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Contents

Preface

Darjeeling Tea Research and Development Centre was established in 1977 at Kurseong including an experimental farm of 21.6 hectares. The Centre besides catering to the advisory requirement of Darjeeling tea gardens has developed technical know-how on various aspects of tea cultivation. The four main Divisions of research are Farm Management (Botany and Agronomy), Soil Science, Bio-chemistry and Plant Protection. The Centre has *inter alia* a Library, Miniature Manufacturing Unit and an Agro-meteorological Observatory.

Significant Achievements

The significant achievements are summarised below.

- The performance of eight popular clones out of thirty clones released for Darjeeling gardens has been evaluated. The comparative performance had indicated superiority of the clone Bannockburn 157 for large scale commercial cultivation. Other clones which could be used in order of priority are P312, T78 and T383.
- Since distinct clonal variations were noticed, the relationship between growth parameters and their quantitative analysis at an early stage of growth of popular tea clones has been established.
- Tea plants in Darjeeling takes as much as 7-8 years to come into full bearing. Evaluation of different methods of training of young plants has been done and pegging was found to be most advantageous in bringing up young plants.
- Replanting is almost universally considered a necessary but it is rather conservative in Darjeeling. The traditional method of replanting tea by manual uprooting of old tea bushes is expensive and promotes soil erosion. This research centre has formulated recommendations as an alternative to the traditional method which would preserve the top soil and involve less expense.
- Experience with binodal cutting have shown their superiority in terms of better growth over single node cuttings.
- Standardised the frequency of plucking in respect of yield and quality.
- A new revised and enlarged soil-fertility status viz., N, P & K map of Darjeeling tea growing soils has been published.
- A Soil Zinc Status Map of Darjeeling tea estates published.
- The positive effect of foliar spray of Zinc on yield has been established.
- Efficacy of pure salt of Zinc, Magnesium and Boron established in the increase of yield as compared to the commercial products.
- Effect of six different sources of sulphur fertiliser has been examined and their efficacy in rectifying the deficiency of this mineral has also been established.
- Potassium ion potential and the quantity -- intensity relationship as affected by organic matter and exchangeable aluminium ions has been studied.
- X-ray diffraction studies of the soils of quality and non-quality sections of Darjeeling tea gardens have been made. The genesis of the soils of this area has also been outlined on the basis of detailed morphological, physico-chemical and mineralogical analysis.
- Bioefficacy of different neem products in controlling certain pests of tea has been tested.

Collaborative Research

This Research Centre is recognised as a centre for Ph. D. work by North Bengal University and Kalyani University.

Advisory Service

The Advisory Services are rendered from this Centre and it acted as an efficient channel for transmitting new findings to the field. The scientists made several advisory visits to different tea estates of the Darjeeling hills.

Farm Management (Botany and Agronomy)

1.1 Production and sale : Total production of green leaf during 2005 was 21,356 kg and was sold to M/s. Castleton Tea Garden, Kurseong at a total price of Rs. 5,12,544.00 @ Rs. 24.00 per kg.

1.2 Pruning :

The following pruning schedule was followed

(I)	Light pruning	5.06 hectare	27.3%
(ii)	Deep/Medium skiff	2.30 hectare	12.4%
(iii)	Light skiff	7.29 hectare	39.4%
(iv)	Levelling of skiff	3.83 hectare	20.7%
	Total	18.48 hectare	

1.3 Manures and Fertilisers :

The following composition and dose of fertilisers were applied through Urea, Rock Phosphate and Muriate of Potash.

(i) Mature Tea - N:P:K :: 120:45:120 kg ha^{-1}

(ii) Young Tea - N:P:K::60:30:60 kg ha^{-1}

1.4 Weed control - Glyphosate 41% SL and Paraquat Dichloride 24% SL were applied at recommended doses. Glyphosate @0.90 to 1.25 kg a.i. ha-1 and Paraquat at 0.2 to 0.5 kg a.i. ha-1 have satisfactorily controlled weeds viz., *Cammelina benghalensis, Ageratum conozoides, Oplismenus burmanni, Oplismenus compositus, Borreria articularis* and *Polygonum runcinatum* etc.

1.5 Meteorology - Monthly data on various meteorological parameters recorded during the year are presented in table 1.

1.6 Research Projects

1.6.1 Efficacy of some growth promoters on yield attributes of pruned and unpruned tea clones (DTRDC/FM/25)

Objectives:

(i) To find out the efficacy of growth promoters in relation to the yield and clones.

(ii) To evaluate the efficacy of growth promoters in relation to early bud break in different clones.

Design : Split plot.

The data presented in table 2 revealed that during the year there is no significant difference recorded among the clones but highest made tea yield was obtained from T78 (472.5 kg/ha) followed by TS 378 (456.9 kg/ha), P312 (455.7 kg/ha) and lowest was recorded from AV2 (428.2 kg/ha). Among the growth promoters, Biozyme @450 ml/ha treated plot gave highest made tea yield (550.7 kg/ha) and was significantly superior over Nutralux @2.5 kg/ha (452.5 kg/ha), Agroboom @1000ml/ha (410.3 kg/ha) treated plot while lowest was recorded from the control plot i.e., 371.7 kg/ha. Moreover, the interaction of clone vs growth promoters also showed non-significant difference.

The successive 4 years average yield data presented in Table 3 shows that the highest yield was recorded in T78 (497.6 kg/ha) followed by P312 (483.5 kg/ha), TS 378 (473.9 kg/ha), T135 (465.9 kg/ha) and lowest was recorded from T383 and among the growth promoters, Biozyme @ 450 ml/ha proved best i.e., 556.9 kg/ha as compared to the ,other 2 growth promoters.

1.6.2. Effect of some new formulations of Biozyme vs other branded formulations of micronutrients on the yield of Darjeeling Tea (DTRDC/FM/26)

Objectives :

(i) To find out the comparative efficacy of the micronutrients in relation to yield.

(ii) To find out any ,phytotoxic effect in relation to health of tea bush.

The experiment was initiated during March, 2005 with the following treatments

T1	Control
T2	Biozyme 001@450ml/ha
T3	Biozyme 002 @ 450ml/ha
T4	Biozyme 003@450ml/ha
T5	Dhanzyme @450ml/ha
T6	Herbozyme@450ml/ha
T7	Biovita@450ml/ha

Design : R B D

Replication : 3

The formulations were applied at recommended doses of manufacturer at an interval of 21 days during the plucking season. In the first year, the data presented in Table 4 does not show any significant difference between the treatments. However, the highest yield was recorded from T4 where Biozyme 003 @450ml/ha have been applied (615.2 kg/ha) followed by T6 (570.1 kg/ha) and T5 (559.6 kg/ha). All the treated plots showed significant increase in yield over control. 40.5% hike in made tea yield was recorded in T4 and lowest 17.2% was recorded in T3. There was no phytotoxic effect on the health of tea bush when applied at the prescribed doses.

1.6.3 Determination of suitable pruning cycle of old chinary tea bushes of Kurseong (DTRDC/FM/17)

Design : Split Plot

Objective : To determine the most appropriate pruning cycle and pruning time.

The experiment was initiated in the year of 1994. The yield data recorded during the year 2005 showed non-significant difference among the different treatment combinations. The maximum yield was recorded in the 4 year pruning cycle followed by the 3 year pruning cycle and minimum yield was obtained in the 5 year pruning cycle.

During this year, the 3 year pruning cycle treatment was levelling of skiffed, 4 year pruning cycle treatment was medium skiffed and 5 year pruning cycle treatment was light pruned. The yield data recorded at 5 days interval is presented in Table 5.

It is also observed that at the end of the eleventh (11^{th}) year of the trial the average annual yield showed an increasing trend with increasing length of pruning cycle.

1.6.4 Effect of environmental factors on the physiological and biochemical attributes of different tea clones (DTRDC/FM/16)

Objectives : To investigate the influence of the climatic variables on physiological and biochemical characteristics of 15 (fifteen) contrasting clones.

The clones used are T253, T78, BS/7/1A/6, B157, B777, MB, K1/1, HV 39, TTV1, Ts 378, RR/17/144, Athrey, B/5/63, Pandian and Spring field. The data on different physiological parameters recorded seasonally is presented in figure 1(a) & 1(b). Photosynthetic photon flux density (PPFD), Net photosynthesis (Pn), Stomatal conductance (gs), Transpiration (E), Water use efficiency (WUE), Vapour pressure deficit (VPD), Intercellular Carbon dioxide concentration (ci) and Temperature leaf (Tl) were measured by Portable Photosysnthesis system (LI-6200)

During this year, the maximum value 14.66 μ mol $m^{-2}s^{-1}$ of net photosynthesis (Pn) was recorded in autumn. In summer and rains higher temperature prevailed but Pn was lowest in summer than rain and winter. The photosynthetic photon flux density (PPFD) was higher in winter and summer but Pn was lowest. Among the clones, HV39, B 777, MB and Pandian recorded higher value of Pn than other clones in autumn, rains and winter. MB, B777 and Pandian showed higher rate of gs and E than other clones. The clones RR17/144, BS/7/1A/6 and MB recorded higher value of ci than other clones in winter, rain and autumn. The maximum VPD was recorded in summer and minimum in autumn and rainy season. Athrey and B777 recorded higher value of water use efficiency than other clones in autumn, winter and rainy seasons.

Leaf water potential (Ψ_L) was measured simultaneously with Pn using a dewpoint hygrometer (model c-52 sample chamber to an HR-33T microvoltmeter). Small circular leaf discs from the leaves on the opposite branches to those for Pn measurement were used and (Ψ_L) values were expressed as megapascales (MPa). Among the clones MB, B777 and HV-39 recorded higher value of (Ψ_L) than other clones in rain and autumn and minimum in summer during the year (figure 5).

1.6.5 Seasonal and clonal variation in shoot extension rates and shoot number in tea clones (DTRDC/FM/24)

Design : Randomized Block Design

Objective : Seasonal variation of the distribution of yield in different clones.

The clones used are T383, AV2, ND, T78, B157, P312, B777 and T135. Shoot lengths were recorded weekly on five randomly selected bushes from each sub-plot. Two shoots about 5 cm long were tagged on each bush. The length of each shoot from the leaf axil to the base of the apical bud was recorded every week until the shoot were 40-50 cm long. When they were removed two further shoots were tagged to provide a continuous record of shoot growth rates in each plot.

During the year 2005, the increment of shoot length was around 1.5 cm to 2.5 cm. $week^{-1}$ in June to September and 3 cm to 4 cm $week^{-1}$ in April in clones B157, T135 and B777. Highest growth was observed in B157 and T135 (Fig. 2).

Shoot number (population) was recorded weekly on the same five bushes within 30X30 cm quadrat placed at the centre of the bush. Recording started in 2nd week of March and ceased in November when shoot number reached a peak. Shoots of harvestable size were plucked. P312, T135, ND and B157 had the highest shoot population density followed by other clones during the year (Figure 3).

The made tea yield for the year 2005 has been recorded (Figure 4) and found that the clones B777, T135 and ND gave the highest made tea yield followed by other clones.

1.6.6 Response of soil and foliar application of some micronutrients in Darjeeling tea (DTRDC/FM/20)

Design : Randomized Block Design.

Objective : To determine the efficacy of foliar spray and soil application of different micro-nutrients (commercial and pure salt form) on the yield of Darjeeling tea.

The said trial has been re-organised by omitting a few foliar combinations of pure salt and in its place a few soil applications of the same salts which was found to be effective as foliar spray has been included. Two new products viz. Phytonol-G (soil application) and micromix-5 (spray) has also been added to study the comparative efficacy of these formulations *vis-a-vis* the yield of made tea. The data in table 6 shows that Phytonol-G treated (soil application 25 kg/ha) plots gave the highest made tea yield followed by micromix-5 (spray) and Zn+Mg+B (Pure salt @2% +2%+1%) soil applied plots. However, this is the first year of the re-organised trial and hence the data showed the initial trend only from which no inference could be drawn for the moment.

Table 2 : Effect of interaction of clones and growth promoters on the yield

Clone/growth promoters	Made tea yield kg/ha				Mean
	Control	Biozyme @ 450 ml/ha	Nutralux @ 2.5 kg/ha	Agroboom @ 1000ml/ha	
B668	384.2	540.9	431.7	392.7	437.3
B157	377.4	530.4	426.7	378.8	428.3
T383	370.0	543.6	477.0	418.8	452.3
P312	354.5	550.6	471.9	436.1	455.7
T78	381.9	587.4	500.1	420.5	472.5
AV2	341.9	536.7	440.7	393.7	428.2
TS378	383.1	555.8	447.0	441.7	456.9
T135	380.7	550.5	428.2	39.7	439.8
Mean	371.7	550.7	452.5	410.3	
CD at 5%	Clones N.S.	Growth promoters 24.0		Clones x growth Promoters N.S.	

Table 3 : Efficacy of certain growth promoters on yield of different clones during 2002, 2003, 2004 and 2005

Treatment	2002 kg/ha	2003 kg/ha	2004 kg/ha	2005 kg/ha	Average
Main Treatment					
B668	447.6 (21.10)	438.5	430.9	437.3	438.6
B157	454.4 (21.29)	467.2	474.0	428.3	455.9
T383	363.6 (21.50)	441.0	485.3	452.3	435.5
P312	493.8 (22.21)	478.9	505.6	455.7	483.5
T78	507.7 (22.41)	501.1	509.2	472.5	497.6
AV2	438.9 (20.92)	444.7	437.7	428.2	437.4
TS 378	477.0 (21.81)	474.4	487.5	456.9	473.9
T135	476.0 (21.81)	471.6	476.3	439.8	465.9
C.D. AT 5%	0.34	21.7	24.8	NS	--
Sub Treatment					
Control	410.0(20.23)	374.3	385.3	371.7	385.3
Biozyme @ 450 ml/ha	537.9 (23.05)	568.0	571.1	550.7	556.9
Nutralux @ 2.5 kg/ha	487.3 (22.06)	486.5	500.8	452.5	481.8
Agroboom @ 1000ml/ha	446.7 (21.07)	429.7	446.0	410.3	433.2
CD at 5%	0.33	26.6	25.16	24.0	-

Table 4 : Efficacy of new Biozyme formulations x branded formulations against made tea yield

Treatment	Formulations	Concentration %	Made Tea yield Kg/ha	Percent increased over control
T1	Control	--	437.6	--
T2	Biozyme 001	0.1	556.2	27.1
T3	Biozyme 001	0.1	513.2	17.2
T4	Biozyme 003	0.1	615.2	40.5
T5	Dhanzyme	0.1	559.6	27.8
T6	Herbozyme	0.1	570.1	30.2
T7	Biovita	0.1	545.7	24.7
	CD at 5%	--	NS	-

Table 5 : Effect of pruning cycle and time of pruning on yield

Pruning cycle	Type of pruning	Pruning Month			Total yield (kg/ha)	Mean yield (Kg/ha)
		Sep 2004 (kg/ha)	Nov 2004 (kg/ha)	Dec 2004 (kg/ha)		
3 years	LOS	713.4	744.6	752.2	2210.2	736.7
4 years	MS	742.1	760.6	799.2	2301.9	767.3
5 years	LP	217.5	243.4	220.7	681.6	227.2
Total		1673.0	1748.6	1772.1	--	--
Mean	--	557.7	582.9	590.7	--	577.0

Note : LP Light Pruning, MS-Medium Skiff and LOS-Levelling of Skiff

Table 6 : Yield of processed tea of various micro-nutrients applied plots

Treat-ments	Name of micro-nutrients	Application	Dose/ha	Made tea yield kg/ha	%
T1	Phytonol Gr-mi	Foliar spray	100ml/ha	526.0	13%
T2	Zn+Mg+B (Pure Salt)	Foliar Spray	2%+2%+1%	525.0	13.%
T3	Zn+Mg+B (Pure Salt)	Soil application	10kg+10kg+5kg	552.4	19%
T4	Zn+Mg+B+Mo (Pure Salt)	Foliar Spray	2%+2%+2%+0.5%	542.3	17%
T5	Phytonol-G	Soil application	25 kg/ha	589.8	27%
T6	Micromix-5	Foliar Spray	1 kg/ha	555.5	20%
T7	Control	--	--	464.5	-

CD at 5% 87.275 Not significant

Table 1 : Climatic Data recorded at the Meteorological observatory

Months	Air Temperature		Mean Soil Temperature (depths)						Mean vapour pressure of Mercury		Mean Relative Humidity		Total Rainfall (mm)	Total sunshine recorded (hd^{-1})	Mean Wind Velocity ($Km\ h^{-1}$)	Mean Pan Evapo-ration (mm)
			5 cm		10 cm		20 cm									
	Max	Min	6.39	13.39	6.39	13.39	6.39	13.39	6.39	13.39	6.39	13.39				
	^0C	^0C	^0C	^0C	^0C	^0C	^0C	^0C	mm of mercury	mm of mercury	%	%				
Apl 05	21.5	11.5	16.2	27.1	18.3	25.2	21.5	22.7	10.7	17.2	84.0	86.0	269.8	4.4	4.4	2.3
May 05	21.9	13.5	18.9	28.8	20.9	26.4	23.2	23.6	13.5	18.3	88.0	90.5	222.0	3.0	1.5	1.3
Jun 05	22.5	13.8	18.3	27.3	21.3	25.6	24.4	22.9	14.1	19.1	88.0	90.0	858.8	1.9	1.2	1.4
Jul 05	22.3	13.9	15.8	28.9	20.0	25.7	25.5	22.2	14.3	18.7	88.0	88.5	1048.8	0.9	--	1.1
Aug 05	22.3	14.0	16.2	28.8	19.6	25.7	25.9	22.0	13.7	18.7	85.0	89.0	1211.1	0.2	--	1.7
Sep 05	22.5	14.3	16.7	28.2	21.1	25.1	25.7	22.1	14.6	18.9	89.0	89.0	327.6	3.0	--	2.0
Oct 05	21.8	12.8	14.3	26.8	15.6	24.0	24.0	21.5	13.0	18.2	87.0	89.0	158.4	--	--	1.9
Nov 05	18.5	9.8	11.1	24.9	14.2	22.7	17.1	19.5	10.7	14.8	83.0	90.0	4.0	--	--	1.8
Dec 05	13.9	5.3	7.1	22.2	10.3	19.0	15.5	15.4	7.6	10.7	80.0	86.0	16.2	5.7	--	2.2
Jan 06	12.0	4.8	7.3	20.5	10.3	17.6	14.1	13.6	7.4	9.5	85.0	86.0	11.4	4.8	--	2.1
Feb 06	13.5	5.9	8.2	21.5	11.1	18.2	15.5	14.5	8.3	10.3	87.0	81.0	0.0	3.8	--	1.9
Mar 06	15.3	7.1	8.9	23.2	11.3	19.2	16.3	15.9	9.1	11.8	86.0	88.0	6.2	5.9	--	1.8

DTRDC 1240 M, 26°55' N 88°12'E

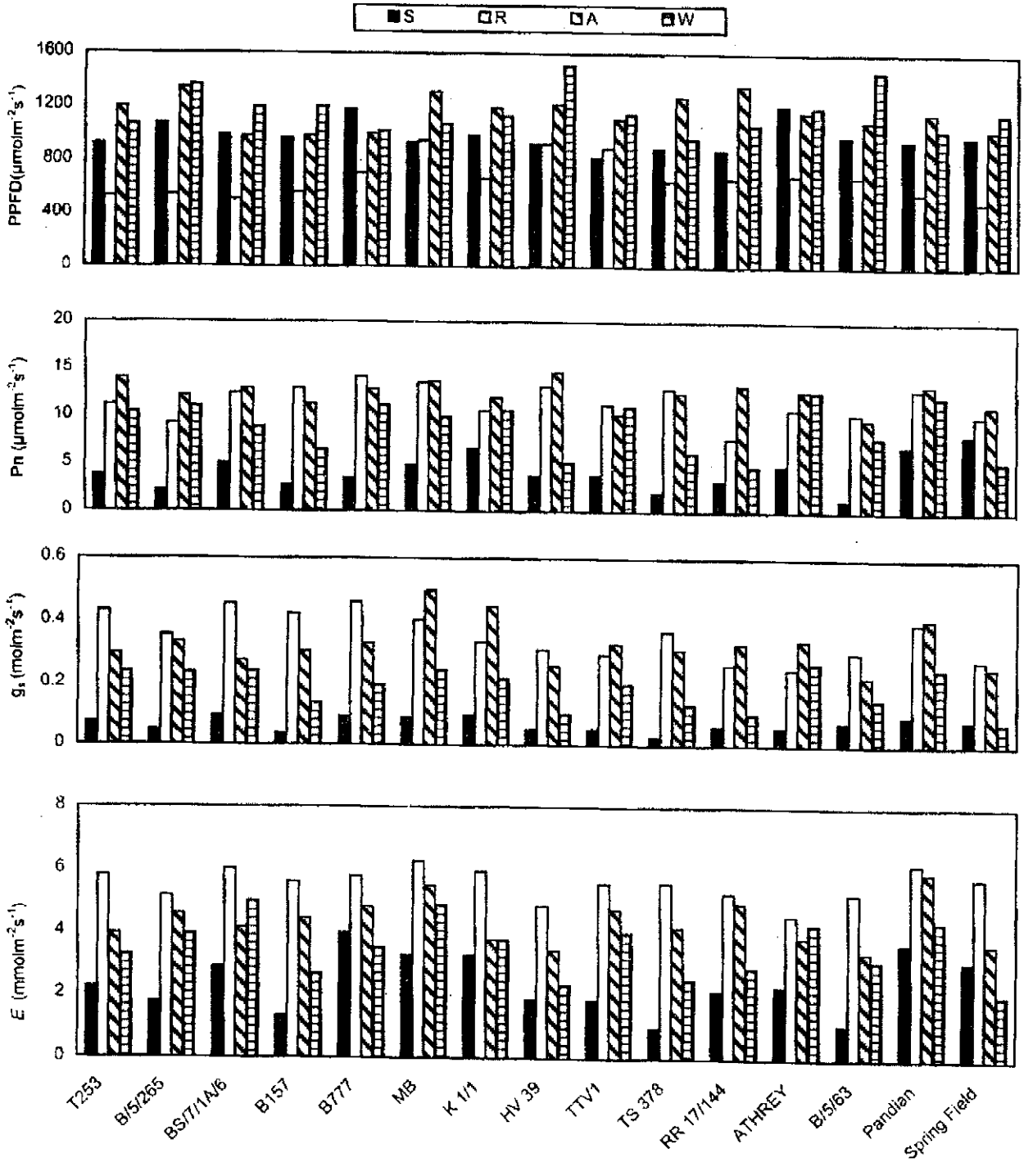

Fig. 1(a) : Seasonal variations of photosynthetic rate and other related parameters of different clones during 2005

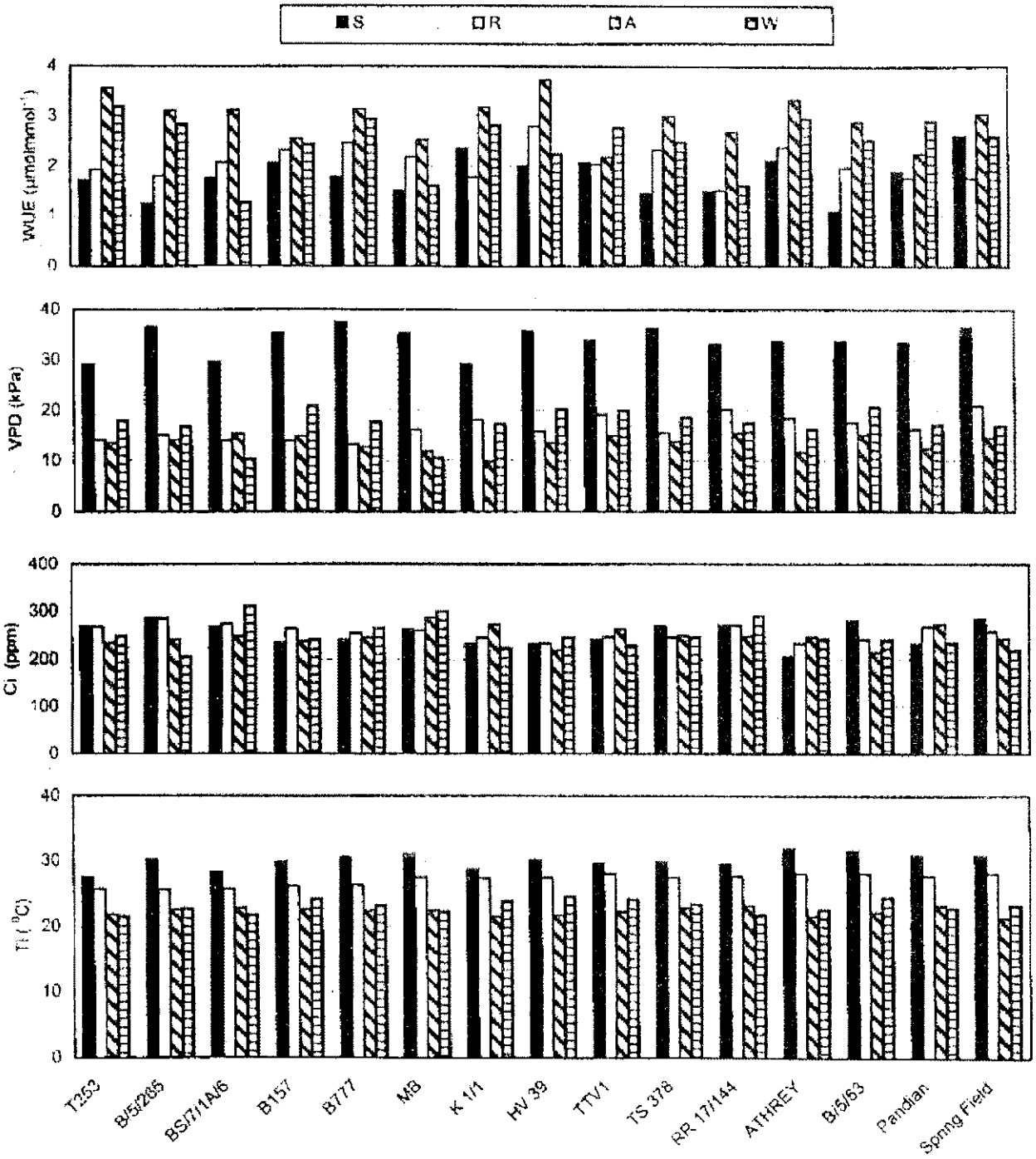

Fig. 1(b) : Seasonal variations of WUE, VPD, Ci and T1 parameters of different clones during 2005

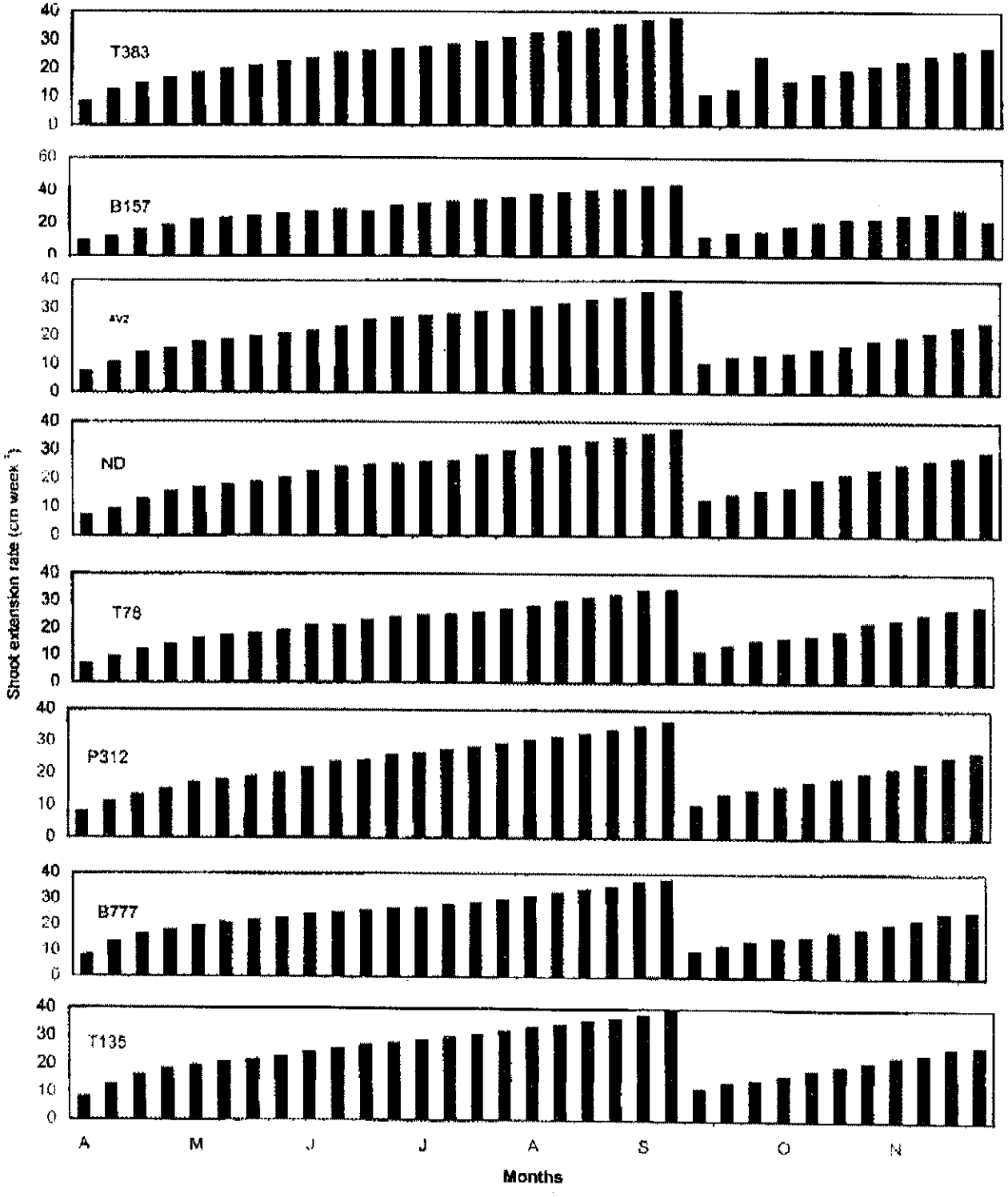

Fig. 2 : Weekly patterns of shoot growth rate in different clones during 2005. Shoots length around 40 cm long were removed and new shoots were tagged to provide a continuous record of shoot growth rate for each clones. No growth of shoots was observed during the period from December to February

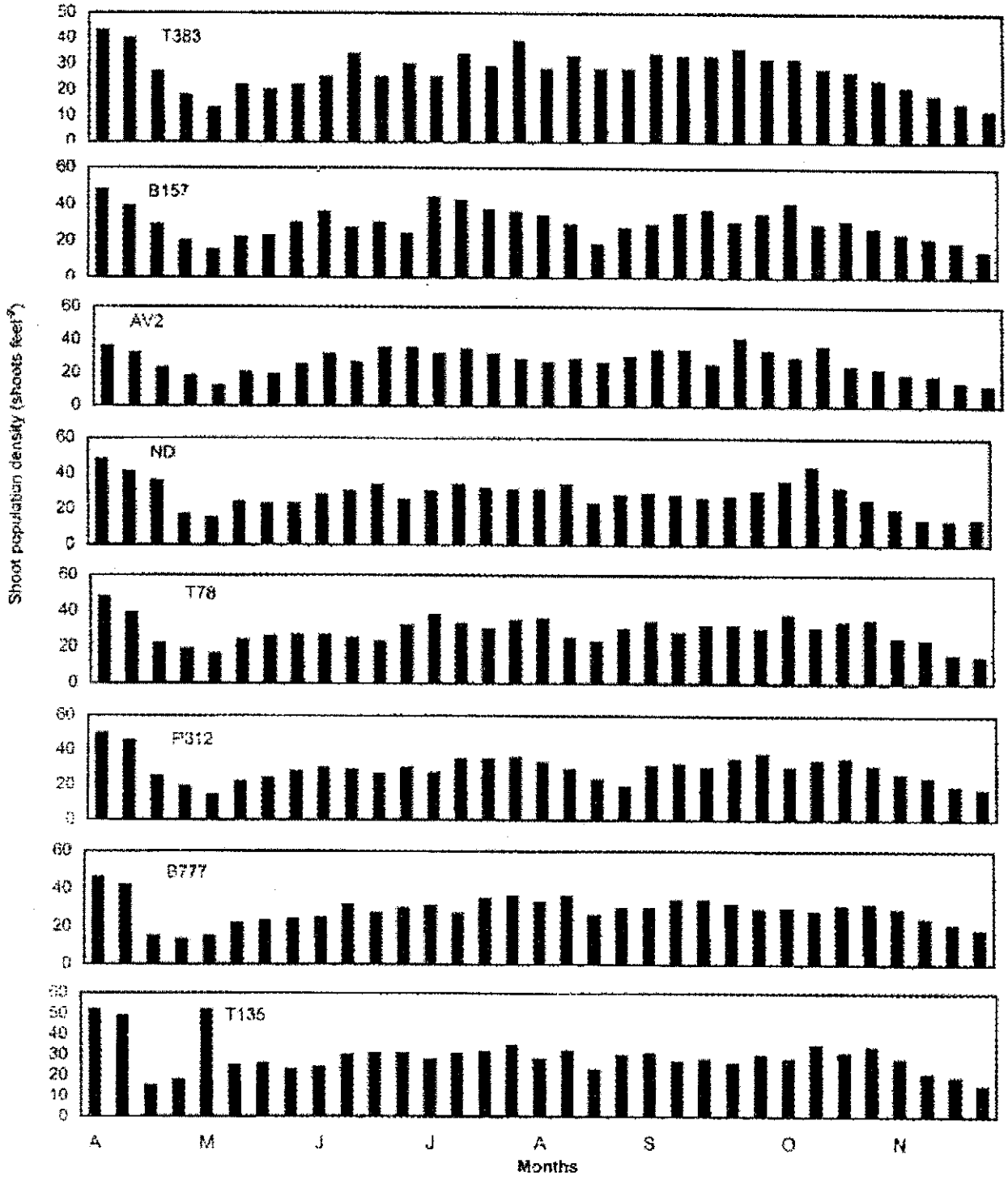

Fig. 3 : Weekly patterns of shoot population density in different clones during 2005. No harvest (shoots) from December to March.

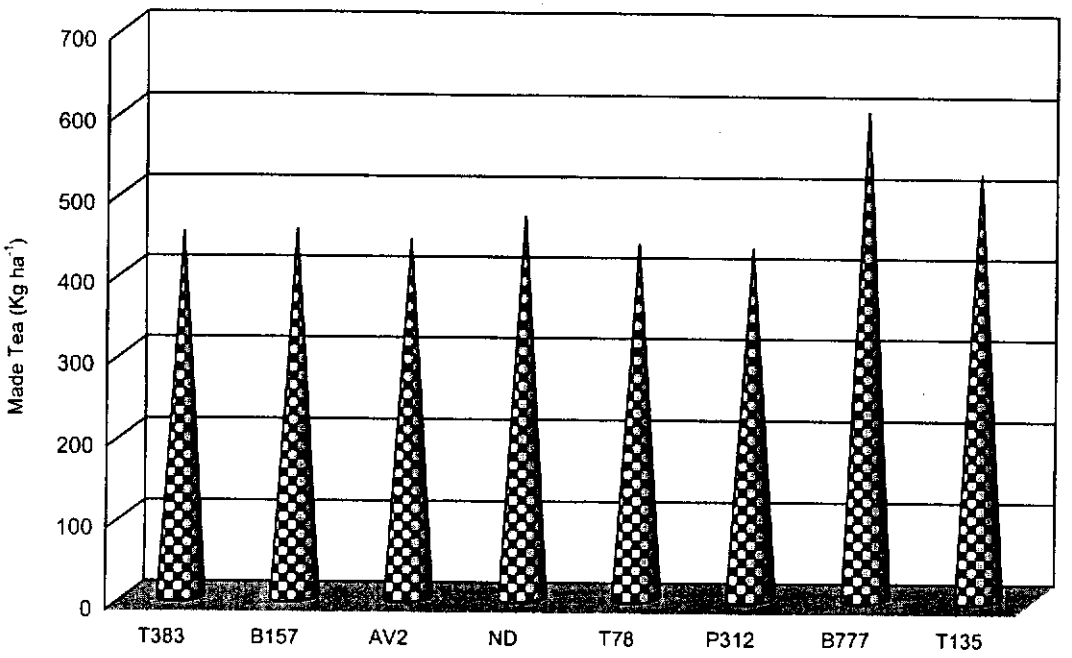

Fig. 4 : Yield of made tea of different tea clones

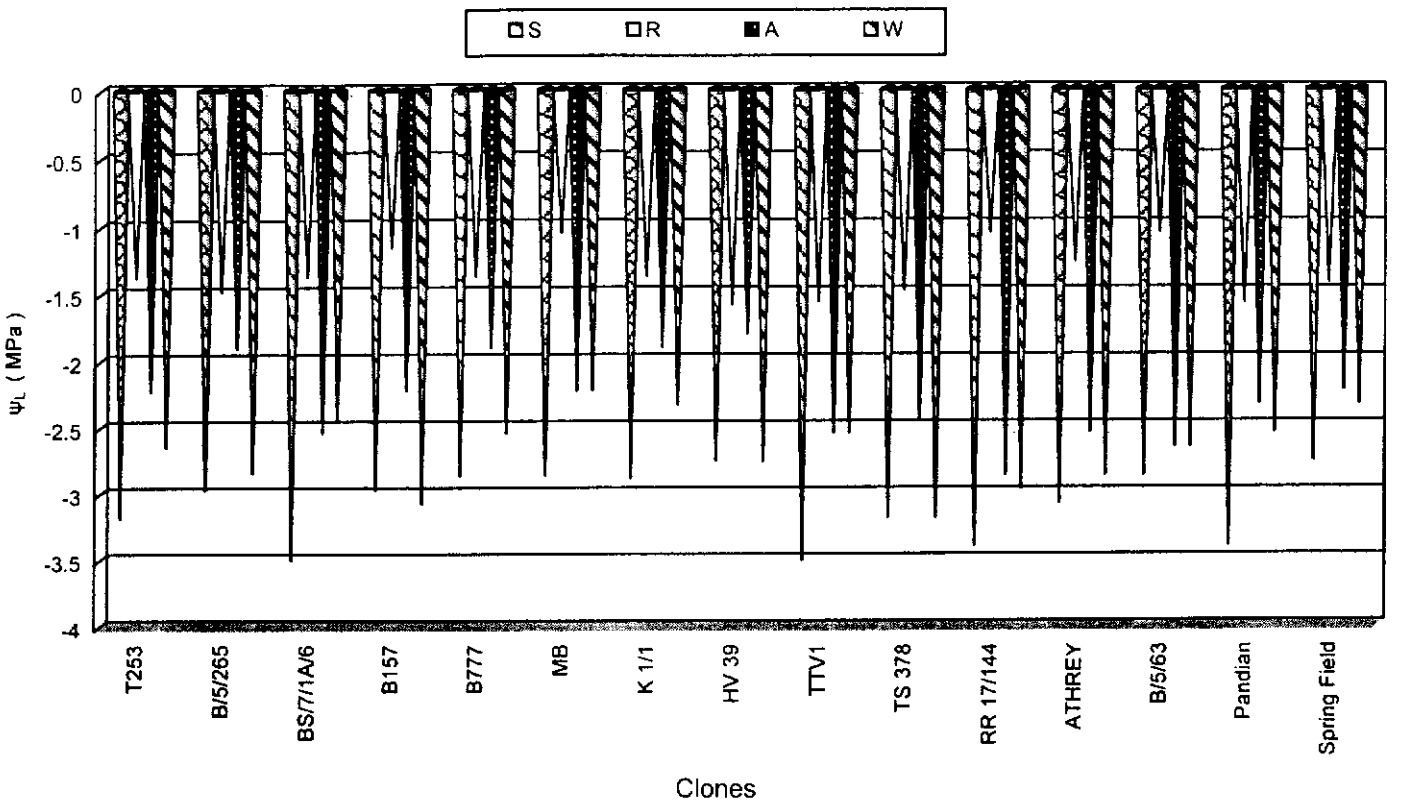

Fig. 5 : Seasonal variations of leaf water potential of different clones during 2005

Soil Science

This Division, besides carrying out research on various aspect of soils of Darjeeling, also offers various testing and advisory services to the tea estates and small growers as well.

1. Services :

1.1 Soil Testing : Several soil, organic manure, compost, de-oiled cakes etc., were received from different tea estates of Darjeeling, Dooars and Assam was tested as per requirements. Recommendations were made wherever required for rectifying mineral deficiencies, correcting soil pH and preparing fertilizer schedule etc, of individual gardens. Some organic manure, compost and de-oiled cake samples were tested for ascertaining the available mineral percent, pH etc., During the year under report 373 soil samples and 12 organic manure/compost/de-oiled cake samples were tested and a sum total of 2031 estimations carried out as detailed below ;

Serial no.	Parameter Tested	Number of Samples Analysed	
1.	Soil pH	357	
2.	Soil Organic Carbon	357	
3.	Soil mineralisable Nitrogen	260	
4.	Soil available Phosphate	357	
5.	Soil available Potash	357	
6.	Soil available Sulphur	235	
7.	Soil available Zinc	16	
8.	Soil available Magnesium	16	
9.	Soil available Boron	16	
10.	Organic Manure/Compost/De-oiled Cake (for pH, moisture percent and NPK)	12	(12X5 = 60 estimations)
	Total	**2031**	estimations

Name of the Tea Estates, whose soil, Organic manure/Compost/De-oiled Cake samples were tested are as follows :

Ambootia, Atree (NGO), Avongrove, Castleton, Chapar, Choibari, Chulsa, Dilaram, Gopaldhara, Lingia, Longview, Makaibari, Monteviot, Mullotar, Nurbong, Rohini, Rungmook and Cedar

1.2. Advisory Vists : 9 Tea Estates of Darjeeling and Dooars (on special request) visited for advisory works.

Research Projects :

2.1 Efficiency of IMO-Certified organic manure (Organomax) in increasing the carbon mineralization, nitrogen release properties and yield of some popular young tea clones of Darjeeling (DTRDC/S/11)

Design : R.B.D., Replication : 3, No. of Plots : 18, No. of treatment : 6

Clones : T78, P312, AV2, T383, T135 and N.D.

Objectives :

i) efficacy of Organomax in increasing the rate of carbon mineralization and nitrogen release in soil.

ii) effect of this manure in increasing the yield of young tea clones of Darjeeling.

The organic manure viz., Organomax (IMO certified) was tested in a pilot project during 2002-03 to find out the efficacy of the same in the release of nitrogen and carbon mineralization *vis-a-vis* Castor DOC which is widely used in organic tea gardens. The results of the said pilot project indicated the superiority of organomax @ 100 kg/ha in enhancing the carbon mineralization and nitrogen release properties of the soil. So, the same project has been selected to find out its efficacy in enhancing the yield of young Darjeeling tea clones. A RBD design was laid out during 2005 in the DTRDC Experimental Farm with 3 replications and 6 treatments. The young tea clones selected were T78, P312, AV2, T383, T135 and N.D. Soil sampling was done during January, 2005 (before the launch of the trial) and pre-trial yield recorded (2004, which was a LP year)

The plots were under a 5 year pruning cycle viz., LP-UP-DS-LOS-LP. Organomax @100kg/ha were applied during February, 2005 and soil sampling has been done after 45 days and 90 days of application to study the carbon mineralization and nitrogen release properties. Each plot contained on an average 30 bushes.

Table No. 1
Effect of Organomax on the yield of young Darjeeling tea clones (kg/ha)

Treatment No.	Name of clones	Pre-trial yield 2004 (LP year)	Yield 2005 (UP)
T1	P312	239.2	414.9
T2	T383	423.89	653.2
T3	AV2	351.0	574.2
T4	N.D.	207.8	351.9
T5	T78	290.6	535.6
T6	T135	249.0	387.4
		C.D. at 5%	107.6

The yield recorded weekly during 2004 (pre-trial) and 2005 (year of application of organomax) are presented in Table no. 1

From the above Table it is evident that during the year under report (2005) the T2 treated plots (T383) recorded the highest yield followed by T3 (AV2) and T5 (T78). Since this is the first year of trial no inference can be drawn regarding the effect of this manure in increasing the yield of young tea clones. Carbon mineralisation and rate of nitrogen release of this trial plot *vis-a-vis* the control plot is under progress.

2.2. Comparative efficacy of organic manures *vis-a-vis* inorganic fertilizers in increasing the yield of mature tea of Darjeeling (DTRDC/S/12)

This trail was launched in the year 2005 in the DTRDC Experimental Farm with the following lay out and objectives.

Design : RBD; Treatment : 5, Replications : 3, No. of plots : 15

Pruning Cycle LP-UP-DS-LOS-LP

Name of Manures/Fertilisers : Organomax, Castor D.O.C., Compost, Urea, RP and MOP

Objectives : To find out the comparative efficacy of organic and inorganic fertilizers in increasing the yield of mature tea.

During the year under report it is observed from Table No. 2 that the T4 treatment viz., Urea, RP and MOP @ 90:45:90 kg/ha recorded the highest yield viz., 519.3 kg/ha of made tea followed by Organomax @100 kg/ha (in a single basal dose during February) which was 504.1 kg/ha. The results are initial trends only from which no inference could be drawn. At a later stage the study of soil physico-chemical and microbial properties would be brought under the purview of this project to find out the extent of beneficial effect of organic manuring, if any, in improving the soil tilth and fertility *vis-a-vis* inorganic fertilizer treated plots.

Soil sampling was done before the application of manures/fertilisers and also after 45 and 90 days of application of the same.

Table No 2
Effect of organic and inorganic fertilizers on the yield of made tea (kg/ha)

Treatment No.	Manure / Fertiliser Dose	Made tea yield kg/ha (2005)
T1	Organomax100 kg/ha	504.1
T2	Castor Cake 2 MT/ha	474.9
T3	Compost 2 MT/ha	422.2
T4	90:45:90 kg NPK/ha through Urea, RP and MOP	519.3
T5	Control	377.7
	C.D. at 5%	43.85

Biochemistry Division

1. Research Projects :

1.1. β-D glucosidase activity in clones released for Darjeeling Tea Industry (DRTDC/BIO/10)

During this period three additional clones viz. RR/17/144, TS 378 and B/6/62 were evaluated for quality related biochemical parameters like polyphenols, caffeine, chlorophyll a, chlorophyll b, total carotenoids and β-D glucosidase activity. The clones RR/17/144 and TS 378 are of Darjeeling origin whereas clone B/6/62 is a popular south Indian clone having a good build-up of dry matter contents yielding good recovery. The clone TS 378 popularly known as Nanda Devi is actually a bi clonal seed stock and has been widely used as standard stock. The biochemical composition of clone RR/17/144 is depicted in table 1. The enzyme activity for clone was recorded maximum during the second flush period whereas it was low during the autumn flush. Similarly, flavour potential of clone was observed quite high during the second flush. The level of total chlorophyll was found low during the first flush and was almost at par in rainy season. The total polyphenolic contents of this clone were found maximum out of three clones under observation. The enzyme activity of clone TS 378 was recorded lower in comparison to RR/17/144 but was always higher as compared to the south Indian clone B/6/62 (Table 2). The total chlorophyll contents were recorded highest during the second flush that was closely followed by RR/17/144. Seasonal variations for chlorophylls and total carotenoids were observed distinct for all these clones. Total polyphenolic contents were registered lowest for clone B/6/62 during the rainy season (Table 3). A substantial difference was also noticed in the polyphenolic contents for all these clones and seasonal variations too were distinct. Higher level of polyphenols and carotenoids in clone RR/17/144 are likely to make this clone more antioxidants rich. Keeping in view the above biochemical attributes it is likely that this clone may well be exploited for making orthodox flavoury black teas in future.

1.2 Biochemical composition of teas cultivated under organic and inorganic systems of cultivation (DTRDC/BIO/11)

Influence of these two cultivation practices was reported in the Annual Scientific Report for the year 2004-05. The study was however, continued in view of locational impact on the experiment. In general, organic flush was found containing higher polyphenols during the quality season but inorganic 2nd flush also showed a higher level of polyphenols. The caffeine contents of quality flush under inorganic cultivation was estimated higher in comparison to organic teas of corresponding period. Drought impact on proline contents was distinct and it was recorded low during rainy season (Table 4,5). The level of total chlorophylls was observed higher in inorganic flush through out the season (Table 5). Similar trend was observed for carotenoids and this year it was found higher in inorganic teas.

2. Miniature Manufacturing Unit :

About seventy tea samples were manufactured in the miniature unit. On some occasions, new plant material was blended to find out their compatibility with each other clone. Informations on manufacturing attributes like withering period, temperature during withering and drying were also generated and found varied with type and texture of leaf tissue.

3. Library :

About eight Indian journals, one foreign journal and one internet magazine related with tea and tea trade were subscribed.

Also, 14 books on various aspects of tea were purchased during the year.

Table 1 : Seasonal variation in β-D-glucosidase activity and biochemical parameters of clone RR/17/144

Sl. No.	Bio-chemical parameters	1st flush	2nd flush	Post second flush	Autumn flush
1.	β-D-glucosidase activity level	10	11	09	08
2.	Flavour	08	09	07	07
3.	Polyphenols %	24.36	27.38	22.87	23.09
4.	Chlorophyll a µg/g	372.40	528.05	372.50	380.92
5.	Chlorophyll a µg/g	160.93	231.93	166.28	165.73
6.	Total Chlorophyll µg/g	533.33	759.98	538.78	546.65
7.	Total Carotenoids µg/g	110.28	135.30	93.68	98.35

Table 2 : Seasonal variation in β-D-glucosidase activity and biochemical parameters of clone TS 378

Sl. No.	Bio-chemical parameters	1st flush	2nd flush	Post second Flush	Autumn flush
1.	β-D-glucosidase activity level	09	08	07	09
2.	Flavour	07	08	06	07
3.	Polyphenols %	23.48	25.16	21.08	22.19
4.	Chlorophyll a µg/g	345.20	610.61	473.68	480.21
5.	Chlorophyll b µg/g	144.98	252.33	200.05	215.37
6.	Total Chlorophyll µg/g	490.18	862.94	673.73	695.58
7.	Total Carotenoids µg/g	97.58	164.45	114.48	121.39

Table 3 : Seasonal variation in β-D-glucosidase activity and biochemical parameters of clone B/6/62

Sl. No.	Bio-chemical parameters	1st flush	2nd flush	Post second flush	Autumn flush
1.	β-D-glucosidase	07	08	05	06
2.	Flavour	07	06	04	06
3.	Polyphenols %	21.37	23.69	20.28	21.40
4.	Chlorophyll a µg/g	336.45	432.53	536.20	470.35
5.	Chlorophyll b µg/g	153.98	183.20	219.18	193.74
6.	Total Chlorophyll µg/g	490.43	615.73	755.38	664.09
7.	Total Carotenoids µg/g	82.73	112.63	115.70	103.93

Table 4 : Seasonal variation in biochemical composition of teas grown under organic cultivation

Sl. No.	Bio-chemical parameters	1st flush	2nd flush	Post second Flush	Autumn flush
1.	Polyphenols %	28.54	29.80	26.32	27.91
2.	Caffeine %	3.80	3.46	3.17	3.19
3.	Proline µg/g	283.42	271.18	152.32	208.70
4.	Chlorophyll a µg/g	543.38	578.65	651.03	555.93
5.	Chlorophyll b µg/g	338.08	359.13	307.28	233.75
6.	Total chlorophyll µg/g	881.46	937.78	958.31	789.68
7.	Total carotenoids µg/g	70.53	57.43	142.60	133.53

Table 5 : Seasonal variation in biochemical composition of teas grown under inorganic cultivation

Sl. No.	Bio-chemical parameters	1st flush	2nd flush	Post second Flush	Autumn flush
1.	Polyphenols %	27.36	30.14	24.80	25.12
2.	Caffeine %	4.21	3.78	3.02	3.51
3.	Proline µg/g	170.38	192.10	132.43	138.97
4.	Chlorophyll a µg/g	728.53	792.35	876.38	706.30
5.	Chlorophyll b µg/g	312.50	315.03	382.86	289.50
6.	Total chlorophyll µg/g	1040.03	1107.38	1259.24	995.80
7.	Total carotenoids µg/g	162.63	185.83	197.05	199.80

Scientific and Supporting Personnel at DTRDC

Dr. N. Ghosh Hajra, M.Sc., Ph.D. Post Doc (Belgium)	Project Director
Soil Science	
Dr. R. Saha, M.Sc (Ag), Ph.D., P.D. Fellow	Soil Scientist
Smt. S. Rai	Laboratory Assistant
Biochemistry	
Shri N. Kumar, M.Sc	Senior Scientific Assistant
Shri R. Rai, B.Sc	Junior Scientific Assistant
Farm Management (Botany and Agronomy)	
Shri J.S. Bisen, M.Sc. (Ag)	Junior Scientific Assistant
Shri R. Kumar, M.Sc. (Ag)	Junior Scientific Assistant
Plant Protection	
Shri M. Singh, M.Sc. (Ag)	Senior Scientific Assistant
Administrative Office	
Smt. S. D. Lama	Accountant
Shri S. Sherpa	Asstt. Accountant
Shri M. Kalita	Office Assistant
Smt. N. L. Yelmo	Cashier
Shri P. Yalmo	Typist/Clerk
Shri B. Periyar	Driver
Smt. Padma Bhutia	Peon
Shri A. Rai	Night Watchman

2 (two) posts of Sr. Sci. Asstt. (Soil) and Sr Sci. Asstt. (FM), 1 (one) post of Jr. Sci. Asstt. (Soil) are vacant since 1992. 1 (one) post of Laboratory Assistant is vacant since 2001.