of FCP with different concentrations (2%, 4%, 6% & 8%). The pre-treatment observations were taken before the first application on the same date along with the post-treatment observations at weekly intervals. The second and third application was done after 3 weeks and 6 weeks intervals respectively. A total of 12 observations were recorded for the field trials. The efficacy of insecticide was calculated by using the Henderson & Tilton (1955) formula.

Results showed that treatments and time had significant effect on the mortality of *Helopeltis* under laboratory condition. The highest mortality (51.28%) was observed in FCP 8% concentration at 72 HAT. The mortality rate was increased with the increasing of FCP concentration and observation duration. Whereas the highest efficacy of Warrior 70WDG was 91.12% in laboratory at 72 HAT (Fig. 4). Results also showed that *Helopeltis* mortality was 35.34% at 8% concentration of FCP in field condition. On the other hand, the efficacy of Warrior 70WDG was calculated as 84.32% in field condition (Fig. 5).

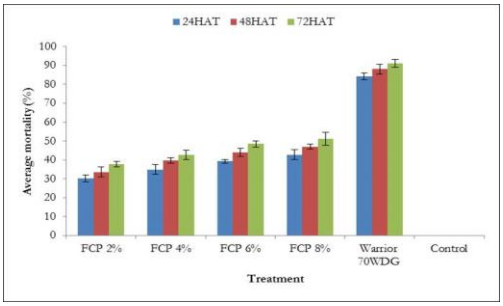


Fig. 4. Mean mortality of *Helopeltis* due to different treatments in laboratory.

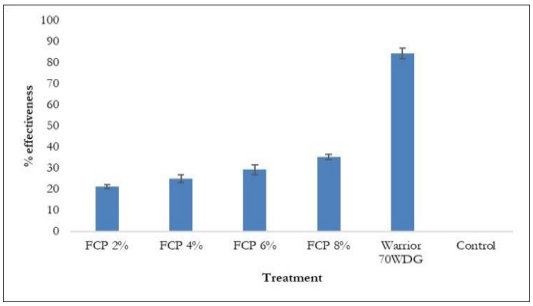


Fig. 5. Effectiveness (%) of different treatments against *Helopeltis* in field.

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 (86.11%) 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 (70.86%) in controlling nematodes (Table 1).

Table 1. 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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0f
T_2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0f
T_3	49.67	45.3	39.91	36.87	53.97	48.96	44.14	40.35	52.64	49.87	47.66	45.33	46.22e
T_4	58.73	55.56	51.78	47.99	59.98	53.54	50.02	46.53	58.99	55.86	53.15	48.84	53.41d
T_5	67.29	62.77	59.86	56.46	68.81	65.51	63.36	59.59	65.19	60.75	56.42	52.12	61.51c
T_6	79.49	75.78	70.73	66.81	76.05	70.71	66.44	60.37	79.81	72.12	67.29	64.68	70.86b
T_7	95.88	83.22	79.34	75.57	92.13	88.49	85.14	82.52	94.69	89.21	85.03	82.15	86.11a
LSD	4.04												
CV%	7.09												

*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 1. BIORATIONAL MANAGEMENT

Expt. 1.3 Isolation, mass culture and application of entomopathogens against major insect pests in tea (2022-2023)

Progress: An experiment was conducted to isolate, identify the potential strain of native entomopathogens and to develop mass culture technique and suitable formulations of those Entomopathogens and finally evaluate their efficacy against major insect pest of tea. The experiment was jointed conducted in association with Plant Pathology and Soil Science Division. The soil samples were collected from the primary nursery bed, secondary nursery bed, young tea plantation, and mature tea plantation of BTRI main farm. Ten (10) g of soil from each sample was taken in a Scott bottle, and added 100 ml of distilled water was then shaken vigorously. These solutions were then filtered and collected in a round bottom flask. One (01) ml supernatant was taken in a 10 ml volumetric flask, and 9 ml distilled water was added. Thus, the soil samples from each location were serially diluted up to 10^{-5}. The 10^{-4} and 10^{-5} solutions were used for inoculation. Five (05) ml solution from each location was poured into 90 mm diameter petri dishes with potato dextrose agar (PDA) medium at the laboratory of the Plant Pathology Division of BTRI. To analyze the physico-chemical properties of soil, soil samples were collected from the above locations with three replications. The analysis of soil moisture, texture, pH, organic carbon (%), total nitrogen (%), available phosphorus, potassium, calcium, and magnesium were carried out following the standard procedure at the Soil Science Division of BTRI.

Some beneficial fungi *Metarhizium anisopliae* and *Beauveria bassiana* were identified from mature tea plantation (Plate 1). Further studies are needed to confirm the fungi species. On the other hand, the physico-chemical properties of soil showed that organic carbon (%) and total nitrogen (%) were higher in mature tea plantations compared to other sampled areas. Therefore, soils with higher organic carbon (%) and total nitrogen (%) are more likely to have beneficial fungi (Table 2). Further studies are needed for the confirmation of the present findings.

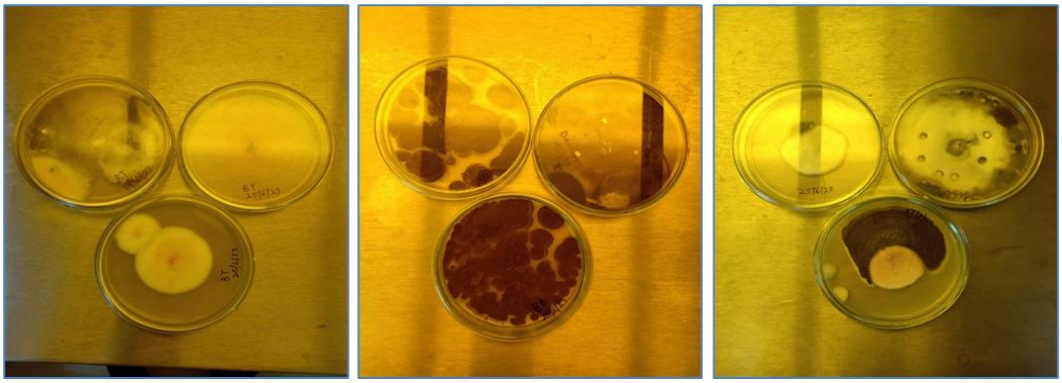


Plate 1. Entomopathogens *Metarhizium anisopliae* and *Beauveria bassiana* isolated from tea soil.

Table 2. Physico-chemical properties of soil samples collected from different locations of BTRI main farm

Sampled locations	Moisture (%)	Textural class	pH	OC (%)	Total N (%)	Av. K (mg/kg)	Av. Ca (mg/kg)	Av. Mg (mg/kg)	Av. P (mg/kg)
Primary nursery bed	11.31b	SCL	4.63a	0.67b	0.07b	33.79bc	391.40a	21.31a	3.70b
Secondary nursery bed	15.46a	SCL	5.36a	0.58b	0.06b	26.66c	510.70a	37.65a	6.57b
Young tea plantation	14.44a	SCL	5.18a	0.65b	0.07b	50.59ab	563.60a	32.13a	20.31a
Mature tea plantation	11.76b	SCL	4.75a	1.30a	0.14a	60.92a	370.60a	26.96a	21.04a
LSD	2.65	-	1.19	0.21	0.02	20.45	251.54	51.32	11.71
CV%	10.02	-	11.96	13.27	9.14	23.81	27.43	87.04	45.43

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

SCL= Sandy clay loom; OC= Organic carbon; N= Nitrogen; K= Potassium; Ca= Calcium; Mg= Magnesium; P= Phosphorus

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: The pest is identified as Green Weevil, *Hypomeces pulviger* (Order: Coleoptera; Family: Curculionidae). The weevil, as the herbivorous pest causing sporadic and irregular damage making an irregular hole in maintenance (mostly) leaves (Plate 2). The pest normally attack in May-June and September in the cropping season. Laboratory and field trials have been conducted to evaluate the efficacy of selected chemical and bio-pesticides against this insect pest. Seven treatments i.e. T1= Acephate (Asatap 75SP), T2= Bifenthrin (Talstar 2.5EC), T3= Imidacloprid+Beta Cyfluthrin (Solomon 30OD), T4= *Metarhizium anisopliae,* T5= *Beauveria bassiana,* T6= *Bacillus thuringiensis*, and T7= control were used in this experiment. For laboratory experiment, the green weevils were collected from the tea plantation of BEF of BTRI. The efficacy of different pesticides was determined through bioassay technique described in the experiment no. 1.2 (laboratory study). Ten weevils (five males & five females) per replication were treated and each treatment was replicated thrice following CRD. In addition, the same numbers of insects were treated with water only for control. After treatment, the insects were transferred into wooden cage (10 insects/cage) containing fresh tea leaves. The data on mortality percentage with the observation time were collected. In the field trial, the pesticides were applied to BTRI recommended doses with an untreated control following RCBD with three replications. The method followed in this study was described in the experiment no. 1.2 (field study).

Imidacloprid+beta cyfluthrin (Solomon 30 OD) @ 1.00 ml per liter of water showed the average effectiveness i.e., 92.25% and 86.09% under laboratory and field trials respectively. Whereas the biopesticides, *Metarhizium anisopliae* @ 5.00 g per liter of water revealed the average effectiveness with 79.57% and 70.89% in laboratory and field condition respectively (Fig. 6 & 7).

Plate 2. Adult weevil pest and its damage symptom on tea leaves

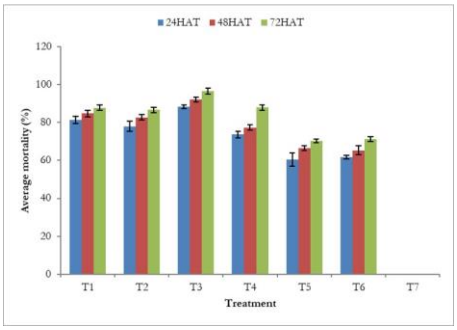


Fig. 6. Mean mortality of green weevil due to pesticides in laboratory.

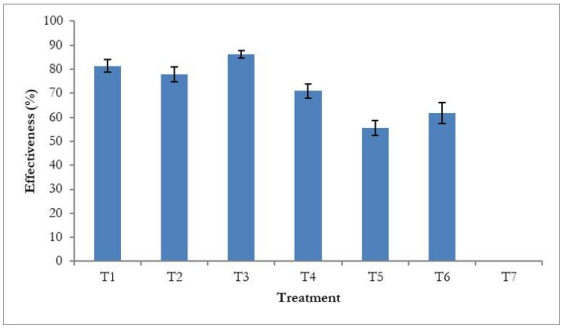


Fig. 7. Percent effectiveness of pesticides against weevil in field condition.

ENT 3. SCREENING OF PESTICIDES

ENT 3.1. Screening of pesticides against major pests of tea (2023-2024)

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 (1955) formula. Ninety seven (97) chemical pesticides and four (04) bio-pesticides under different groups were evaluated against *Helopeltis* (36+1), Red spider mite (19+2), Termite (30), Thrips (2+1), Aphid (6) and Nematode (4) in the field and the reports were sent to plant protection wing for their standardization (Fig. 8 a & b). The results revealed that more than 80% of tested pesticides were found satisfactory (>80% effectiveness) for the control of pests of tea.

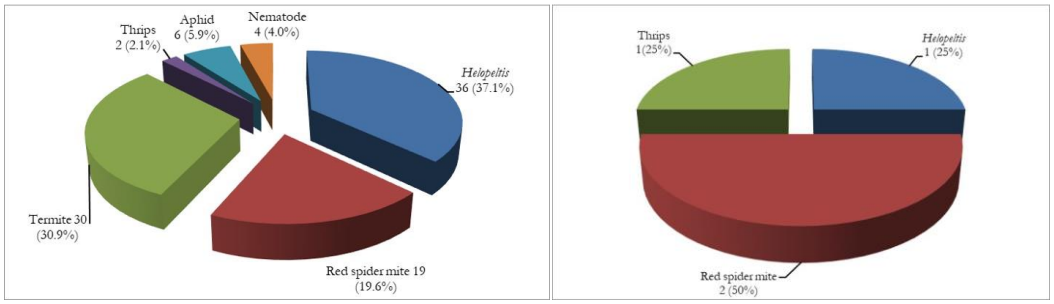


Fig. 8. Number (Percent) of chemicals trial against *Helopeltis*, Red spider mite, Termite, Thrips, Aphid and Nematode (a) Chemical pesticides and (b) Bio-pesticides.

Table 3. Different group of new molecule of pesticides trial against *Helopeltis*, Red spider mite, Termite, Thrips, Aphid and Nematode of tea

Pests	Technical Name	Dose/ha
(a) Chemical pesticides		
Helopeltis	Flometoquin 10%	500 ml
	Pymetrozine 60%+Nitenpyram 20%	250 g
	Indoxacarb 20%+Emamectin Benzoate 5%	250 g
	Dinotefuran 20%+Pymetrozine 50%	250 g
	Thiamethoxam 20%+Emamectin Benzoate 20%	150 g
	Clothianidin 20%+Lambda cyhalothrin 5%	200 ml
	Lambda cyhalothrin 10%+Thiamethoxam 10%	250 ml
	Fipronil 40%+Imidacloprid 40%	200 g
	Cartap 92%+Acetamiprid 3%	100 g
	Acetamiprid 20%+ Pyridaben 25%	150 g
	Lufenuron 40%+Emamectin Benzoate 10%	150 g
	Acetamiprid 10%+Chlorfenapyr 25%	200 ml
	Dinotefuran 40%+Fipronil 40%	200 g
	Pymetrozine 50%+Thiamethoxam 20%	100g
Red spider mite	Hexythiazox 20.4%+Abamectin 3.6%	200 ml
	Pyriproxyfen 5%+Fenpropathrin 15%	500 ml
	Monomehypo 80%	250 g
	Bifenzate 50%+Fluonicamid 10%	500 g
Termite	Dinotefuran 20%+Thiamethoxam 30%	500 g
	Cartap 92%+Acetamiprid 3%	500 g
	Fipronil 40%+Imidacloprid 40%	500 g
	Thiamethoxam 25%+ Imidacloprid 45%	500 g
Thrips	Pymetrozine 40%+Dinotefuran 20%	300 g
Aphid	Emamectin Benzoate 20%+Thiamethoxam 20%	100 g
Nematode	Clothianidin 5%	165 g/m^3
(b) Bio-pesticides		
Red spider mite	Oxymatrine 1%	1.00 L
	Azadirectin 1%	1.00 L
Helopeltis	Azadirectin 1%	1.00 L
Thrips	(s)-(-)-verbenone	100 no.

OTHER ACTIVITIES

Advisory and Experimental visits

A total of thirty one (31) advisory visits were paid to different tea estates to identify and render advice on specific pest problems and twenty nine (29) 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 eighty eight (88) soil samples were analyzed in the Laboratory for nematode count and reported to different tea estates. Physical test of one (01) insecticide sent from tea estates were done and reported to different tea estates.

Tours/Visits

A total of four (04) official visits were paid by the Scientists of the division to different organizations/T.E. for Official purposes.

Courses on tea culture

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

Workshop/Seminar conducted

A total of six (06) workshops were conducted at different tea estates under different valley circles on tea pest management during 2023.

Publications

1. A.K.M Rafikul Hoque, M.S.A. Mamun and M.M. Akanda. 2023. Validation of different IPM techniques for sustainable tea production in Bangladesh. *Tea Journal of Bangladesh,* 49: 9-18. https://doi.org/10.5281/zenodo.7974784
2. M.S.A. Mamun, S.K. Paul, M.J. Alam, M. Ahmed and M.I. Hossain. 2023. Determination of residues of two organophosphates and their dissipation pattern by QuEChERS method. *Tea Journal of Bangladesh,* 49: 24-31. https://doi.org/10.5281/zenodo.7974886
3. S.K. Paul, M.S.A. Mamun**,** M. Ahmed, A.Q. Khan, M.M. Hoque and M.A. Rahman. 2023. Population dynamics of plant parasitic nematodes and their relation to soil properties in tea. *Tea Journal of Bangladesh,* 49: 44-51. https://doi.org/10.5281/zenodo.7977698
4. K.M. Mohotti, D. Amarasena and M.S.A. Mamun. 2023. Nematode problems in tea and their sustainable management. pp. 597-621. In: Khan, M.R. and Quintanilla, M. (eds) Nematode Diseases of Crops and their Sustainable Management. Chapter 24, Academic

Press, Elsevier Inc., 50 Hampshire St., 5th Floor, Cambridge, MA 02139, USA. https://doi.org/10.1016/B978-0-323-91226-6.00020-1

5. M.S.A. Mamun. 2023. Integrated pest management of tea. Paper presented in the webinar on integrated pest management of tea held on 4 March 2023 organized Tea Research Centre, Horticultural Science Research Institute, Iran.
6. M.S.A. Mamun. 2023. Impact of climate change and its adaptation strategies for sustainable tea production in Bangladesh. Paper presented in webinar on climate changes regarding challenges mitigation and adaptation measures for tea sector held on 20 March 2023 organized by Asia Tea Alliance, India.
7. M.S.A. Mamun**.** 2023. Development and application of IPM technology for sustainable and safe tea production. (Bangla). *Adhunik Krishi Khamar*. Quarterly Agricultural Magazine. Year 14, No. 1, January-February 2023. Dhaka. pp. 41-43.
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PLANT PATHOLOGY DIVISION

Mohammed Syeful Islam
Principal Scientific Officer

(1) STAFF

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

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. Fungicides were applied with RCBD design with three replications.
- Shoot and leaf sample were taken at 3 and 7 days after last spraying.
- Shoot 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 by same mentioned scale and compared with control; (Kazuma Sakoda, 2020)

Progress:

1. Statistically similar absorbance was found for all treatments.
2. Absorbance against all fungicides were statistically similar

3. No abnormalities were observed in Cells and tissues of vascular bundle of tea shoots.
4. No abnormalities were observed in Cells and tissues of tea leaves (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	1.435 a	1	1
2	Propineb	1.436 a	1	1
3	Copper Hydroxide 77 WP	1.437 a	1	1
4	Carbendazim 50 WP	1.435 a	1	1
5	Azoxystrobin + Tebuconazole	1.437 a	1	1
6	Mancozeb 80 WP	1.436 a	1	1
7	Mancozeb + Metalaxyl 72 WP	1.437 a	1	1
8	Carbendazim + Mancozeb	1.436 a	1	1
9	Azoxystrobin + Difenoconazole	1.437 a	1	1
10	Control	1.437 a	1	1
	CV= 0.099 and LSD 3.180			

The experiments will be continued for residue analysis

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

Objective:

1. To specify the alternate accede of tea pathogens by the multi sets of plants in tea ecosystem.
2. To screen out compatible and incompatible reactions and the identification of races of pathogens in tea ecosystem.

Activities

1. Collection, isolation and purification of pathogens (from tea plants, shade trees and others plant species in tea plantations)
2. Performing pathogenicity test.
3. Studies Cross inoculation through direct and wounded inoculation method
4. Host range analysis **(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). *Fusarium* from Gumosis disease of *Albizia lebbeck* was isolated. These pathogens were inoculated in succulent tea shoots. No diseases were found in tea shoots of inoculated plants. 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 (Table 2). 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: 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)	
Fusarium	Gumosis disease	*Albizia lebbeck*	

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. The experiment was conducted in two ways viz (1) Survey method and (2) Inoculation method. In survey method, disease severity among different BTRI released tea clones were measured by scoring method in ambient environment.
2. In inoculation method, spore suspensions of different pathogens were prepared and sprayed to the plant following wounding and non-wounding technique.
3. *Colletotrichum gloeosporioides* (Die back), *Corticium theae* (Black rot) and *Pestalotia theae* (Leaf Blight) were inoculated in BT2, BT5, BT6, BT8, BT10, BT11 and BT12
4. Disease development observations were done

5. Data were recorded on the prevalence and severity of the diseases by observing the typical symptom. These will be done by using the standard scoring scale.

Progress:

Inoculated results revealed that BT6, BT10 and BT12 are more prone to Black rot disease followed by BT11 and BT4. BT5, Bt8 and BT10 are predisposed to dieback disease. More negligible rating of Blight disease was found in BT4 and BT6 (Table 1)

Table 1: Percent disease index of different diseases in inoculated plants

Clone inoculated	Black rot	Dieback	Blight
BT2	00	00	06
BT4	10	08	08
BT5	00	12	06
BT6	14	00	08
BT8	00	12	00
BT10	14	12	06
BT11	12	10	00
BT12	14	10	10
LSD (0.05)=	1.1278	1.0998	1.878

In case of survey result, 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 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	32.00bc	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: Prevalence and severity of tea diseases in Northern areas of Bangladesh.

Objectives:

1. To assess the distribution and significant importance of tea diseases in Northern part of Bangladesh
2. To identify diseases and disorder of tea bushes.

Plan of Activities:

- A survey will be conducted in every month of all the year round on variety, age and topography basis. 50 plants of each attribute will be selected randomly and replicated thrice.
- Data will be recorded on disease prevalence and severity by observing the typical symptom of the diseases by using 0- 5 rating scale; 0= no infection, 1= 1- 20% infection, 2= 21- 40%, 3= 41- 60%, 4= 61- 80% and 5= 81- 100% infection (Singh, 2000)

- The severity was expressed in percent disease index (PDI), which was computed following a standard formula as described below (Singh, 2000):

$$\text{Percent Disease Index (PDI)} = \frac{\text{Sum of all disease ratings}}{\text{Total number of ratings} \times \text{maximum disease grade}} \times 100$$

Progress:
The experiment could not be initiated

(5) Title: Management of Collar rot and Charcoal stump rot diseases of tea in Northern areas of Bangladesh

Objectives:

1. To find out suitable control options

Plan of Activities:

- Treatments: 10 viz. (1) Control, (2). Only organic manure/ compost, (3) Only dolomite, (4) Trichoderma, (5) Trichoderma+ organic manure/ compost, (6) Trichoderma+ Dolomite, (7) Trichoderma+ organic manure/ compost+ Dolomite, (8) Fungicides, (9) Fungicides+ organic manure/ compost and (10) Fungicides+ Dolomite
- Replication: 3
- Design: RCBD design

Progress:
The experiment could not be initiated.

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

Objectives:

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

Progress

A total of seventy fungicides of different groups and twenty seven herbicides of Glufosinate Ammonium; Diquat dibromide and 2,4- D Amine Salt groups were tested against respective pests. Fungicide groups were mainly Copper Oxycloride+ Metalaxyl; Iprodione+ Carbendazim; Mancozeb+ Carbendazim; Mancozeb+ Dimethomorph; Mancozeb+ Cymoxanil; Azoxystrobin+ Difenoconazole; Tricyclazole+ Carbendazim; Azoxystrobin+ Cyproconazole; Tricyclazole+ Bismerthiazol; Azoxystrobin+

Tebuconazole; Azoxystrobin+ Boscalid; Tebuconazole+ Hexaconazole; Pyraclostrobin+ Tricyclazole and *Trichoderma viride*. 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 six (6) advisory visits were paid to different tea estates to identify and render advice on specific disease & weeds problem and seven (7) correspondences issued to different tea estates in respect of identification of various diseases and their control measures during the reporting year. Thirty six (36) experimental visits were made with particular preference to experimental data collection in tea estates.

The scientific personnel of the division delivered a total of sixteen (16) hours lectures on tea disease and weeds management in Professional Diploma Course arranged by Project Development Unit, Bangladesh Tea Board, Srimangal.

There are two scientific research article was published during the reporting year. There are seventy different groups of fungicides and twenty seven herbicides were standardized also in same year. No workshop on disease & weed management was carried out and no official visit was paid by the scientists of the division to different organizations during the reporting 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. Shahadot Hossen has joined as Statistical Assistant on 28th February 2021. There was no other change in personnel position of the division.

RESEARCH

There were three 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 B2-40 and B2-43 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 were collected.

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: The BCR analysis was done by the COP and average selling price of BTRI and the test clones were found economically efficient. Final result was prepared with the broker's valuation of the test clones. All the test clones are economically viable. Made tea of the individual test clone will be profitable for the tea industry. The analysis of secondary data of production and approximate expenditure of last 10 years is going on.

Table1. **Cost benefit analysis of Expt. B2-40 as per Broker's valuation (2023)**

Clones/Test clones	Made Tea Production (kg)	Cost per kg (Tk)	Total cost (Tk)	Valuation price/ kg (Tk)	Total Return (Tk)	Total Benefit	BCR
T2	9.269	191.36	1773.716	400	3707.60	1933.88	2.09
T3	8.878		1698.894	475	4217.05	2518.16	2.48
T4	10.373		1984.977	400	4149.20	2164.22	2.09
T5	9.683		1852.939	450	4357.35	2504.41	2.35
T6	9.085		1738.506	500	4542.50	2803.99	2.61
T7	10.442		1998.181	470	4907.74	2909.56	2.46

Table 2. **Cost benefit analysis of Expt. B2-43 as per Broker's valuation (2023)**

Clones/Test clones	Made Tea Production (g)	Cost per kg (Tk)	Total cost/kg (Tk)	Valuation price/ kg (Tk)	Total Return (Tk)	Total Benefit (Tk)	BCR
T1	6.900	191.36	1320.384	575	3967.5	2647.116	3.005
T2	4.600		880.256	475	2185	1304.744	2.482
T3	6.509		1245.562	475	3091.775	1846.213	2.482
T4	7.567		1448.021	450	3405.15	1957.129	2.352
T5	6.003		1148.734	500	3001.5	1852.766	2.613

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.

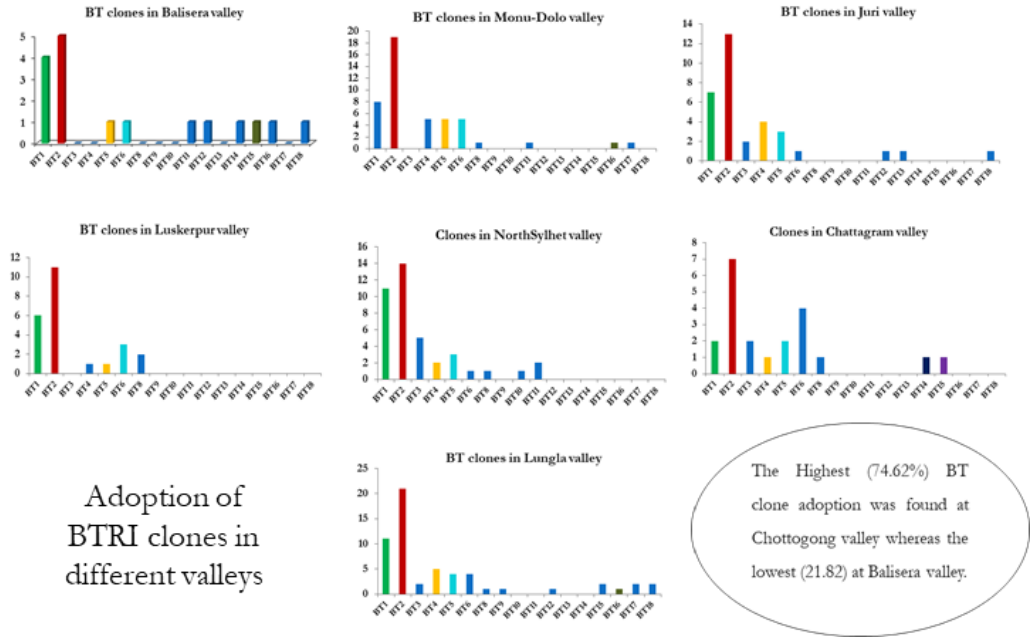


Fig. Adoption of BTRI released clones in different valleys

Table 3. Adoption of BTRI cultural practices (%) by the gardens

Cultural Practice	Specific Cultural Practice	Garden follow BTRI Recommendation
Spacing	Spacing for flat area	75%
	Spacing for Tillah area	92%
Pruning Cycle	4 year cycle	98%
	Pruning cycle sequence	54%
Young tea pruning	Dec/Break=6-9"- FFP1=14-16"- Skiff=20-21"- FFP2=18-20"- Skif=27-29"	79%
Pests and disease control measures	BTRI recommendation	80%
Shade tree management	BTRI recommendation	9%
Fertilizer application	BTRI recommendation	90%

Figure 1: Different BT clones in different tea estates.

S. E. 4.3 Title: Assessment of potentiality for enhancing export accordance with the production and internal consumption of Bangladesh tea

Bangladesh increases its production day by day. The current reports stated that the production is up trending in comparison to previous years (BTB, 2021). Several forecasting studies showed increasing rate of tea production and consumption whereas decreasing trend of export in Bangladesh. In this context to find out the possible ways for increasing export, demand analysis of national and international is compulsory. The tea market situation of national and international perspective needs to be assessed to find out the challenges and the opportunities for exploring Bangladesh tea. An in-depth study is needed to find out the export potential of Bangladesh tea and to promote it worldwide as well as to create a flourished market internationally.
In this situation, the main attention of this study is given to find out the export potential after filling up the demand of inter country consumption. The specific objectives defined as:

Objectives:

i. To assess the current tea production and consumption scenario of Bangladesh

ii. To find out the challenges and obstacles for exporting Bangladesh tea

iii. To explore the export demand of Bangladesh tea; and

iv. To find out the opportunities or possible ways to increase export

Work plan: The study requires revealing the overall feature of present status of the tea production, local consumption and consumption trend. Also needs to collect data on the demand of variable tea commodities and their supplies in the local and foreign market. Also study on consumer's choice and demand and business policies of different stages of sellers, buyers, merchandizing etc. Present status of international demand of Bangladesh tea, export destinations and deficit reason behind the imports and importers activities are required to be point out. Some well-designed questionnaires were prepared for collecting the data on the basis of:

1. International market analysis of Bangladesh tea
2. Demand analysis of Bangladesh tea in tea exporting countries
3. Local consumption trend of tea in Bangladesh
4. Export potential of Bangladesh tea based on entrepreneur's opinion.
5. To suggest recommendations to remove the challenges in tea industry of Bangladesh.

Methodology: The qualitative and quantitative surveys to the relevant sources are going on by questionnaire and interview method. Most of the data were collected from secondary sources for different trend analyses. The secondary information were collected from books, Annual reports, Tea Market procedures, Tea exporters, entrepreneurs, traders, Bangladesh Tea Board, Web portal, Bangladesh Tea Research Institute, Food and Agricultural Organization etc. In the process of analyses of collected data, various statistical tools like averages, percentages, tables, and diagrams were applied in order to make the study worthier, informative, and helpful to fulfill the objectives of the study.

Progress: The initial result was presented in a national workshop and the preparation for publication including the participant's suggestions is going on. The per day cup consumption by Bangladeshi people was determined.

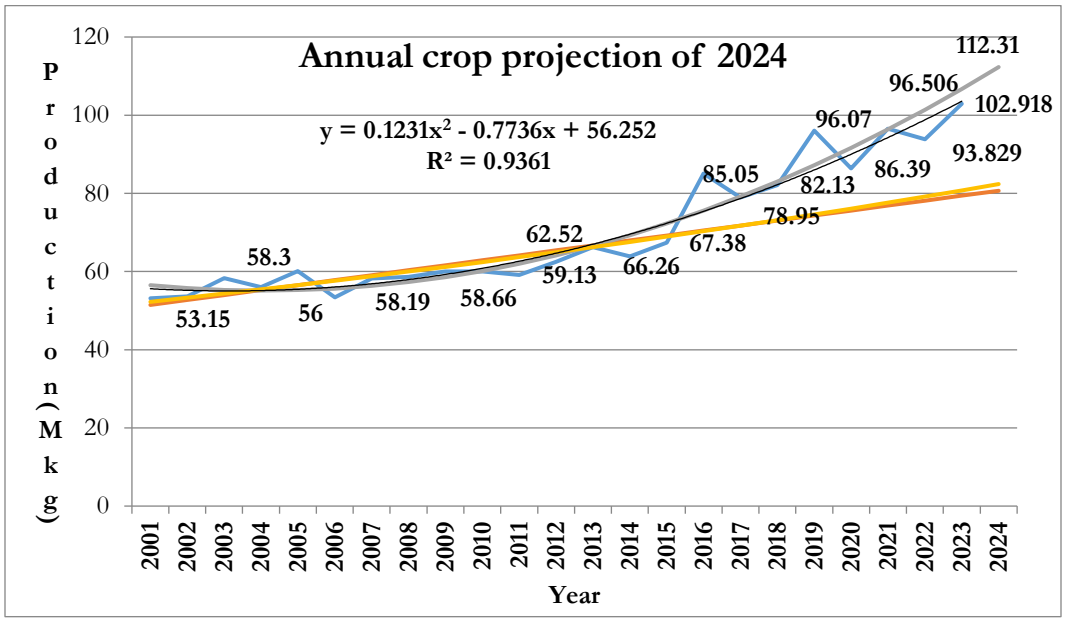
STATISTICS

1. Estimation of Annual Crop for 2024:

Annual crop forecasting (2024) using time series data (last 23 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 23 years data for forecasting the tea crop of 2024.

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

Sl	Year	Production(MKg)	Linear	Polynomial	Exponential
1	2001	53.15	51.46	56.52	52.24
2	2002	53.62	52.73	55.77	53.29
3	2003	58.3	54.00	55.30	54.35
4	2004	56	55.27	55.13	55.44
5	2005	60.14	56.54	55.24	56.55
6	2006	53.41	57.81	55.64	57.68
7	2007	58.19	59.08	56.33	58.83
8	2008	58.66	60.35	57.31	60.01
9	2009	59.99	61.62	58.58	61.21
10	2010	60.04	62.89	60.14	62.43
11	2011	59.13	64.16	61.99	63.68
12	2012	62.52	65.43	64.13	64.95
13	2013	66.26	66.70	66.55	66.25
14	2014	63.88	67.97	69.27	67.58
15	2015	67.38	69.23	72.27	68.93

16	2016	85.05	70.50	75.56	70.31
17	2017	78.95	71.77	79.15	71.71
18	2018	82.13	73.04	83.02	73.15
19	2019	96.07	74.31	87.18	74.61
20	2020	86.39	75.58	91.63	76.10
21	2021	96.506	76.85	96.36	77.62
22	2022	93.829	78.12	101.39	79.18
23	2023	102.918	79.39	106.71	80.76
24	2024		80.66	112.31	82.37
SD		16.11489998	8.976720587	18.27601437	9.25
Mean		70.109	63.522	65.835	63.46

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

Three observations were found in linear (80.66), Polynomial (112.31) and Exponential (82.37) model for the estimation of annual crop of 2024. In Polynomial model the estimated data was found more relevant to last 24 years examined production data along with the closer SD value of time series data. So, the estimated crop for 2024 will be 112.31 million kg. (NB. The analysis was done depending only on the yield parameter of the last 23 years. The climatic factors (e. g. rainfall parameters, temperature, RH, day length, wind velocity etc.) along with the pest and disease infestations are directly influence the yield of crop as well as the projection.

Conclusion: Correlation analysis using time series data showed estimated production of 112.31 M.kg teas for the year 2024. 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 2024.

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	89.33	0.78	0.72
2023	102.918	90.81	1.04	0.29

Source: BTB

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

Month	Production (Mkg)				
	2019	2020	2021	2022	2023
January	0.495	0.175	0.268	0.507	0.364
February	0.114	0.026	0.019	0.033	0.046
March	1.917	1.625	1.681	1.585	2.046
April	6.110	2.365	3.932	4.934	5.107
May	7.645	8.655	6.151	7.420	8.272
June	11.667	8.963	13.354	12.585	10.716
July	11.104	12.178	12.338	11.267	13.654
August	13.505	11.321	14.387	10.762	14.489
September	13.382	12.144	12.607	14.740	14.296
October	13.407	11.486	14.578	11.377	14.593
November	10.300	10.495	10.241	10.840	11.574
December	6.423	6.961	6.932	7.779	7.794
Total	96.069	86.394	96.506	93.829	102.918

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 2023 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 58th Annual Course of BTRI held at BTRI Main Station, Sreemangal.

BILASHCHERRA EXPERIMENTAL FARM
BTRI, SREEMANGAL

In-charge & Staff

Dr. Toufiq Ahmed (C.S.O, Agronomy) was appointed as In-charge of the Farm on 09.01.2023 by the office order of Bangladesh Tea Board.

Staff Mr. Abul Kalam Azad (Senior Field Assistant) resigned and left his job on 01.07.2023. Mr. Ajit Kumar Sarker (Field Assistant) was transferred to BTRI Farm on 16.08.2023. Mr. Abdullah Al Mamun (Chainman) joined at the Farm 0n 05.09.2023. There was no other change in the personnel position during the reporting year.

FARM

Table 1. Land Distribution

Sl. No.	Description	Approx. Area (ha)	
A.	**Under Tea**		**129.00**
	I. Plucking Area		
	1. Immature Tea (under 5 years)	14.00	122.00
	2. Tea bushes 5 to 10 years	10.00	
	3. Tea bushes 11 to 40 years	35.00	
	4. Tea bushes 41 to 60 years	63.00	
	II. Seed Bari		6.00
	II. Seed Nursery		0.50
	III. Clone Nursery		0.50
B.	**Under Subsidiary Crops**		**22.00**
	I. Fruit Tree	5.15	
	II. Soft and Hard Wood Timber Garden	10.55	
	III. Agar	6.30	
C.	Office/Bungalow/Godown, Staff Quarter, Labour Line, School, Hospital, Graveyard, Masjid/Mandir/Church and Roads		**25.30**
D.	Cultivable land, Fellow land, Water reservoir and Stream (Cherra)		**52.06**
Total Area of the Farm (Approx.)			**228.36**

Table 2. Production of Improved Bi-clonal Seeds and Sales of Farm Products

Bi-Clonal Seed production(kg)	Institutional use (kg)	Sales of Bi-Clonal Seed (kg)	Sale amount (Tk)	Sales of Different Fruit (Tk)
867	After collection, seeds were sent to BTRI regularly			-

Table 3. Green leaf production of BEF in the Year 2023

Name of the Month	Green leaf supplied to the Black Tea Factory (Kg)	Green leaf supplied to the Black Tea Factory (Kg)	Total (Kg)
January	0	0	0
February	0	0	0
March	2974	46	3020
April	50675	0	50675
May	42568	328	42896
June	112814	256	113070
July	139516	471	139987
August	102795	1630	104425
September	118826	1102	119928
October	118154	349	118503
November	111864	135	111999
December	26014	0	26014
Grand Total	**826200**	**4317**	**830517**

Raising of tea plants, Extension and Development

It has a nursery with the average capacity of 100000 tea plants. During the reporting year, about 80000 tea plants were infilled in vacancies and extended about 1.0 ha. Water supply, labor houses, roads and bridges were regularly maintained. Experiments of different divisions had been facilitated at the period.

Miscellaneous

The Victory Day and the Independence Day were celebrated with due solemnity during the reporting year. Prizes for sports and sweets were distributed among the labourers and their children of the farm on both occasions. During the winter season of the year, blankets were distributed among the skilled labourers as incentive.

BTRI Sub-station, Fatickchari, 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) carried out his responsibilities as in before, consecutively.

Production of green leaves

During the year, about 81,784 Kg of green leaves were plucked from the existing tea plantation and supplied to Kaiyacherra Dolu Tea Estate for further processing and marketing.

Distribution of improved planting materials

About 2,47,000 no. of fresh cuttings were collected from the mother bush area and 102 Kg of bi-clonal tea seeds and 74 kg seeds of temporary shade trees were harvested and distributed to the different tea gardens, and small tea growers. About 48,500 no. tea seedlings were supplied to newly established BTRI Experimental Farm, Banshkhali, Chattogram during the reporting year.

Infilling Program

About 25,620 tea saplings were planted to fill the vacancies in the existing young tea plantation during the reporting year.

Soil sample analysis

About 193 soil samples from 8 tea gardens and small tea holdings of Chattogam were analyzed and reported during the reporting year.

Annual Course

2-day long BTRI Annual Course on Tea Culture in presence of the tea garden owners, managers and assistant managers of Chottogram region was organized as per schedule by the sub-station during the reporting year.

BTRI KALITI SUB-STATION
Kulaura, Moulvibazar

STAFF

During the reporting year 2023, there was no change in the personnel position of the Sub-station.

PRODUCTION

Year	Production of Green leaf (Kg)	Fresh cutting supplied to different Tea Estates (Nos.)	Tea plants raised in the nursery (Nos.)
2023	37,440 *	1,15,000 **	20,000 ***

*Following an agreement, produced green leaf was sold to Kaliti Tea Estate @ 35 Tk/Kg.
**After getting demand letters from different tea estates, fresh cuttings were supplied @ 0.50 Tk/Nos.
*** Tea plants raised in the nursery mainly for infilling the vacancies of existing tea area. Among the raising tea plants, 6,050 nos. planted in 2023 and rest of the plants were kept for 2024.

BTRI SUB-STATION
Bandarban

Selina Akther Lipa
Scientific officer & Office In-charge

Scientific Officer, Botany division, B.Sc., MS (CU), Bangladesh Tea Research Institute joined BTRI SUB-Station, Bandarban, on 2023 January. There were no other changes in the personnel position of the Sub-station during the reporting year.

Extension Progress

"Extension of small holding tea cultivation in chattogram hill tracts", project ended in December 2023. The total no. of small grower under registration 372, and total land 494.21acre extended in this project and adding with previous land total 785.211-acre land extended in bandarban. In 2023 around 99.211 acre extended from the total land under tea cultivation. Provided technical support all over the year to small holding tea growers. Also coordinated sales of green leaves over whole year and manufactured in bandarban tea factory.

Works under this duration

1. Given newly registration small tea grower about 12 and total registered small grower are 372.
2. Tea sapling raised total 13.33 lac in this project among them 2.643 lac saplings distributed in 2023 to the 40 small tea growers.
3. Land acquisition completed for camp office and nursery at Ruma Upazila 0.60 Acre.
4. Ruma office building and boundaries have been constructed.
5. Training of different topics such as tea plantation, land preparation, pruning, plucking, disease and pest management, numbered 13 under around 320
6. Necessary repairing of the office building has been done in the reporting year.
7. Proper maintenance of mother bush plot around the year.
8. Made tea processed from factory 6000 kg in 2023.
9. Leaf collection center established in Sharonpara for small tea grower.
10. Hand spray machine and pruning knife provided to small tea grower from this project.
11. Two experiments set up for fixing right pruning cycle for mature tea and young tea bush preparation in Bandarban.

BTRI SUB-STATION
Lalmonirhat

Md. Arif Khan
Development Officer

BTRI Sub-Station Lalmonirhat was established in 1st January, 2024 under the Lalmonirhat Tea Project funded by BTB own source. There were 08 (eight) personnel position of the Sub-station during the reporting year.

Progress

There was a total no. of small grower under registration 186, No. of small grower under tea cultivation 136, total land under tea cultivation 248.02 Acre in the year 2023. Provided technical support all over the year to small holding tea growers. Co-ordinated sales of green leaves all over the year.