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PREFACE

Darjeeling Tea Research Centre has been 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 notable accomplishments are summarised below.

- The performance of eight popular clones out of thirty clones released for Darjeeling gardens was 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 as 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 cuttings 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 soil-fertility status viz., N, P, & K map of Darjeeling tea growing soils have been published.

- The positive effect of foilar spray of Zinc on yield has been established.

- Effect of six different sources of sulphur fertilizer 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 of 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 fields. The scientists made several advisory visits to different tea estates of the Darjeeling hills.

Visitors

Important visitors to the Research Centre include.

i. Prof. Salim Javed and his team, Centre for Wildlife and Ornithology, Aligarh Muslim University, U.P.

ii. Shri M. B. Pranesh, IAS, Special Commissioner and Transport Commissioner, Govt. of TamilNadu.

iii. Shri Bharat Bhusan, IAS, Director, Ministry of Commerce, Govt. of India.

FARM MANAGEMENT (BOTANY & AGRONOMY)

1.1. Production & Sale :

Total production of green leaves was 18, 464.0 kg and this quantity was sold to M/s. Tiru Tea Limited (Castleton Tea Estate) at a cost of Rs. 3,32,352.00

1.2 Pruning :

The following pruning schedule was followed.

Light pruning	-	4.51	hectare	-	24.42%
Deep/Medium skiff	-	3.24	hectare	-	17.54%
Light skiff	-	4.01	hectare	-	21.71%
Levelling of skiff	-	6.71	hectare	-	36.33%
Total		18.47	hectare		

1.3 Manures and fertilisers:

The following composition and dose of fertilisers were applied.

Mature Teas - N:P:K::120:45:120

Young Teas - N:P:K::60:30:60

Trasco - 5 (Tea special) and Phytonol - Gr.+Mi. were also sprayed (400ml/ha and 100ml/ha)

1.4 Weed Control :

Glyphosate, Paraquat and 2,4-D were applied at recommended doses and the control of weeds was satisfactory. Weeds were also controlled manually during rainy season.

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. Determination of suitable pruning cycle of old chinary tea bushes of Kurseong (DTRC/FM/17)

The experiment was initiated in the year of 1994. During this year, 3 year pruning cycle treatment was light pruned, 4 year and 5 year pruning cycle treatments were unpruned/levelling off skiff. The yield data recorded during the year is presented in Table 2.

1.6.2. Effect of nutrient management on stomatal behaviour and growth of young tea plants (DTRC/FM/19).

Net photosynthesis(Pn), Stomatal conductance, Transpiration (E), Intercellular CO_2 Conc., Leaf temp. (^{0}C), Water Use Efficiency (WUE) (Pn/E) and Vapour Pressure Deficit (VPD) were measured by Portable Photosynthesis System (LI-6200). During different seasons outside bark diameter of the stem at 5cm above the ground was also recorded. The highest photosynthetic rate, stomatal conductance and transpiration were recorded from the plots under treatment no. T6 wherein N:P:K::120:45:80 kg/ha (basal) was applied through CAN, Rock Phos and MOP. The maximum girth has been recorded in the treatment no. T6 and T9 in comparison with other treatments (Fig. 1 to 6 and Table 3 &4).

The yield of green tea leaf was recorded at weekly intervals during plucking season. It was observed that highest yield was recorded from the plot under treatment no. T6 (Table - 5)

1.6.3. Monthly Diurnal variations of photosynthesis and PPFD:-

Fluctuations of net photosynthesis (Pn) and photosynthetic photon flux density (PPFD) in different months showed that Pn was low in the morning, rose in general between 0900 and 1100 hrs, with a mid-day depression around 1300 hrs and declined sharply after 1500 hrs.(Fig. 7 and Table-6)

1.6.4. Response of foliar application of some micronutrients in Darjeeling Tea (DTRC/FM/20)

The experiment was conducted in the old chinary tea plantation of DTRC.

Location	:	Experimental Farm, DTRC.
Design	:	R.B.D.
Replication	:	3
No. of treatments	:	7
No. of plots	:	21
Plants per plot	:	28-30

Treatments :

T1	=	Control			
T2	=	Trasco -5 (Tea Special)	-	400ml/ha	
T3	=	Phytonol - Gr.+Mi.	-	100ml/ha	2 splits
T4	=	Zn+Mg	-	(2%+2%)	
T5	=	Zn+Mg+B	-	(2%+2%+1%)	
T6	=	Zn+Mg+B+Mo	-	(2%+2%+1%+0.5%)	
T7	=	Zn+Mn+B	-	(2%+1%+1%)	

1st spray : before onset of first flush.

2nd spray : after rain flush in September

Cultural practices followed were as per the Darjeeling garden standard.

Objectives:

To ascertain the efficacy of foliar spray of various micro nutrients (commercial and pure salt form) on the yield of Darjeeling Tea.

Results :

The micronutrients selected for the trial were pure salt mixtures made in the laboratory and 2(two) renowned commercial grade micronutrients were also taken for meaningful comparison. The pre trail made tea yield (1997) has been recorded (Table No.-7) and found that there was no significant difference in yield due to variation of plots. The made tea yield for the year 1998 (after application of the micronutrients) has been recorded (Table-7) and found that the treatment no. T5 (Zn+Mg+B) gave the highest made tea yield i.e. 771.1 kg/ha followed by treatment no. T3 (Phytonol-Gr.+Mi.) 703.9kg/ha. However the trial is at a very preliminary stage hence it would be premature to comment about the efficacy right at this stage.

Table 1 : Weather observations recorded at the Meteorological Observatory

Months	Air Temperature		Mean Soil temperature (depth)						Mean Vapour pressure of mercury		Mean Relative Humidity		Total Rain-fall	Mean wind velo-city	Mean sun shine recor-ded	Mean pan Evapo-ration
			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	(mm)	(Kmh $^{-1}$)	(hd $^{-1}$)	(mm)
	°C	°C	°C	°C	°C	°C	°C	°C	mm of Mercury	mm of Mercury	%	%				
April 98	21.2	16.0	15.8	24.6	16.7	23.1	17.9	19.5	13.9	18.4	90.0	81.0	87.5	4.8	4.1	2.7
May	22.8	18.0	19.9	26.2	20.4	25.2	21.5	22.1	18.3	21.7	94.0	92.0	145.8	4.7	4.6	3.4
June	21.0	19.8	21.5	24.0	21.8	23.7	22.8	22.9	20.4	21.3	100.0	95.0	641.6	4.7	0.5	2.0
July	21.5	19.2	21.1	23.7	21.4	23.4	22.5	22.6	19.6	20.9	96.0	95.0	1367.0	5.8	0.3	1.6
August	21.5	19.0	21.2	23.6	21.5	23.3	22.5	22.5	19.6	20.7	96.0	95.0	1035.3	4.1	0.2	2.4
September	22.1	18.3	19.9	25.5	20.3	24.7	21.8	22.5	18.5	21.1	94.0	98.0	395.8	4.9	2.3	3.2
October	20.8	14.7	19.3	24.1	19.0	23.6	20.7	21.7	17.2	20.7	91.0	98.0	26.8	4.7	2.7	2.4
November	19.2	13.0	13.9	19.9	14.4	19.7	16.6	17.4	13.5	17.1	96.0	89.0	27.2	3.6	4.7	2.9
December	16.8	9.4	9.4	17.4	9.8	16.7	13.0	14.0	10.1	13.4	91.0	88.0	10.0	4.4	5.1	4.0
January '99	14.3	7.3	7.5	17.3	7.8	17.1	11.1	12.5	8.0	13.2	90.0	91.0	00.0	2.4	6.4	3.9
February	18.7	11.0	12.1	22.5	12.4	21.8	14.3	16.4	11.5	17.8	93.0	92.0	00.0	2.6	5.2	4.0
March	20.9	13.5	14.6	23.9	15.3	23.2	17.8	20.7	13.3	19.3	89.0	91.0	30.6	--	5.8	5.5

(DTRC - 1240 m, 26° 55' N 88° 12'E)

Table 2 : Effect of pruning cycles and time of pruning on yield Kg/ha^{-1}

Pruning cycle	Pruning in 1997	Sept.	Nov.	Dec.	Total	Mean
3 year	L.P.	102.5	91.0	86.9	280.4	93.5
4 year	LOS	673.0	757.6	780.1	2210.7	736.9
5 year	LOS	688.1	715.9	828.3	2232.3	744.1
Total		1463.6	1564.5	1695.3	4723.4	--
Mean		487.9	521.5	565.1	--	--

Table 3 : Seasonal variation of leaf temp. (^{0}C)

Treatments	Leaf Temp. (^{0}C)					
	A	J	A	O	D	F
T1	29.2	25.5	26.4	24.2	22.0	22.9
T2	29.4	26.1	26.9	25.9	24.6	23.0
T3	29.4	25.9	28.7	28.2	24.3	23.6
T4	30.2	25.3	26.6	27.4	23.9	23.6
T5	28.5	25.9	26.8	27.8	22.3	24.5
T6	30.1	26.1	26.2	26.4	23.4	23.2
T7	29.5	25.9	26.1	27.5	22.7	24.9
T8	28.2	26.5	27.7	28.0	23.6	23.0
T9	29.9	26.2	26.3	25.7	24.3	24.4

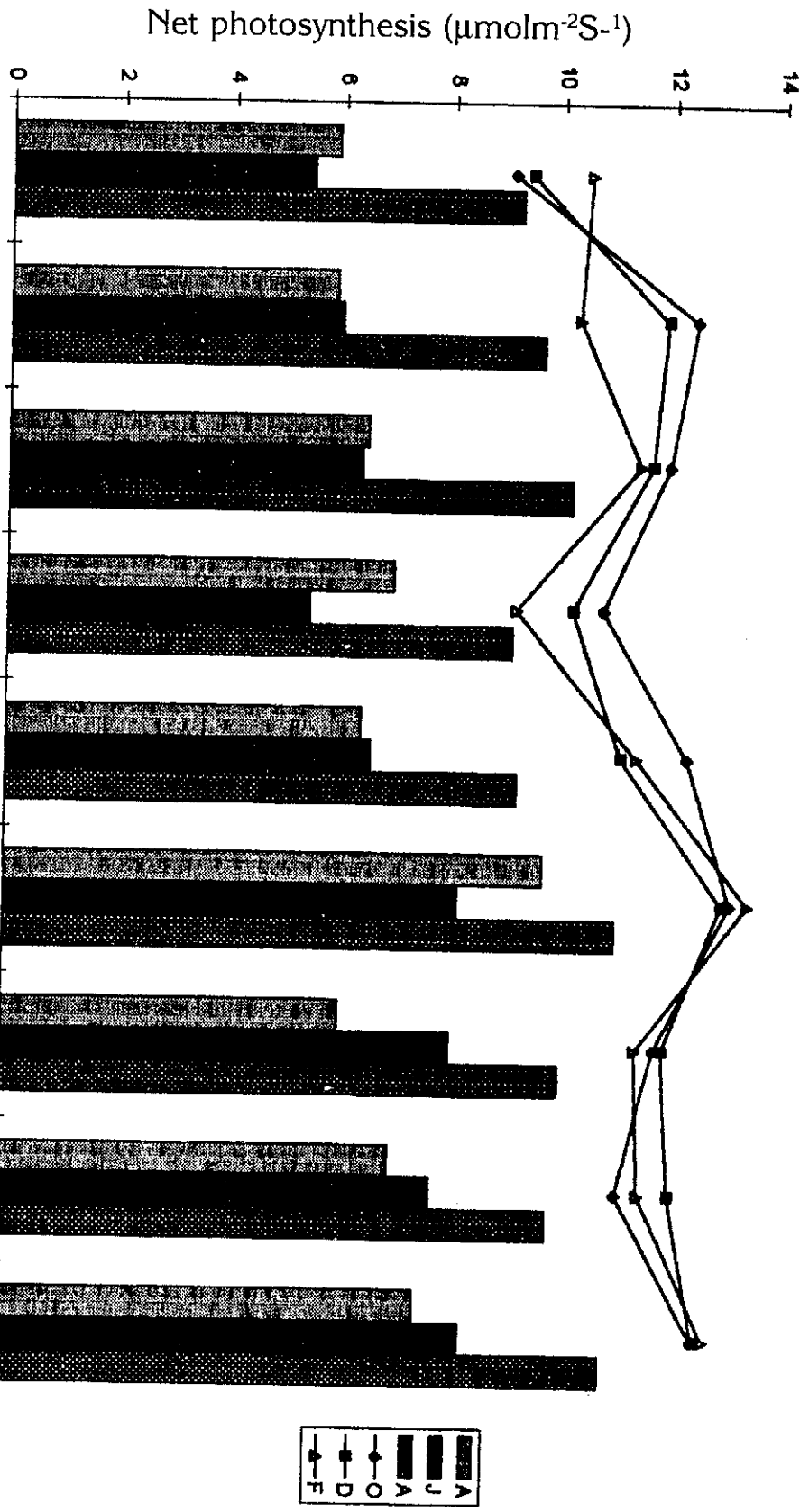

Fig. 1. Seasonal variation of photosynthetic rate at different treatments.

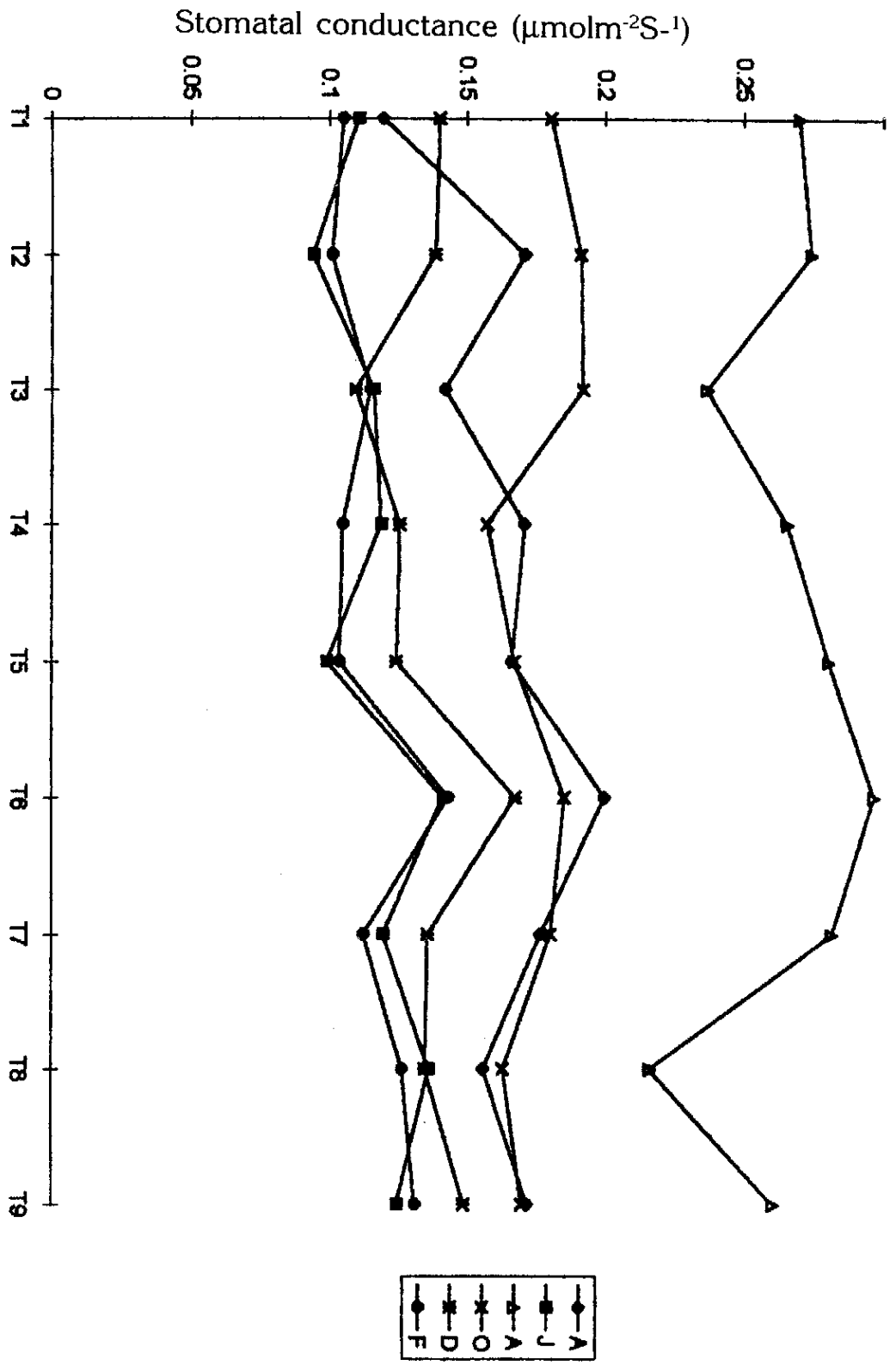

Fig. 2 seasonal variation of stomatal conductance at different treatments.

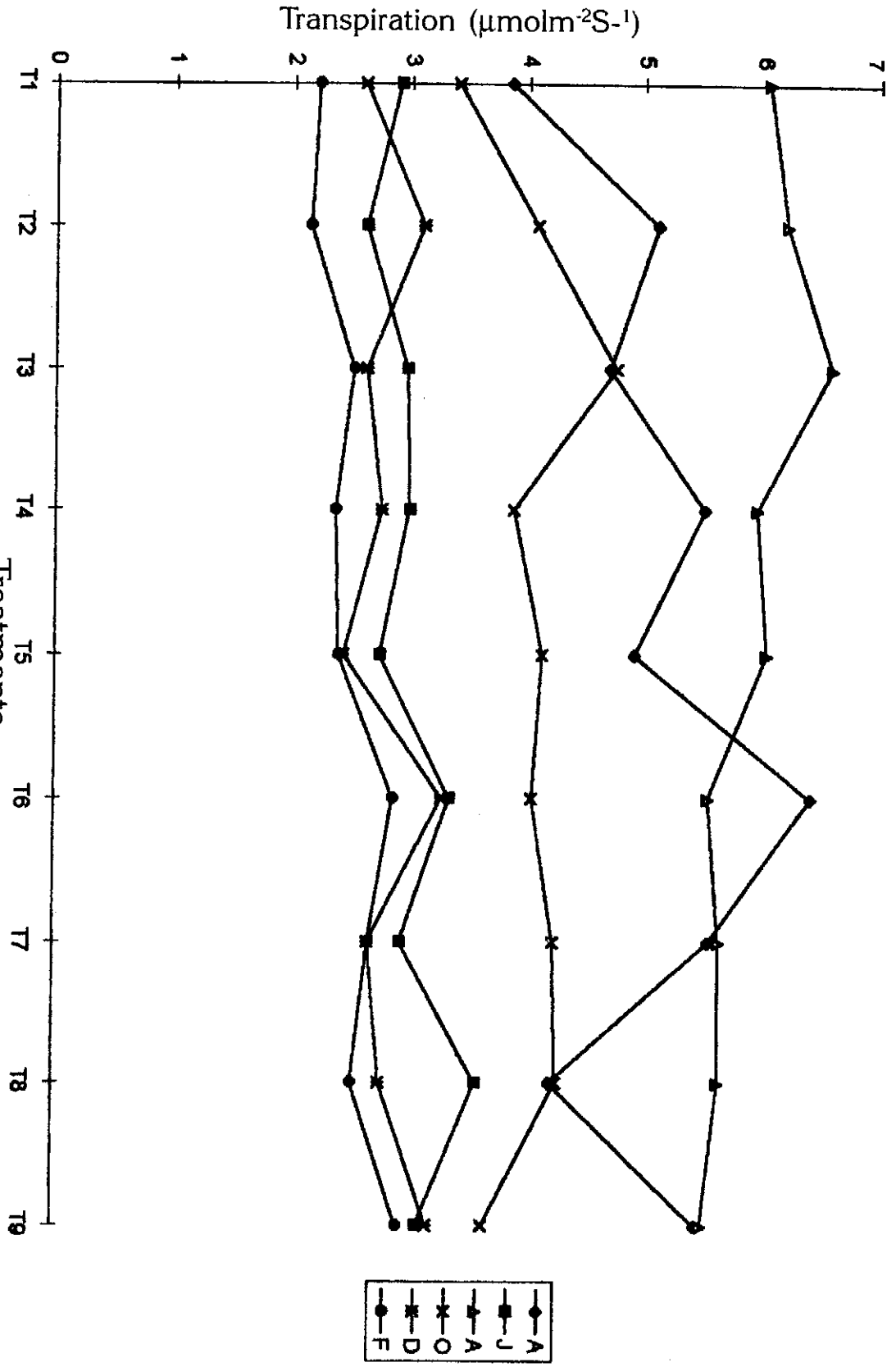

Fig. 3. Seasonal variation of transpiration at different treatments.

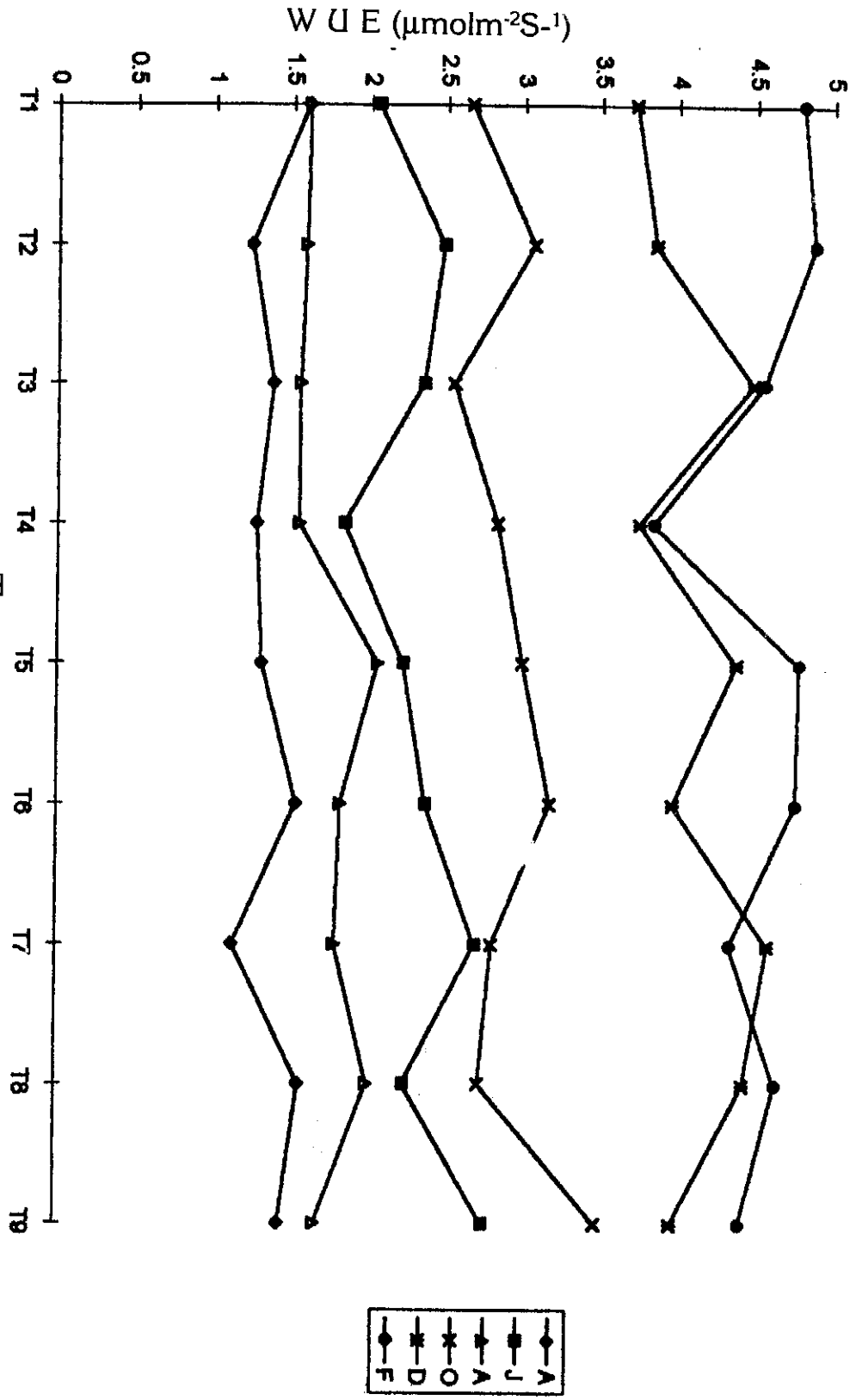

Fig. 4. Seasonal variation of W U E (Pn/E) at different treatments.

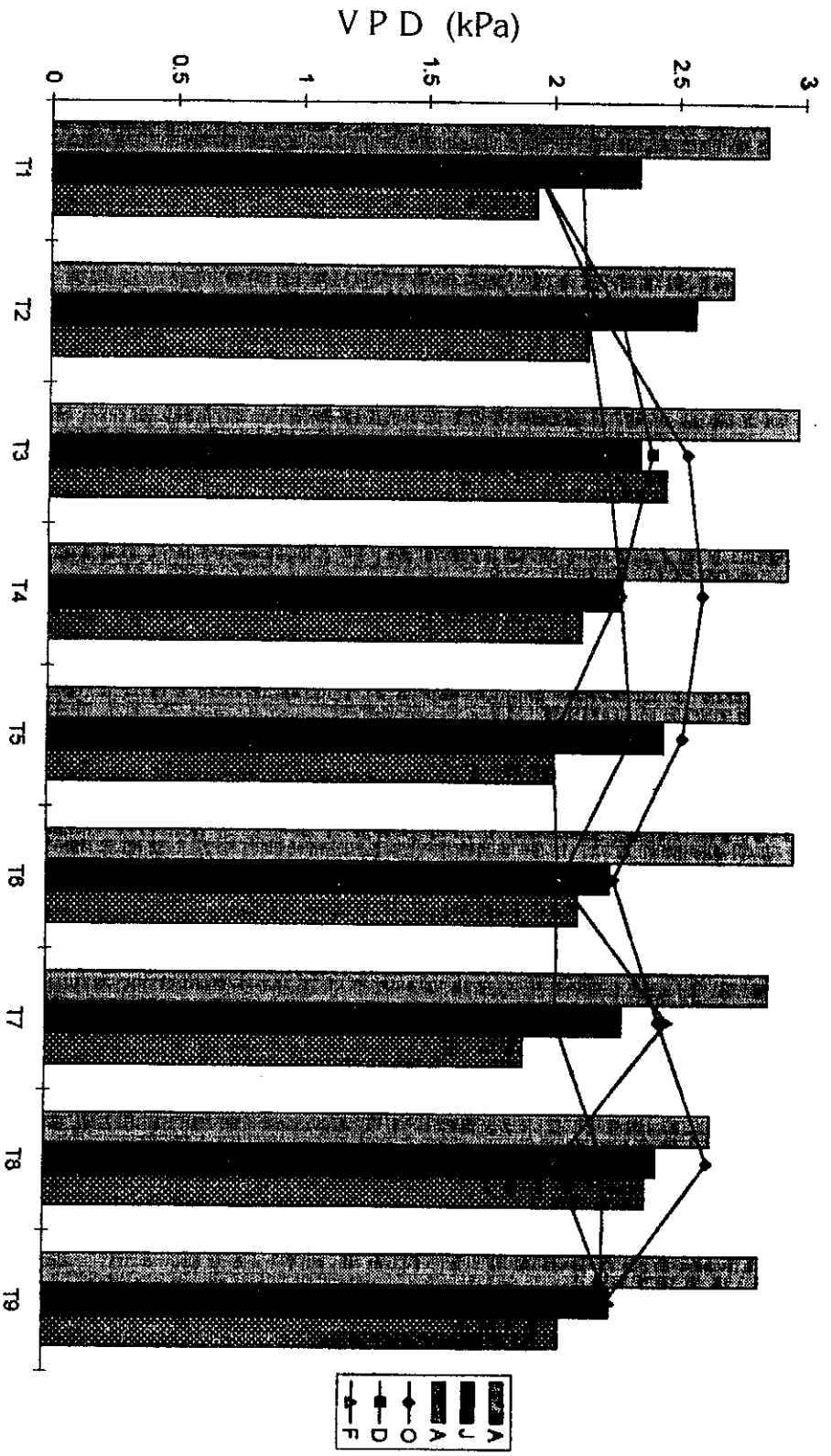

Fig. 5. Seasonal variation of V P D (kPa) at different treatments.

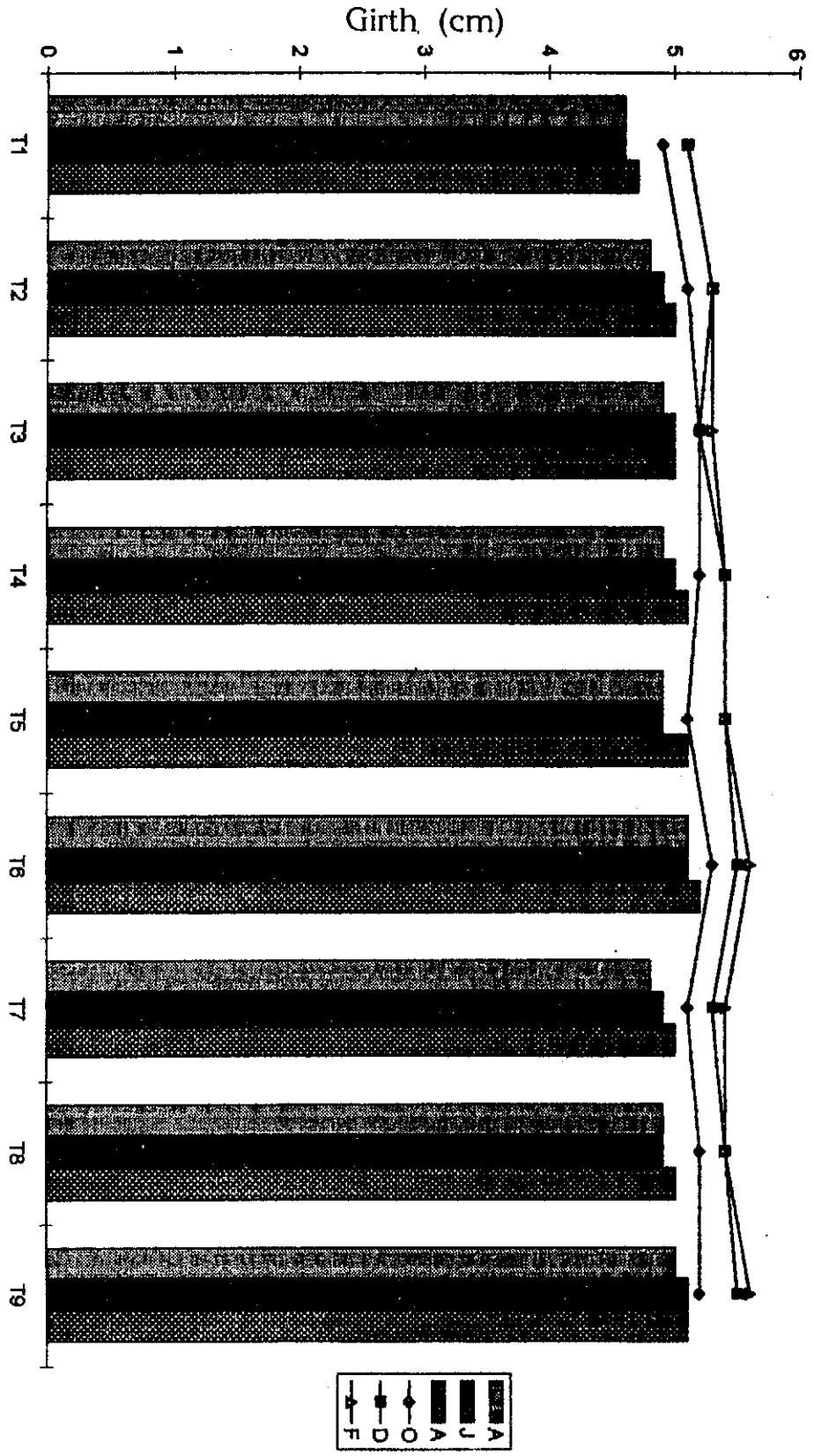

Fig. 6. Monthly variation of girth at different treatments.

Table 4 : Seasonal variation of intercellular CO_2 Conc. (ppm)

Treatments	Intercellular CO_2 Conc. (ppm)					
	A	J	A	O	D	F
T1	229.6	236.3	291.0	241.6	214.1	181.4
T2	258.1	203.9	266.8	205.8	178.3	173.6
T3	232.4	226.0	254.2	206.3	151.3	181.8
T4	244.4	254.5	273.7	192.3	191.5	208.2
T5	243.8	236.3	252.4	181.5	177.8	160.8
T6	216.0	216.6	266.5	198.7	191.2	177.5
T7	253.2	210.0	277.7	198.7	179.0	183.8
T8	233.4	226.6	233.6	191.4	162.6	195.8
T9	236.8	205.3	273.2	187.7	179.7	176.4

Table 5 : Effect of Organic and Inorganic fertilisers on Made Tea Yield.

Treatments	Dose of Fertiliser		Made Tea kg/ha(1998)	Result
T1	Control	-	409.45	
T2	Organic Manure (F.Y.M.)	-	512.91	
T3	Organic Manure+Urea+Rock Phos. & MOP	-	561.55	
T4	120:45:80 Kg/ha (basal) through Urea, Rock Phos. & MOP	-	567.27	
T5	120:45:80 kg/ha (basal) through Amm. Sulph., Rock Phos. & MOP	-	561.51	
T6	120:45:80 kg/ha (basal) through CAN, Rock Phos. & MOP	-	601.02	Significant at 5%
T7	90:22.5:40 kg/ha, 30:22.5:40 kg/ha } 2 splits through Urea, Rock Phos. & MOP	-	563.31	
T8	90:22.5:40 kg/ha, 30:22.5:40 kg/ha } 2 splits through Amm. Sulph., Rock Phos. & MOP	-	555.21	
T9	90:22.5:40 kg/ha, 30:22.5:40 kg/ha } 2 splits through CAN, Rock Phos. & MOP	-	582.3	

a) single basal dose applied in the month of May only.

b) 2 split doses applied in the month of May and 1st week of September.

Table 6 : Diurnal variations of PPFD at different months

Time Hrs	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
6.00	7.0	9.0	27.7	88.4	133.5	16.2	25.2	15.1	52.6	28.0	61.8	11.6
7.00	61.5	52.2	75.0	695.0	241.8	82.2	28.6	18.3	63.2	83.5	91.5	51.2
8.00	116.8	182.2	267.6	1327.0	1081.0	124.7	38.7	57.2	885.4	194.5	185.9	92.2
9.00	7.5	344.7	1315.0	1360.0	1273.1	140.4	50.1	67.5	1354.0	1289.0	688.7	1026.0
10.00	874.0	560.0	1493.0	1368.4	1409.0	154.8	55.2	121.8	1536.0	1311.0	1357.0	1189.7
11.00	1230.0	854.0	1646.0	1367.1	1450.9	265.0	103.4	163.5	1426.0	1312.0	1351.0	1535.0
12.00	1340.0	810.0	1633.0	1413.7	859.3	835.3	114.4	165.4	1203.0	1319.0	1392.0	1512.0
13.00	1071.0	598.0	1547.0	486.8	752.8	679.1	417.3	202.3	866.4	1193.5	1157.0	1511.0
14.00	1024.0	560.0	1448.0	321.6	188.1	287.5	430.6	328.2	1170.0	857.5	1213.9	1426.0
15.00	254.0	98.6	1232.0	215.1	115.2	217.3	764.1	284.8	1080.0	761.1	816.5	1080.0
16.00	113.9	12.5	373.0	32.9	112.9	184.1	147.1	106.3	462.0	178.0	96.6	309.5
17.00	10.5	1.6	77.2	74.0	19.6	73.6	63.0	16.5	22.0	13.8	2.9	0.8
18.00	0.0	0.0	0.0	0.0	15.2	39.8	14.5	1.4	0.0	0.0	0.0	0.0

Table 7 : Pre-trial Made tea yield (1997) and made tea yield during the first year of micronutrient application (1998)

Treatments	Name of the micronutrients	Dose	Pre-trial made tea yield kg/ha (1997)	Made tea yield kg/ha during (1998)
T1	Control		630.7	643.1
T2	Trasco-5 (Tea special) -	400ml/ha	665.5	677.4
T3	Phytonol - Gr.+Mi.	100ml/ha	695.3	703.9
T4	Zn+Mg	2%+2%	651.0	658.2
T5	Zn+Mg+B	2%+2%+1%	698.5	771.1
T6	Zn+Mg+B+Mo	2%+2%+1%+0.5%	665.4	703.2
T7	Zn+Mn+B	2%+1%+1%	635.7	676.9

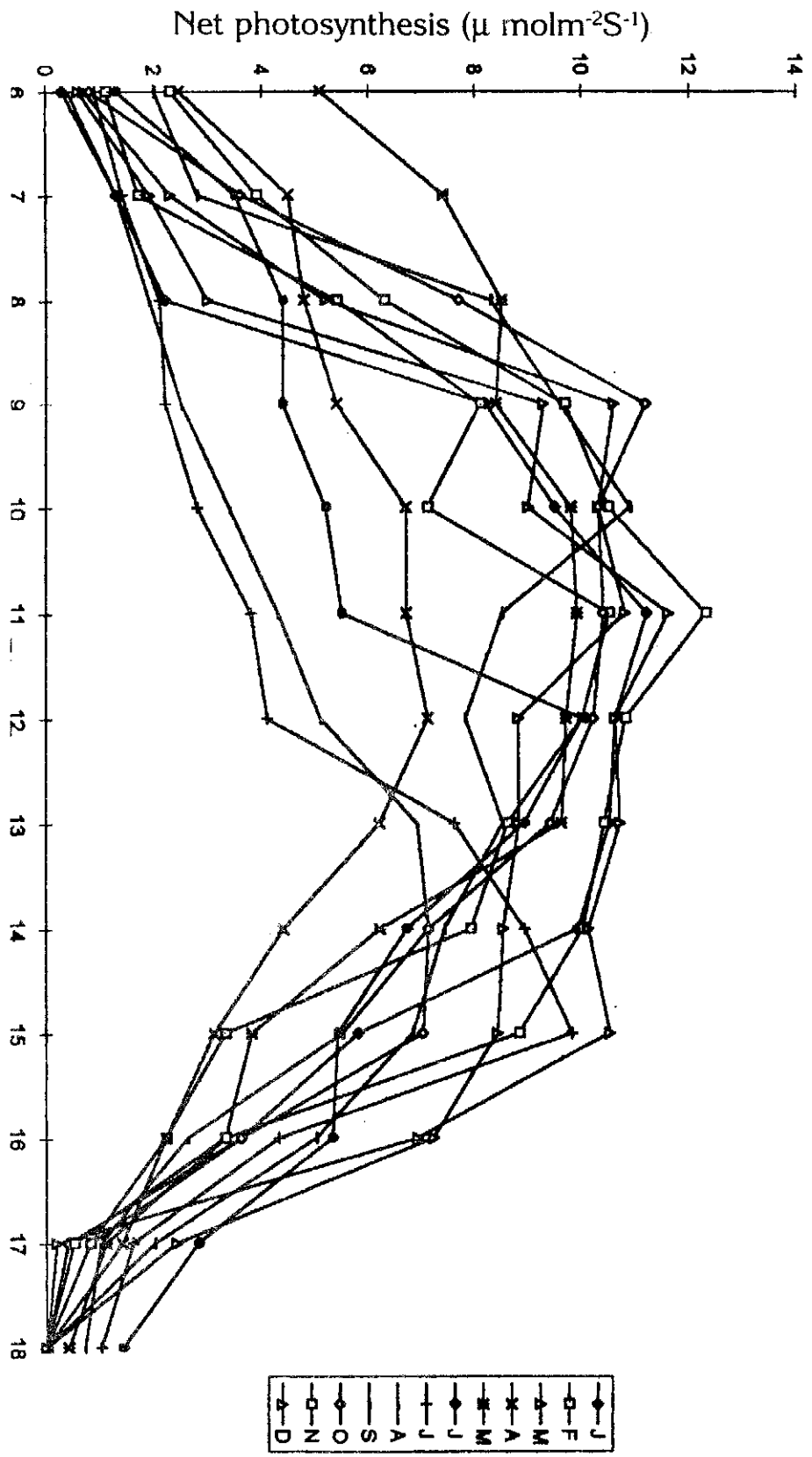

Fig. 7. Diurnal variation of photosynthesis (µ molm^{-2}S^{-1}) at different months.

SOIL SCIENCE DIVISION

2.1 Soil Testing:

Soils from different Tea Estates of Darjeeling, Terai, Dooars and Assam have been received and tested as per requirement. Recommendations have been offered wherever required for preparing fertiliser schedule, rectifying deficiencies of minerals if any, correcting the pH etc. of individual garden. During the year under report 835 soil samples have been tested and 3396 estimations of various parameters carried out as follows.

Sl. No.	Parameters	No. of samples analysed
1.	pH	835
2.	Organic carbon	835
3.	Mineralisable Nitrogen	132
4.	Available Phosphate	797
5.	Available Potash	797
	Total estimation:	**3396**

The name of the Tea estates whose soil have been tested are as follows:

Darjeeling Gardens : Ringtong & Hopetown, Dooteriah, Thurbo, Castleton, Dilaram, Margarets' Hope, Soureni, Kalej Valley, Selim Hill.

Dooars and Terai Gardens : Sunil Pratap (Small Grower), Mohan Agarwal (Small Grower), Rabi Sarkar (Small Grower), Toonbarie, Carron, P.G. Plantations (Small Grower)

Assam Garden : Kopati.

2.2. Research Projects :

2.2.1 Effect of different levels of Nitrogen (Basal and Split) on the long term yield and quality (DTRC/S/9).

The trial has been launched in 1998. The one year made tea yield data is presented in the following Table no. 8.

From the table it is evident that the Treatment no. T5 viz.; 60+30:45:100kg NPK/ha through 2 split (Urea, RP and MOP) has the highest made tea yield which was 478.3kg/ha. which is followed by T4 viz.; 60:45:100kg NPK/ha through single basal dose of Urea:RP:MOP

2.2.2. Effect of Organic and Inorganic fertilisers on long term yield and soil fertility (DTRC/S/10).

The trial has been launched in 1998. Made tea yield data for the year 1998 has been depicted in the following Table 9. From the said table it is evident that the treatment no. T4 i.e., 90:45:90 kg NPK/ ha through single basal dose of Urea:RP:MOP gave the highest return i.e. 497.0 kg/ha made tea which is followed by T2 i.e., 60:30:60 kg/ha (100% N through FYM and remaining P and K through RP and MOP in a single basal dose). The physico-chemical properties of the soils of the organic and inorganic plots are being studied and would be presented in the 1999-2000 report.

Table 8 : Effect of different levels of Nitrogen (basal and split) on the yield during 1998 (DTRC/S/9)

Treatment No.	Dose	Source	Made Tea yield (Kg/ha)
T1	Control		293.3
T2	0:45:100kg NPK/ha	Urea:RP:MOP	394.7
T3	30:45:100kg NPK/ha	Urea:RP:MOP	422.0
T4	60:45:100kg NPK/ha	Urea:RP:MOP	462.3
T5	60+30:45:100kg NPK/ha	Urea:RP:MOP	478.3
T6	80+40:45:100kg NPK/ha	Split of Nitrogen	466.0
T7	100+50:45:100kg NPK/ha	Split of Nitrogen	479.0
	C.D. at 5%		60.15

Table 9 : Effect of organic and inorganic fertilisers on long term yield and soil fertility during 1998 (DTRC/S/10)

Treatment No.	Dose	Source	
T1	Control		341.0
T2	60:30:60 kg NPK/ha	100% N by FYM, remaining P and K by RP and MOP	450.7
T3	60:30:60 kg NPK/ha	Urea:RP:MOP	445.5
T4	90:45:90 kg NPK/ha	Urea:RP:MOP	497.0
T5	60:30:60 kg NPK/ha	50% N by FYM, remaining N, P and K by Urea, RP, MOP	418.2
T6	90:45:90 kg NPK/ha	50% N by Neem Cake, remaining N, P and K by Urea, R/P, MOP	439.2
T7	60:30:60 kg NPK/ha	50% N by FYM, remaining N, P and K by Urea, RP, MOP	407.2
T8	90:45:90 kg NPK/ha	50% N by Neem Cake, remaining N, P and K by Urea, RP, MOP	442.7
	C.D. at 5%		40.17

BIOCHEMISTRY

3. Research Project

3.1 Studies on Biochemical composition of clones released for Darjeeling Tea Industry- Assessment of Fermentation period. (DTRC/Bio/2)

During this period clone SP/4/5, B/5/63, B157, AV2, P312, T78, T383, and TS378 were subjected for fermentation studies. Fermented tea samples of these clones were drawn at different time intervals and analysed for total polyphenols, theaflavins, Thearubigins and Caffeine contents. Clone SP/4/5 that was fermented for 2 hours 10 mts. ranked superior to the sample fermented for 2 hrs. 20 mts. Clone B/5/63 which is a high yielding variety and also produces good quality teas in South India failed to produce desirable flavour and good quality in the agroclimatic conditions of Kurseong. This clone got fermented at a quite faster rate as compared to other Darjeeling clones under observation. Optimum fermentation period for this clone was observed at 1 hr 45 mts. Clone B157 always produced unique Darjeeling flavour when fermented for 2 hrs 35 mts. Beyond this period level of Theaflavins though increased but decline in flavour was noticed. Clone AV2 always produced high degree of flavour resembling with the rose. Under the manipulated processing conditions when the room temperature was low and hygrometric differences were 2 to 3 degree, quality of this clone was adjudged best at 2 hrs. 30 mts. in comparison to 2 hrs. 40 mts. of fermentation. Theaflavin content was estimated low at this stage. Clone T135 also got fermented faster and optimum fermentation period for this clone was observed to be 2 hrs when it was ranked good in flavour. Similarly the clone P312 produced better flavour at 2 hrs. 35 mts. and a decline in quality and flavour was noticed at 2 hrs. 45 mts. The level of theaflavins was low at this fermentation period.

From the on line experiments of fermentation it was also observed that the level of residual total polyphenols in these clones was apparently higher. But the differences were not significant for the 10-15mts variation in fermentation period which may be due to experimental error also. Further, the optimum fermentation period always coincided with the development of flavour and no trend could be observed for the high level of Theaflavins at this fermentation period in Darjeeling orthodox teas. Total polyphenols of these teas varied from 21.35 to 25.16 percent. Theaflavins 0.68 to 0.92 percent, thearubigins 8.14 to 12.20 percent and brightness 44.65 to 52.31 percent (Table 10)

3.2 Influence of Pruning cycle on chemical composition and aroma precursors of Darjeeling Tea (DTRC/Bio/7)

During this period pigment composition of harvested shoot was studied.Corresponding made teas of different pruning treatments were also analysed for total polyphenols, theaflavins, thearubigins and Caffeine contents. Chlorophyll "a" was recorded lowest in LOS-LP treatment and the highest in UT-MS sections. The level of chlorophyll "b" and total carotenes were also registered highest in UT-MS sections. However, the low amounts of chlorophyll "b" and total carotenes were synthesized in LOS-LP treatments. Decline in total polyphenols was observed highest in LP-UT sections which was closely followed by LOS-LP and UT-DS sections. Caffeine contents were also observed varying with the type of pruning. In the initial works after tipping of pruned teas the level of caffeine was found to be increased and further, it gradually decreased with the time from pruning. Similarly low contents of theaflavins were observed in pruned teas and with a lapse of time from pruning it got increased again.

Type of pruning, advancement in age from pruning and season significantly affected the chemical composition of teas as evidenced from the results recorded in Table 11, 12 & 13.

3.3 Degradation of polyphenols during manufacture (DTRC/Bio/8)

Degradation of polyphenols during withering stage of manufacture revealed that about 7 to 8 percent of polyphenols were degraded. However, there was a sharp decline in the loss of moisture. Degradation of polyphenols during fermentation was observed at a much faster rate. In case of China hybrid it varied from 4 to 6 percent. Similarly for clones these variations were larger depending upon the varying rate of oxidation and the level of polyphenol oxidase in these teas. In high withered (71%) teas degradation of polyphenols was more as compared to the normal withered teas (65%). Degradation process was significantly affected by the type of rolling. Heavy rolling caused much loss to polyphenolic contents as compared to light rolling. Similarly a difference of 10-15mts in fermentation period near the optimum fermentation time degraded 1.5 to 2 percent of total polyphenolics. Shorter fermentaion period thus helped to retain the higher levels of polyphenols. Conversely low temperature of dry bulb and less hygrometric difference in dry and wet bulb thermometer also helped to retain the higher level of residual polyphenols in orthodox black teas.

3.4 Miniature Unit:

90 experimental tea samples were manufactured during the season. Six tea samples of different clones were received from Thurbo T. E. for advice on suitable processing conditions of manufacture that would suit to these clones for better flavour development. Power failure obstructed the process of manufacture at several occasions and spoiled the experimental tea samples.

Table 10 : Chemical composition of clones in relation to Fermentation.

Sl. No.	Clone	Total polyphenols	Theaflavin	Thearubigins	Caffeine	Fermentation hours	Flavour
		%					
1.	SP/4/5	21.64	0.65	8.14	3.92	2-10	5
		19.84	0.58	8.75	3.68	2-20	4
2.	B/5/63	24.98	0.92	12.20	4.60	1-45	4
		21.63	0.78	12.84	4.26	2-00	3
3.	B157	22.68	0.66	8.62	4.16	2-35	7
		21.04	0.70	9.28	3.52	2-45	6
4.	T135	21.35	0.62	12.16	4.35	2-00	4
		20.62	0.48	12.74	3.90	2-10	3
5.	T78	23.48	0.68	8.92	3.80	2-30	6
		21.26	0.59	9.20	3.47	2-40	5
6.	T383	25.00	0.82	9.70	3.68	2-20	5
		23.70	0.68	10.40	4.12	2-30	6
7.	P312	23.04	0.64	8.56	4.42	2-35	7
		21.38	0.72	9.72	4.18	2-45	6
8.	AV2	22.34	0.68	8.10	4.20	2-30	8
		20.92	0.70	8.98	3.98	2-40	7
9.	TS378	25.16	0.70	10.67	4.46	2-15	5
		23.64	0.74	11.72	4.24	2-25	3

Table 11 : Pigment composition of pre-monsoon teas in relation to different pruning treatments.

Sl. No.	Treatment	Chl a	Chl b	TC
			(µg/g)	
1.	UT-MS	727.28	406.59	115.82
2.	UT-DS	647.35	390.28	78.59
3.	LOS-LP	501.76	380.60	60.38
4.	LOS-LP	536.90	346.80	76.72
5.	LOS-LP	502.39	390.42	70.29
6.	LP-UT	617.42	350.27	98.67

Table 12 : Pigment composition of monsoon teas in relation to different pruning treatments.

Sl. No.	Treatment	Chl a	Chl b	TC
			(µg/g)	
1.	UT-MS	780.20	456.75	140.48
2.	UT-DS	790.14	470.28	129.57
3.	LOS-LP	589.37	382.70	89.20
4.	LOS-LP	601.42	365.32	95.21
5.	LOS-LP	582.63	410.27	111.59
6.	LP-UT	614.38	365.10	102.60

Table 13 : Chemical composition of monsoon teas in relation to different pruning treatments.

Sl. No.	Treatment	Total polyphenols	Theflavin	Thearubigin	Caffeine	Remarks if any
			(%)			
1.	UT-MS	25.68	0.74	10.26	3.70	
2.	UT-DS	25.26	0.67	10.52	3.87	
3.	LOS-LP	25.18	0.72	10.68	4.28	
4.	LOS-LP	24.60	0.65	11.42	4.12	
5.	LOS-LP	25.90	0.68	10.40	4.36	
6.	LP-UT	27.80	0.84	9.68	3.78	

LIBRARY

During the year 5 Indian books were procured and 6 Indian journals were received / subscribed which are as follows:

1. Indian Journal of Agronomy
2. Pestology
3. Indian Phytopathology
4. Journal of Entomological Research
5. Indian Journal of Entomology
6. Journal of Plantation Crops.

APPENDIX

Serial No.	Name of the Division	Project Code No.	Title of the Project	Remarks
1.	Farm Management (Botany & Agronomy)	DTRC/FM/16	Effect of Environmental factors on the Physiological and Biochemical attributes in Tea	*Ongoing*
		DTRC/FM/17	Determination of suitable pruning cycle of old chinary Tea Bushes of Kurseong	*Ongoing*
		DTRC/FM/19	Effect of Nutrient management on stomatal behaviour and growth of young tea plants.	*Ongoing*
		DTRC/FM/20	Effect of various micronutrients in optimising yield and quality of Darjeeling Tea.	*Ongoing*
		DTRC/FM/7	Performance of certain Tea clones in Kurseong	*Concluded*
		DTRC/FM/8	Comparison of methods of replanting old tea bushes.	*Concluded*
		DTRC/FM/9	Evalution of herbicides for weed control in Darjeeling Tea.	*Concluded*
		DTRC/FM/10	Training of young tea in Darjeeling	*Concluded*
		DTRC/FM/11	Effect of plucking interval on crop yield and flavour of made tea.	*Concluded*
		DTRC/FM/12	Growth analysis of five clones under Kurseong condition.	*Concluded*
2.	Soil Science	DTRC/S/8	Effect of organic and inorganic forms of fertilisers on long term yield and soil fertility.	*Concluded*
		DTRC/S/9	Effect of different levels of nitrozen (Basal and split) on the long term field and soil fertility.	*Ongoing*
		DTRC/S/10	Effect of organic and inorganic fertilisers on long term yield and soil fertility.	*Ongoing*
		DTRC/S/2	Effect of foliar application of Zinc on Tea in Darjeeling	*Concluded*
		DTRC/S/4A	Tea soils of Darjeeling - Morphology, classification, mineralogy and genesis.	*Concluded*
		DTRC/S/4B	NPK Soil fertility status map of Darjeeling tea growing soils.	*Concluded*
		DTRC/S/5	Studies on potassium ion potential and quantity intensity (Q/I) relationships of some Acidic tea growing soils of Darjeeling.	*Concluded*
		DTRC/S/6	Sulphur in Darjeeling tea soils - deficiencies and remedies.	*Concluded*
		DTRC/S/7	Phosphorus and potassium fertilisers in optimisation of yield and quality of Darjeeling tea.	*Concluded*

3.	Plant Protection	DTRC/PP/7	Effet of neem products in controlling of tea pests and its effects on quality	*Ongoing*
		DTRC/PP/8	Population dynamics of some tea pests infesting chinary bushes.	*Ongoing*
		DTRC/PP/9	Effect of inorganic, organic fertilisers and green manure crops in the optimisation of yield as well as pest management.	*Ongoing*
		DTRC/PP/12	Bioefficacy, phytotoxicity and compatibility of organic pesticides against tea pests.	*Ongoing*
		DTRC/PP/13	Bioefficacy of certain plant extracts against sucking pests of tea.	*Ongoing*
		DTRC/PP/14	Efficacy of certain fungicides against blister blight of tea.	*Ongoing*
		DTRC/PP/2	Effect of neemoil, neemcake and neem seed kernel powder in controlling tea pests.	*Ongoing*
		DTRC/PP/4	Ineffectivity of *Baccillus thuringiensis* var *kurustaki* against bunch caterpillar.	*Ongoing*
		DTRC/PP/5	Bioefficacy of neem products in controlling certain pest of tea.	*Ongoing*
		DTRC/PP/10	Testing of Delfin *(Baccillus thuringiensis* var. *kurustaki* serotype 3a, 3b) against flush worm *(Cydia leucostoma)* in young tea in Darjeeling.	*Ongoing*
		DTRC/PP/11	Studies on the residue and persistence of monocrotophos, malathion, quinalphos, fenvalerate, dimethoate and dicofol in made tea of Darjeeling	*Paper under preparation.*
4.	Biochemistry	DTRC/Bio/2	Studies of biochemical parameters of clones of tea grown in the Darjeeling hills - assessment of fermentation periods.	*Ongoing*
		DTRC/Bio/7	Influence of pruning on chemical composition of aroma precursors of Darjeeling flavoury teas.	*Ongoing*
		DTRC/Bio/8	Degradation of polyphenols and chlorophyll during manufacture of Darjeeling flavoury and nonflavoury teas.	*Ongoing*
		DTRC/Bio/9	Isolation, identification and characterisation of β-D-Glucosides in Darjeeling flavoury teas.	*Ongoing*
		DTRC/Bio/1	Darjeeling teas in perspective of ISO specification 3720	*Concluded*
		DTRC/Bio/4	Determination of clonal compatibility in relation to improvement of flavour and quality of Darjeeling clones.	*Concluded*
		DTRC/Bio/5	Effect of copper and zinc on the chemical composition and quality of Darjeeling teas.	*Concluded*
		DTRC/Bio/6	Effect of plucking intervals on the flavour and quality of Darjeeling teas.	*Concluded*

Scientific and supporting personnel at DTRC

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M. Singh, M.Sc. (Ag)	*Senior Scientific Assistant*
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The total staff of the centre is seventeen which includes 2 scientists, 7 scientific assistants and 7 administrative personnel.