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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 efficiency 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. High-powered Govt. of Iran delegation.

ii. A team led by President, Japan Tea Foundation.

Farm Management (Botany & Agronomy)

1.1 Production:

Total production of green leaf during 1997 was 18,005.0 kg. and this quantity was sold to M/s. Tiru Tea Limited (Springside T.E.) Kurseong which generated a total earning of Rs. 2,92,581.25

1.2 Pruning :

The following pruning schedule was followed.

i.	Light pruning	-	6.72 hectres	-	36.38%
ii.	Light skiff	-	4.51 hectres	-	24.42%
iii.	Levelling of skiff	-	7.24 hectres	-	39.20%
	Total	-	18.47 hectres		

1.3 Manures and Fertilisers:

The following composition and dose of fertilisers were applied.

i. Mature teas - N:P:K::120:45:120

ii. Young teas - N:P:K::60:30:60

1.4 Weed Control :

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

1.5 Meteorology:

Monthly data on various meteorological parameters recorded during the year are presented on Table - 1.

1.6 Research Projects:

1.6.1 Seasonal variation in photosynthesis and productivity of young tea (DTRC/FM/16)

The maximum irradiance (PPFD) was recorded in October (1340 μmol $m^{-2}s^{-1}$) and decreased gradually in December and February. In April it increased (1320) μmol $m^{-2}s^{-1}$) and was very close to the October value (Fig. 1) An increase in VPD took place from December and it was maximal in April (4.3 Kpa). The volumetric water content of

both top and subsoils decreased gradually from October and declined rapidly during February (Table-2) The rate of Pan evaporation also increased gradually from October until April.

Photosynthesis :

The maximum value of Pn (11.9 μ mol $m^{-2}s^{-1}$) was recorded in October (Table-3). During June and August, when the temperatures were almost equal to those in April, Pn increased. In April, June and August high temperature prevailed but Pn was much lower in April rather than in June and August. Low temperature accompanied by low soil moisture during winter reduced Pn in February. In general, a linear relationship between ψL and the VPD of the atmosphere was observed. Pn, in general decreased with lower ψL. VPD was higher in the dry months (December, February and April) than in wet months. The maximum value of Pn was recorded up to a VPD of 1.9 Kpa; thereafter Pn declined slowly. When PPFD increased from lower intensities to about 1340 μmol $m^{-2}s^{-1}$ in October, Pn increased but in April, when humidity and soil moisture were low, although the PPFD recorded was about 1320 μ mol $m^{-2}s^{-1}$, very similar to the value recorded in October, the Pn value recorded was at its lowest. The correlation coefficients among the environmental and plant factors are given in Table - 4.

Yield :

The annual yield of made tea was only 618 and 712 ha^{-1} in 1996 and 1997 respectively (Fig-2) There were also differences in the distribution of seasonal yield between the first two years. High temperature, high soil moisture and moderate to high Pn were observed during June to October, but were highest in June and then gadually declined. Moderate yields were recorded in April in both years despite low soil moisture and a high rate of evaporation from the soil surface, but high air temperature, high PPFD, and the highest sunshine hours occured in April. No yield was recorded during the cold and moisture-stress period from November until end of March.

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

The experiment was initiated in the year of 1994. The yield during the year 1997 showed non-significant difference among the different treatment combinations (Table-5)

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

The details of the experiment were discussed in ASR for 1996-97 (P-5)

Table - 1

Weather observations recorded at the Meteorological observatory in DTRC (1997-98)

Months	Mean Air Temperature		Mean Soil Temperature						Mean Vapour Presure		Mean Relative Humidity		Mean Sunshine duration (hd^{-1})	Total Rainfall mm.	Mean *Wind Velocity ($km\ h^{-1}$)	Mean daily Evaporation 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				
	°C	°C	°C	°C	°C	°C	°C	°C	mm of mercury	mm of mercury	%	%				
April '97	23.2	—	16.0	24.5	15.8	23.5	18.5	22.7	11.4	17.0	71.0	82.0	4.4	19.6	4.7	2.3
Nay	23.5	—	17.8	25.0	18.5	25.8	20.5	23.9	14.5	18.5	91.0	81.0	3.7	121.3	6.1	3.2
June	23.8	—	19.5	27.0	20.0	27.9	21.6	24.9	16.1	21.1	96.0	97.0	1.8	369.7	6.4	2.1
July	24.0	20.0	20.3	25.0	20.9	25.4	21.9	23.4	16.8	20.1	94.0	93.0	1.2	750.0	5.8	1.2
August	22.1	19.8	20.7	24.6	21.2	24.2	22.4	22.5	16.4	18.4	91.0	93.0	1.0	890.4	6.5	1.4
September	20.5	18.2	19.5	23.3	20.0	23.1	21.2	21.8	15.4	17.3	94.0	96.0	1.5	748.0	4.3	1.2
October	20.0	15.5	15.2	25.1	16.4	22.9	18.8	19.7	12.1	14.3	86.0	80.0	3.5	8.2	4.6	2.3
November	17.3	12.7	16.7	19.8	14.3	18.6	16.2	16.4	9.9	12.0	85.0	82.0	6.6	00	4.3	1.8
December	13.5	8.8	9.8	15.0	10.3	13.9	12.4	12.8	8.2	10.2	92.0	87.0	4.0	251.4	4.8	1.6
January '98	11.8	7.1	6.9	14.8	7.7	13.3	10.1	10.9	6.9	8.6	84.0	82.0	3.2	00	4.4	1.5
February	14.0	8.9	9.1	17.6	10.0	15.9	12.1	13.2	7.9	10.3	85.0	81.0	3.6	00	5.3	2.2
March	15.9	10.9	11.6	18.8	12.5	17.9	14.6	15.5	8.5	11.2	86.0	86.0	4.2	246.0	5.2	2.1

(Lat - 26° 55° N, Long - 88° 12° E, Altitude - 1240 m)

Table - 2

Volumetric water content in the plots at the Darjeeling Research Centre at the time of experimentation. Data are the averages of each month for 1996 and 1997

Month	*Top Soil (0-15 cm)*	*Sub Soil (15-30 cm)*
February	20.7	21.9
April	23.9	25.4
June	33.1	34.3
August	32.2	34.1
October	30.8	31.9
December	28.1	29.9

Table - 3

Seasonal changes in photosynthetic rate (Pn) per unit leaf area μ mol m^{-2} s^{-1} and leaf water potential (ψL) (MPa) with standard errors (s.e) for the tea clone T78 during 1996 abd 1997.
Total samples for Pn and ψL per month were 600 and 60 respectively.

	Month						
Parameter	Feb.	Apr.	Jun.	Aug.	Oct.	Dec.	L.s.d season
Pn	7.2	4.3	8.5	9.3	11.9	10.4	0.92**
s.e	0.67	0.26	0.43	0.62	0.53	0.41	
ψL	1.4	1.4	0.8	1.0	1.2	1.3	0.43**
s.e.	0.24	0.27	0.17	0.28	0.19	0.42	

**significant at p = 0.01

Table - 4

Correlation coefficients among photosynthetic rate (Pn), air temperature (Ta), vapour pressure deficit (VPD), photosynthetic photon flux density (PPFD), leaf water potential (ψL) and yield of the tea cultivar Tukdah 78 in Darjeeling

Variables	Correlation coefficient (r) †
Pn and Ta	-0.92 n.s.
Pn and VDP	- 0.66 n.s.
Pn and PPFD	- 0.04 n.s.
pn and ψL	- 0.33 n.s.
VPD and ψL	- 0.86 n.s.
Pn and yield	- 0.08 n.s.

† significant at p = 0.05
n.s. = not significant

TABLE - 5

EFFECT OF PRUNING CYCLES AND TIME OF PRUNING

Pruning Cycle	Pruning 1996-97	Time of Light Pruning 1994			Total	Mean	C.D. at 5%	Result
		Sep.	Nov.	Dec				
3 Years	L.S.	703.7	709.6	743.7	2157.0	719.0		
4 Years	M.S.	662.3	760.8	786.7	2209.8	736.6	139.75	
5 Years	D.S.	644.8	804.1	865.3	2314.2	771.4		N.S.
	TOTAL	2010.8	2274.5	2395.7	6681.0	---		
	MEAN	670.3	758.2	798.6	---	---		

Table - 6

Photosynthesis and stomatal conductance at different seasons

Treatments	Net Photosynthesis (μ mol m^{-2} S^{-1})						Stomatal Conductance (μ mol m^{-2} S^{-1})					
	A	J	A	O	D	F	A	J	A	O	D	F
T1	7.438	6.46	6.955	7.822	6.888	8.009	0.1356	0.0735	0.1014	0.1708	0.1365	0.1183
T2	7.320	8.81	8.402	8.902	7.903	9.895	0.1673	0.0964	0.1599	0.1786	0.1402	0.1361
T3	7.691	8.78	9.664	9.772	9.110	9.354	0.1499	0.1055	0.1637	0.1571	0.1374	0.1163
T4	8.279	7.77	9.310	8.642	10.717	8.610	0.1669	0.0879	0.1661	0.1373	0.2085	0.1336
T5	7.898	8.33	9.589	9.074	7.600	8.529	0.1427	0.0935	0.1547	0.1201	0.1162	0.1056
T6	10.288	10.29	12.202	11.598	12.300	10.956	0.1763	0.1202	0.1951	0.2004	0.2139	0.1521
T7	7.342	7.725	9.981	9.062	10.225	9.242	0.1381	0.0994	0.1581	0.1479	0.1474	0.1128
T8	8.073	8.439	10.717	9.390	7.829	9.429	0.1622	0.0930	0.1782	0.1684	0.1531	0.1279
T9	8.343	8.175	11.371	10.405	10.633	10.817	0.1438	0.0889	0.1902	0.1763	0.1775	0.1455

T1 -- Control
T2 -- FYM
T3 -- FYM + Urea + RP + MOP
T4 -- NPK :: 120:45:80 (Urea + MOP)
T5 -- NPK :: 120:45:80 (AMM.SULP. + RP + MOP)
T6 -- NPK :: 120:45:80 (CAN + RP + MOP)

T7 -- 90:22.5:40 / 30:22.5:40 } - NPK, 2 SPLITS (UREA + RP + MOP)
T8 -- 90:22.5:40 / 30:22.5:40 } - NPK, 2 SPLITS (A.S. + RP + MOP)
T9 -- 90:22.5:40 / 30:22.5:40 } - NPK, 2 SPLITS (CAN +RP + MOP)

Table - 7

Intercellular Co_2 conc and Stomatal Resistance at Different Seasons

Treatments	Intercellular Co_2 Conc (ppm)						Stomatal Resistance (S cm^{-1})					
	A	B	C	D	E	F	A	B	C	D	E	F
T1	272.9	194.0	250.3	251.9	261.6	213.3	2.622	5.400	3.068	1.948	2.517	3.038
T2	277.3	183.3	272.6	279.9	258.2	206.4	2.096	3.602	2.192	2.010	2.645	2.637
T3	243.5	191.8	205.0	217.4	207.9	188.4	2.357	3.305	2.509	2.400	2.964	3.209
T4	242.2	186.6	220.0	222.3	240.9	229.5	2.127	4.178	2.264	2.299	1.665	2.711
T5	242.1	182.2	199.0	189.9	224.9	197.9	2.460	3.75	2.327	2.991	3.105	3.514
T6	284.3	193.2	206.3	230.7	237.7	221.4	2.323	3.802	2.112	1.844	1.922	2.372
T7	245.1	180.8	206.4	218.7	208.4	187.2	2.366	4.537	2.303	2.374	2.210	3.274
T8	269.9	186.8	197.8	237.5	247.9	204.0	2.033	3.743	2.189	2.998	2.164	2.786
T9	242.0	183.2	200.8	213.2	233.9	199.6	2.929	4.061	2.125	2.306	1.926	2.468

For treatment details see Table - 6

Table - 8

Transpiration and Girth in Different Seasons

Treatments	Transpiration (μ mol m^{-2} S^{-1})						Girth (cm)					
	A	B	C	D	E	F	A	B	C	D	E	F
T1	3.6	2.7	4.2	4.1	1.9	2.2	3.8	3.9	4.0	4.2	4.4	4.5
T2	5.1	3.3	5.2	4.8	2.4	2.7	4.1	4.2	4.2	4.4	4.7	4.8
T3	4.8	4.0	5.8	4.5	2.6	2.3	3.9	3.9	4.1	4.4	4.7	4.8
T4	4.2	2.6	5.6	4.4	3.4	2.5	4.1	4.1	4.3	4.3	4.6	4.8
T5	4.7	3.0	5.8	4.0	2.1	2.1	4.2	4.3	4.4	4.5	4.6	4.8
T6	4.2	3.3	6.1	5.5	2.9	2.8	4.2	4.3	4.6	4.7	4.9	5.0
T7	4.9	3.8	6.0	4.7	3.2	2.3	3.9	4.1	4.2	4.5	4.7	4.8
T8	4.3	3.2	5.9	3.7	2.7	2.6	4.2	4.3	4.4	4.6	4.8	4.9
T9	4.7	3.0	6.3	4.7	2.9	3.0	4.2	4.3	4.5	4.6	4.9	4.9

For treatment details see Table - 6

Table - 9

Monthly Variation in Chlorophyll Content
(mg. ch/g fresh weight green leaf)

Month	TREATMENTS								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Apr.	1.203	1.754	1.522	1.986	1.681	2.348	1.666	2.145	2.318
May	1.275	1.449	1.681	1.493	1.507	1.928	1.449	1.609	1.783
June	1.913	2.449	2.507	2.420	2.217	2.536	2.377	1.986	2.754
July	1.783	2.928	2.739	2.362	2.551	3.232	2.812	2.739	2.913
Aug.	2.014	2.855	2.536	2.464	2.522	3.087	2.710	2.521	3.029
Sep.	2.246	2.783	2.319	2.565	2.493	2.928	2.594	2.290	3.145
Oct.	2.246	2.739	2.565	2.232	2.464	2.971	2.869	2.507	3.014
Nov.	1.986	3.043	2.420	2.725	2.841	3.145	2.870	2.841	3.217
Dec.	2.362	2.898	2.443	2.377	2.493	2.913	2.754	2.696	2.855
Jan.	1.304	1.725	1.478	2.159	1.826	2.420	1.609	2.116	2.390
Feb.	1.101	1.783	1.551	1.826	1.536	2.217	1.710	2.174	2.362
Mar.	2.391	2.754	2.811	2.579	3.072	3.203	2.855	3.028	3.232

For treatment details see Table - 6

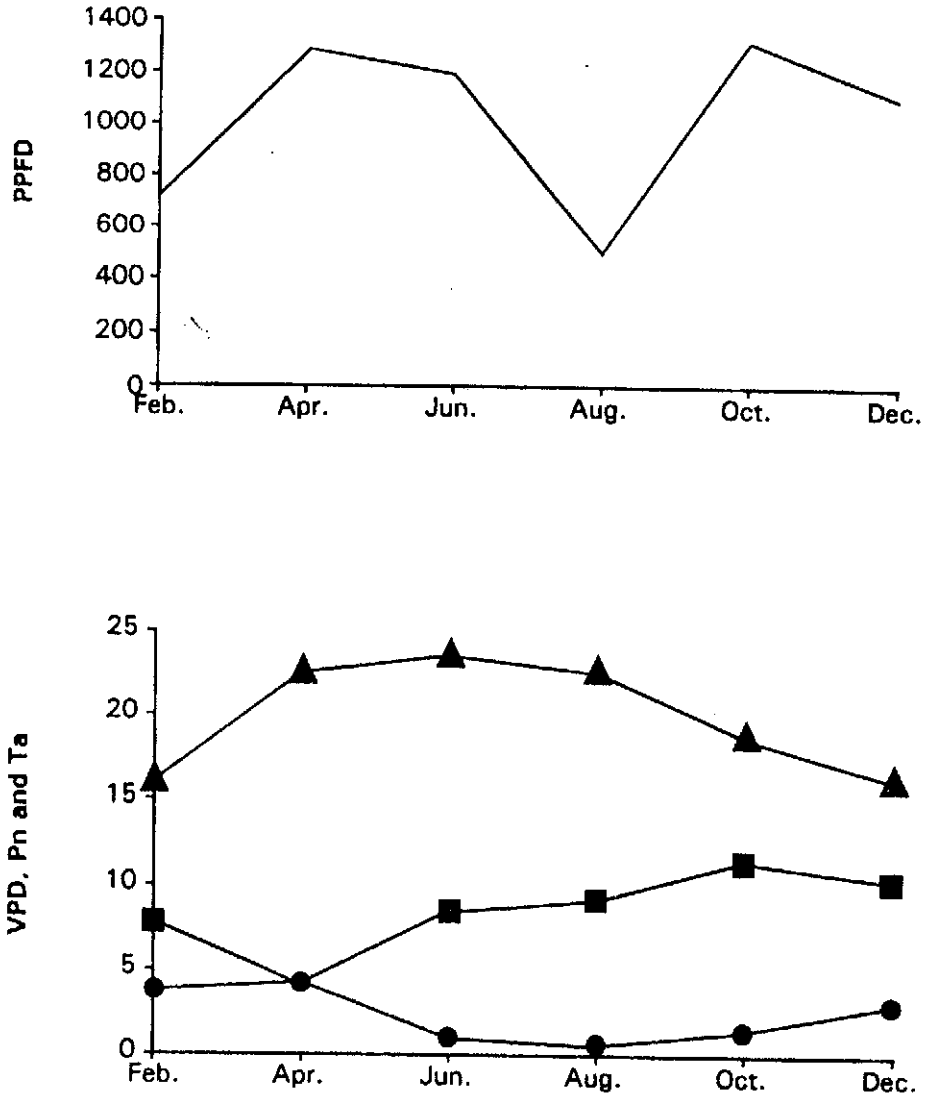

Fig. 1. The relationships between vapour pressure deficit (VPD, kPa, ●), photosynthetic photon flux density (PPFD, μ mol $m^{-2}s^{-1}$ -- (7200 observation), ambient temperature (Ta,°C-▲) and net photosynthesis (Pn, μmol m^{-2} s^{-1}-■ (7200 observations) of the tea cultivar Takdah 78 during 1996 and 1997 at Darjeeling.

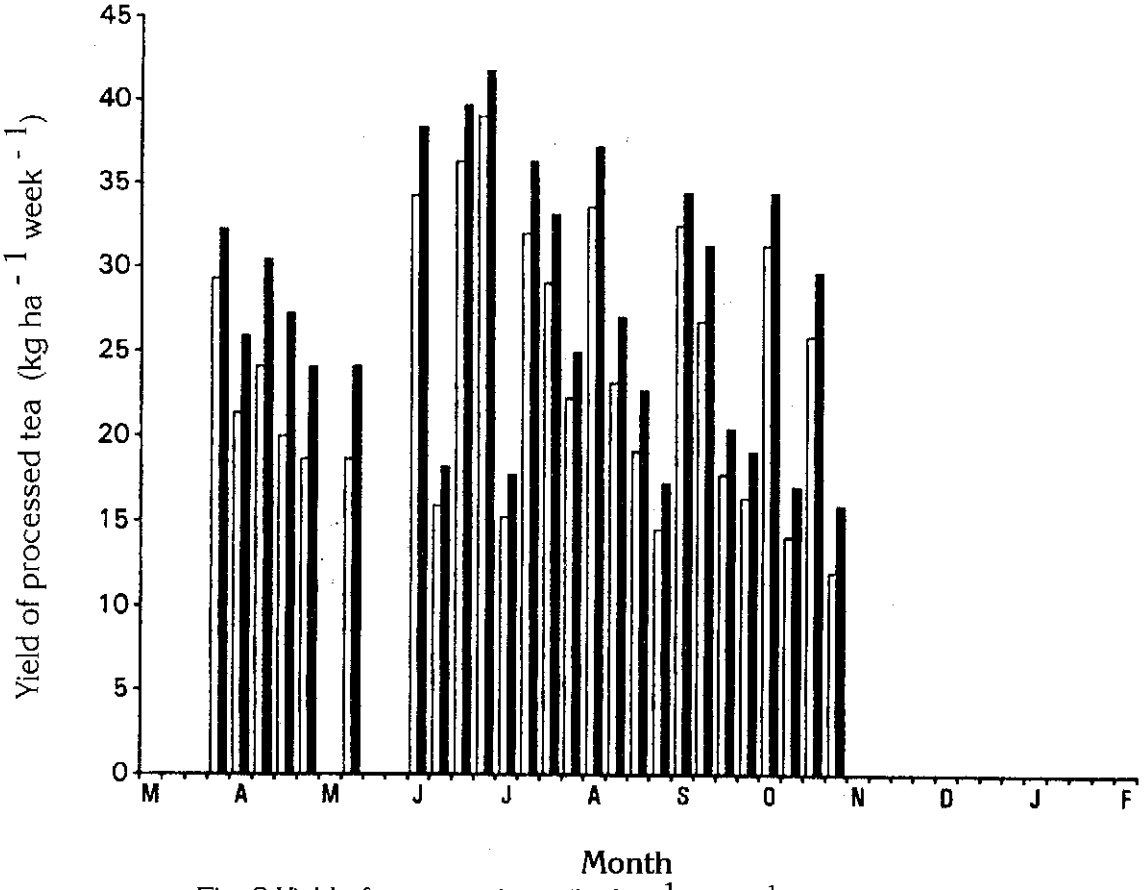

Fig. 2 Yield of processed tea (kg ha $^{-1}$ week $^{-1}$) during 1996 (□) and 1997 (■). No. harvest from November to February.

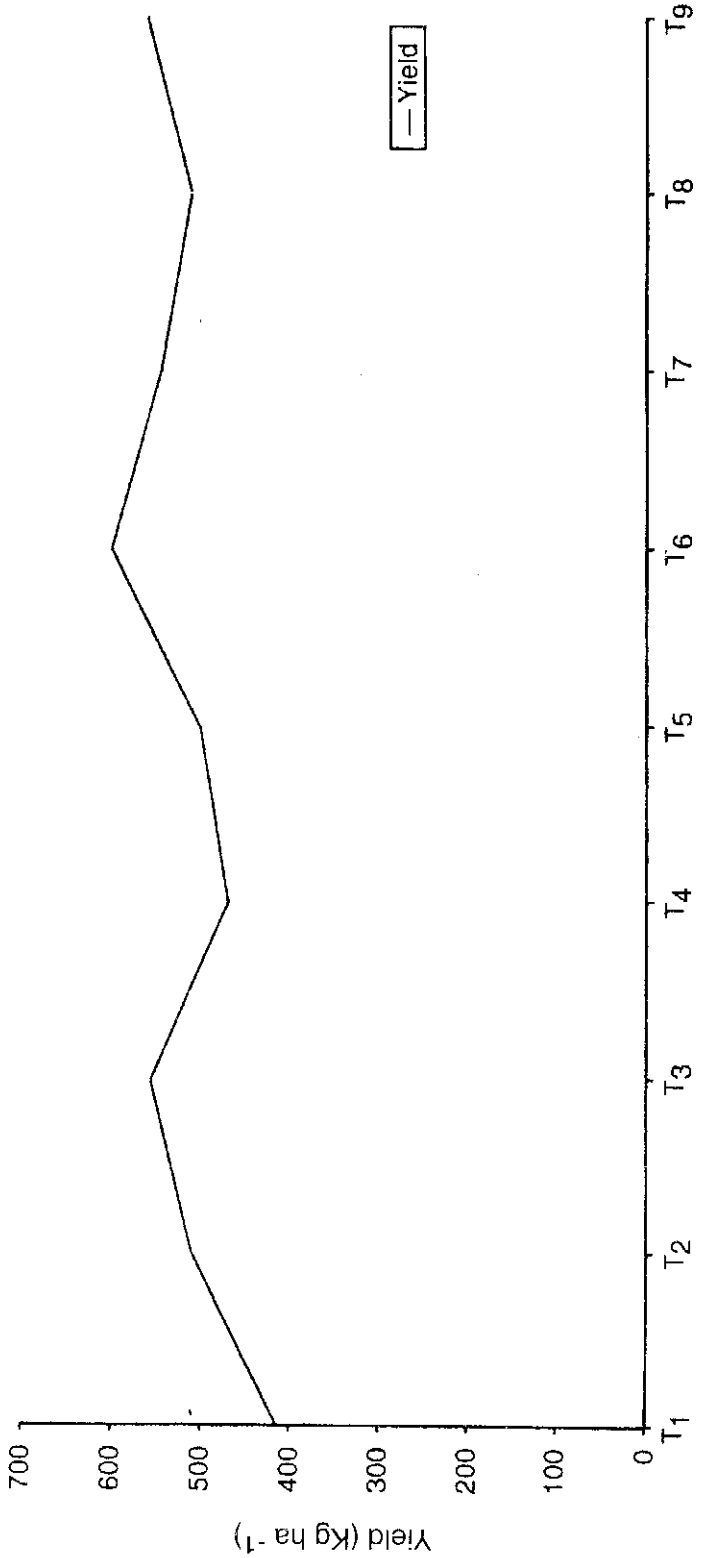

Fig. 3 Effect of different treatments on the yield of made tea.

Net photosynthesis, stomatal conductance, stomatal resistance, intercellular CO_2 Conc., Transpiration and W.U.E. etc. were measured by portable photosynthesis system (LI - 6200) in the months of April '97, June, August, October, December & February '98) Table - 6 to 8) The chlorophyll content at different seasons have also been estimated (Table-9) Higher yield recorded in treatment no T6 (Fig. - 3)

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 fertilizer schedule of individual garden and also advise offered to undertake corrective measures, if any. During the year under report 1159 soil samples have been tested. In all 5519 estimations have been carried out for various parameters as follows.

Sl. No.	Parameters	No. of samples analysed
1.	pH	1159
2.	Organic Carbon	1159
3.	Mineralisable Nitrogen	653
4.	Available Phosphate	1159
5.	Available Potash	1159
6.	Available Sulphur	230
	Total Estimations:	**5519**

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

Darjeeling Gardens - Ambootia, Makaibari, Dilaram, Seeyoke, Thurbo, Singell, North Tukvar, Kalej Valley, Gielle, Sungma, Selim Hill, Saicon (Consultants), Mungpoo Cinchona Plantations, Giddapahar.

Dooars and Terai Gardens - Dalgaon, Rahimpur, Ranicherra, Atal, Hope, Dhowlajhora, Patkapara, Samsing, Toonbarie, Dagapur, Kohinoor, Motidhar, S. S. Roy (Small Grower)

Assam Gardens - Rydak and Doomni

2.2. Research Projects

2.2.1. Efficacy of split and basal applications of organic and inorganic fertilisers in the optimisation of yield and quality of mature Darjeeling Tea (DTRC/S/8)

A field experiment was initiated during 1993 to ascertain the efficacy of split and basal applications of inorganic and organic (only basal) fertilisers on the yield and quality of Darjeeling Tea. Soil samples were collected before and 15 days after application of fertiliser to ascertain the physico-chemical properties. 5 years made tea yield data alongwith tasters' report on quality is being preented below in Tables 10 and 11 and Fig.4

From Table-1 it is evident that the single basal dose of treatment No. T6 i.e., CAN:DAP:MOP @ 120:45:80 NPK Kg/ha gave the highest made tea yield during all the 5 years of trial. This was followed by treatment no. T4 i.e. Urea:DAP:MOP @ 120:45:80 NPK Kg/ha in a single basal dose during April/May.

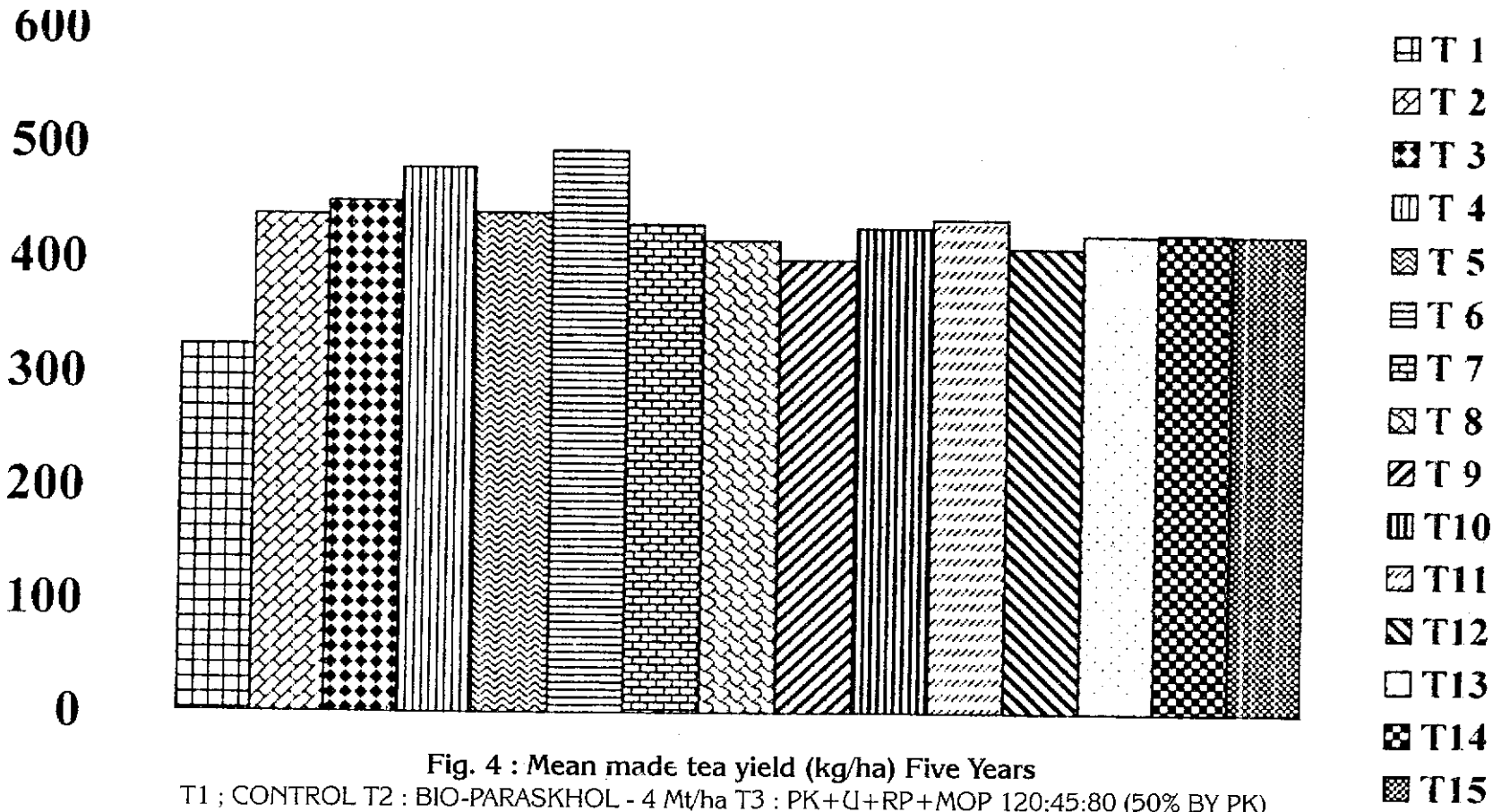

Fig. 4 : Mean made tea yield (kg/ha) Five Years

T1 ; CONTROL T2 : BIO-PARASKHOL - 4 Mt/ha T3 : PK+U+RP+MOP 120;45:80 (50% BY PK)
T4 : U+DAP+ MOP 120:45:80 T5 : AS+DAP+MOP 120:45:80 T6 : CAN+DAP+MOP 120;45:80
T7 : U+DAP+MOP 90;22.5:40 & 30:22.5:40 T8 : AS+DAP+MOP 90:22.5:40 & 30:22.5:40
T9 : CAN+DAP+MOP 90:22.5:40 & 30:22.5:40 & 30:22.5:40 T10 : U+RP+MOP 120:45:80
TII : AS+RP+MOP 120:45:80 T12 : CAN+RP+MOP 120:45:80
T13 : U+RP+MOP90:22.5:40 & 30:22.5:40 T14 : AS+RP+MOP 90:22.5:40 & 30:22.5:40
T15 : CAN+RP+MOP 90:22.5:40 & 30:22.5:40 CD AT 5% : 41.29

Table - 10 : Made Tea Production (Year-wise)

Treatment	Name of Fertilizers	Dose NPK Kg/ha.	Time of application	MADE TEA PRODUCTION (YEAR-WISE) 1993 Kg/ha	1994 Kg/ha	1995 Kg/ha	* 1996 Kg/ha	1997 Kg/ha	** Mean Made tea yield Kg/ha	Organo-leptic Evaluation
T1	CONTROL	--	--	226.1	295.1	472.6	287.6	333.0	323.1	6.5
T2	BIO-PARASKHOL	4MT/HA	MAY-JUNE	359.4	471.0	565.0	361.6	431.6	437.2	6.0
T3	PARASKHOL + UREA + RP + MOP	120:45:80 50% by Paraskhol	"	380.5	470.3	609.6	375.3	410.3	449.0	6.0
T4	UREA + DAP + MOP	120:45:80	"	391.6	485.9	659.3	416.0	440.6	478.5	6.0
T5	AMMO.SULPH + DAP + MOP	120:45:80	"	337.9	451.8	587.3	407.3	414.3	439.5	5.5
T6	CAN + DAP + SAP + MOP	90:22.5:20 AND 30:22.5:40	"	348.9	411.3	562.8	378.3	383.0	416.6	6.0
T9	CAN + DAP + MOP	90:22.5:40 AND 30:22.5:40	"	326.3	419.2	536.3	343.6	376.0	399.6	6.0
T10	UREA + RP + MOP	120:45:80	MAY-JUNE	351.5	464.8	573.0	358.3	389.6	417.3	6.0
T11	AMMO.SULPH + RP + MOP	120:45:80	"	346.4	443.5	585.6	414.3	386.3	435.1	6.5
T12	CAN + RP + MOP	120:45.80	"	330.5	426.4	547.3	364.6	384.3	410.5	6.0
T13	UREA + RP + MOP	90:22.5:40 AND 30:22.5:40	MAY-JUNE AND AUG-SEPT.	322.7	440.3	538.3	390.0	419.6	422.1	6.0
T14	AMMO.SULPH + RP + MOP	90:22.5:40 AND 30:22.5:40	"	328.3	428.1	582.6	386.3	394.0	423.7	6.0
T15	CAN +RP + MOP	90:22.5:40 AND 30:22.5:40	"	335.9	424.3	600.0	392.6	429.6	422.9	5.5
	C.D. at 5%			54.14	64.03	83.53	55.43	48.85	41.29	

* - L.P. Year.
** - Average of 5 years.

Table - 11 : Made Tea Production

Treatment	Name of Fertilizers	Dose NPK Kg/ha.	Time of application	MADE TEA PRODUCTION (YEAR-WISE) 1993 Kg/ha	1994 Kg/ha	1995 Kg/ha	1996 * Kg/ha	1997 Kg/ha	Mean Made tea yield ** Kg/ha	Organo -leptic Evaluation
T1	CONTROL	--	--	226.1	295.1	472.6	287.6	285.3	313.33	7.0
T2	UREA + ROCK PHOSPHATE + MOP	120:45:80 Kg NPK/ha	MAY-JUNE	392.5	498.6	677.6	381.0	429.0	471.70	6.0
T3	UREA + ROCK PHOSPHATE + MOP	120:45:100 Kg NPK/ha	"	340.3	472.6	633.6	335.0	382.0	432.77	6.0
T4	UREA + ROCK PHOSPHATE + MOP	120:45:120 Kg NPK/ha	"	336.1	440.3	603.6	350.0	397.7	425.57	5.5
T5	UREA + ROCK PHOSPHATE + MOP	120:3080 Kg NPK/ha	"	326.8	438.2	582.6	360.3	401.0	421.80	6.0
T6	UREA + ROCK PHOSPHATE + MOP	120:30:100 Kg NPK/ha	"	342.9	450.9	569.6	362.0	406.3	426.36	5.5
T7	UREA + ROCK PHOSPHATE + MOP	120:30:120 Kg NPK/ha	"	329.3	432.1	548.3	372.0	422.0	420.60	6.5
T8	UREA + ROCK PHOSPHATE + MOP	120:20:80 Kg NPK/ha	"	312.0	393.5	552.6	357.6	401.2	404.71	5.5
T9	UREA + ROCK PHOSPHATE + MOP	120:20:100 Kg NPK/ha	"	329.3	414.3	574.3	363.3	413.3	418.93	6.0
T10	UREA + ROCK PHOSPHATE + MOP	120:20:120 Kg NPK/ha	"	323.4	421.4	578.0	362.6	412.7	419.6	6.0
	C.D. at 5%			49.23	56.76	89.03	N.S.	N.S.	45.6	---

* L.P. Year.

* Average of 5 years.

In an adjacent plot trial on different doses of phosphatic and potash fertilisers (Nitrogen constant) the 5 years yield data has been recorded in Table 11
From table - 11 it is evident that the treatment no. T2 viz. Urea:rock Phos:MOP @ 120:45:80 NPK Kg/ha in a single basal dose gave the highest made tea yield during all the 5 years of trial. This was followed by treatment no T3 i.e. Urea:Rock Phos:Mop @ 120:45:100 Kg NPK/ ha
As per the taster's report it is pointed out that the quality of tea is not affected by any of the above doses of fertilisers mentioned in above Table-10 and 11
Note : this trial has been wind up and split into 2 different trials presented below as 2:2:2 and 2:2:3

2.2.2. Effect of different levels of nitrogen (Basal and split) on the long term yield and fertility (DTRC/S/9)

This trial has been launched during 1998 with the following objectives.

i) To ascertain the most economic level of Nitrogen while P nad K are being kept constant in respect of the maximum return.
ii) To ascertain the split and basal applications of Nitrogen in respect of yield, quality and soil fertility. Pre-trial yield of different plots (Table No. 12) showed no significant difference in their yield.

During 1997 the pretrial yield of the plots has been recorded as presented in Table-12 to ascertain the plot variation affecting the yield, if any, at all.
Design : RBD, Replications-3, No. of plots-21, No. of plants per plot:30-40 bushes; No. of treatments-7
T1 = Control
T2 = 0:45:100 kg NPK/ha through Urea, RP and MOP
T3 = 30:45L100 kg NPK/ha through Urea, RP and MOP
T4 = 60:45:100 kg NPK/ha through Urea, RP and MOP
T5 = 60+30:45:100 kg NPK/ha through split Nitrogen
T6 = 80+40 :45:100 kg NPK/ha through split Nitrogen
T7 = 100+50:100 kg NPK/ha through split Nitrogen
Basal application during April/May (depending upon rain)
Split application during April/May and Aug/Sept (depending upon rain)

(DTRC/S/9)

Table - 12 : Mean pretreatment yield during 1997-98

Plot Nos.	Made tea yield Kg/ha
1,8,15	63.000
2,9,16	57.000
3,10,17	66.000
4,11,18	57.667
5,12,19	63.000
6,13,20	57.000
7,14,21	56.000
C.D. at 5%	NS

*yield recorded from 27th Aug to 2nd October '97

2.2.3 Effect of organic and inorganic fertilisers on long term yield and soil fertility (DTRC/S/10)

This trial has been launched in 1998-99 with the following objectives.

i) To assess the best sources of Nutrient (organic and inorganic) in respect of maximum return.

ii) To ascertain the appropriate dose of N, P and K in respect of yield, quality and soil fertility.

Design	:	RBD
Replication	:	4
No. of Plots	:	32
Plants per plot	:	30-40 bushes
No. of Treatments	:	8

Treatments :

T1	=	Control
T2	=	FYM 60::30:60 Kg/ha (60 kg N through FYM and P and K to be supplemented through RP and MOP)
T3	=	60:30:60 kg NPK/ha through Urea, RP and MOP
T4	=	90:45:90 kg NPK/ha through uear, RP and MOP
T5	=	Castor Cake + Inorganic Fert. 60:30:60 kg NPK/ha (50% N through Castor Cake + 50% through inorganic urea + RP + MOP)
T6	=	90:45:90 kg NPK/ha (50% N through Castor cake and 50% through Urea + RP + MOP)
T7	=	FYM 90:45:90 NPK/ha (50% through FYM + 50% through Urea+RP+MOP)

retrial yield data recorded during 1997 is presented in Table-13 which shows no significant difference etween the plots.

Table - 13

Mean Pretreatment yield during 1997-98

Plot Nos.	Made tea yield kg/ha
1,9,17,25	76.250
2,10,18,26	83.000
3,11,19,27	85.500
4,12,20,28	66.750
5,13,21,29	71.250
6,14,22,30	75.500
7,15,23,31	76.500
8,16,24,32	73.500
C.D. at 5%	NS

* yield recorded from 26th Aug to 2nd October '98

Bio Chemistry

3. Research Project

3.1 Studies on Biochemical composition of Clones released for Darjeeling Tea Industry - Assessment of Fermentation Period (DTRC/BIO/2)

Fermentation is the most characteristic part in the black tea processing. During this stage important properties of tea are produced. Balck tea character is developed in this stage only. Flavour and quality mainly depend on this process. Catechins (Polyphenols) are oxidised by polyphenol oxidase enzyme ultimately producing theaflavins and thearubigins which are associated with brightness, briskness and colour of liquor respectively. In plains CTC teas period of fermentation is chemically assessed by the estimation of theaflavins whose maximum production coincide with the better quality. This stage is referred to as the optimum fermentation period. This varies with the type and cultivar of tea. With the increasing cultivation of clonal material in Darjeeling hills it seems quite essential to know about the fermentation behaviour of such clones in order to produce the teas of best quality.

This experiment was started in June '97. The flush was harvested from eleven year old clonal section comprising of variety AV2, P312, TS378, T383, T78 and T135 and regularly being plucked at 7 days interval. Orthodox black tea was manufactured in the miniature unit using piezy rollers. Made teas were analysed for total polyphenols, theaflavins, thearubigins and caffeine contents spectro photometerically. Organoleptic evaluation of such tea was done by J. Thomas & Co. , Calcutta. Clone AV2 which was fermented for 2 hrs. 15mts. ranked superior to the sample fermented for 2 hrs. 30mts. Clone T135 fermented faster at 2 hrs. 5 mts. and adjudged best in quality over the same teas fermented for longer period.Similarly biclonal seed stock TS 378 could be exploited for better flavour development when fermented for 2 hrs. 10mts. Clone T78 and T383 were found quite similar in their fermenting behaviour. In these cases better flavour development was noticed at 2 hrs. 30 mts. rather than fermented at shorter periods. Clone P312 could withstand high degree of wither and heavy pressure and produced better quality at 2 hrs. 30 mts. of fermentation. All these clones were found with distinct flavour and quality of flavour varied in each case. Total polyphenolic constituent of these teas varied from 18.24 to 24 percent, theaflavins 0.62 to 0.78 percent, thearubigins 7.87 to 11.35 percent, brightness 39.42 to 43.38 percent (Table 14)

3.2 Influence of pruning cycle on chemical composition and aroma precursors of Darjeeling Teas (DTRC/BIO/7)

The prime objective of pruning is to keep the bush in vegetative phase. It is an essential agronomic practice that facilitates the harvesting of flush. It further helps the bush in maintaining its physiological activities properly. Directly or indirectly it influences the yield and quality of the tea bush.

During this period biochemical parameters like chlorophyll a Chlorophyll b total carotenes, polyphenols, theaflavins, thearubigins and caffeine were studied in pruned and unpruned

TABLE - 14 CHEMICAL COMPOSITION OF CLONES IN RELATION TO FERMENTATION

Sl. No.	Clone	Total Polyphenols	Theaflavins	Thearubigins	Caffeine	Fermentation Hours	Flavour
1.	AV2	21.68	0.62	6.29	3.58	2.15	9
		20.40	0.68	7.87	3.62	2.30	7
2.	P312	22.18	0.58	7.54	3.97	2.30	6
		21.64	0.70	8.20	3.80	2.40	5
3.	TS378	24.03	0.74	9.28	4.43	2.10	5
		23.50	0.76	10.30	4.10	2.20	4
4.	T383	24.70	0.78	9.87	4.25	2.15	4
		23.26	0.64	10.35	4.37	2.30	5
5.	T135	19.58	0.50	11.35	4.20	2.05	4
		18.24	0.48	11.88	4.08	2.15	3
6.	T78	22.45	0.62	8.40	3.89	2.15	4
		21.90	0.52	8.68	3.92	2.30	5

TABLE - 15 PIGMENT COMPOSITION OF PRUNED TEAS DURING PREMONSOON SEASON

Sl. No.	Treatment	Chl a	Chl b	T C
			μ g / g	
1.	HP - UT	509.48	306.27	80.85
2.	LP - UT	601.50	366.75	117.70
3.	DS - LOS	398.87	267.82	50.85
4.	MS - LOS	475.93	299.99	73.09
5.	LDS - LOS	466.16	289.36	72.18
6.	LOS - LP	489.04	316.55	66.54

TABLE - 16 PIGMENT COMPOSITION OF PRUNED TEAS DURING-MONSOON SEASON

Sl. No.	Treatment	Chl a	Chl b	T C
			μ g / g	
1.	HP - UT	627.6	326.2	149.6
2.	LP - UT	706.73	378.55	137.73
3.	DS - LOS	656.76	348.96	140.25
4.	MS - LOS	536.37	300.08	107.38
5.	LDS - LOS	575.10	324.64	113.03
6.	LOS - LP	502.64	284.72	97.43

teas. A distinct variation was recorded in these parameters with type of pruning. The time from pruning was also observed significant in the recovery of the level of these chemical constituents. Total polyphenols were recorded lowest in the heavy pruned teas. Similarly level of theaflavins and thearubigins declined in the corresponding made tea. Chlorophyll a was found lowest in deep skiff - level of skiff and was closely followed by LDS-LOS. However, highest amounts of Chlorophyll a in harvested shoot was recorded for LP-UT pruned sections.Similarly lowest amount of chlorophyll b was synthesised in DS-LOS pruned sections while it was found highest in LP-UT pruned sections. The similar pattern was observed for total carotenes. During the monsoon level of these constituents was registered higher but a different pattern was found for total carotenes being lowest in LOS-LP pruned sections and highest in HP-UT sections. Other pigments like chlorophyll a and chlorophyll b were also recorded highest in LP-UT pruned sections. (Tables 15 & 16)

3.3. Degradation of Polyphenols during manufacture (DTRC/Bio/8)

A study of variables that affected withering process revealed that behaviour of moisture loss during withering played a key role in the development of flavour. Therefore, moisture content of these teas were determined by oven method at regular intervals throughout the withering period. With the help of this data moisture curve was developed at different occasions. It was observed that a definite pattern of moisture loss was a characteristic of ideal withering and also the residual moisture content of the withered teas paved the way for the production of better quality product. Moisture content of such teas declined to 40-45 percent. Total polyphenols at various stages of withering were also estimated. A slow degradation of polyphenois was founded to produce better quality teas. Total polyphenols of such teas varied from 25.10 to 23.50 percent and further declined to a level of 22 to 18 percent.

3.4 Miniature unit:

125 experimental tea samples were manufactured during the season. Eight samples of various clones were received from thurbo T. E. to get a picture/know about the set of processing conditions that would suit to these clones for better flavour development. Power failure obstructed the process at several occasions and spoiled the experimental tea samples.

Plant Protection

4. Research Projects

4.1 Effect of organic inorganic fertilizers and green manure crop on the optimization of yield as well as pest management (DTRC/10)

The data presented in Table - 17 revealed that the highest yield was obtained from treatment No. 10 (150:45:80 Kg NPK/ha) i.e. 270 Kg/ha followed by treatment No. 9 (120:45:80 Kg NPK/ha), treatment No. 5 (Neem cake 0.5 MT + 80:30:53 Kg NPK/ha). The yield recorded in treatment no. 11,4 and 2 are at par with control. The yield recorded this year is low because of L.P. prunning operation have been done. Pest population recorded at monthly interval after one month of fertilizer application highest population of pests were recorded from the plot where 150 Kg Nitrogen per hectare have been applied in the inorganic form (Urea) closely followed by 120 and 90 Kg Nitrogen/ha. However, the population of insect does not differ significantly amongs the different doses of nitrogen while lowest pest population was recorded where Neem cake @ 1 MT/ha were applied.

4.2. Residue Study Of Some Common Tea Pesticides (DTRC/PP/11)

It is evident from the present study (Table 18,19,20,21 and 22) that all insecticides applied were gradually dissipated with increment of time. No residue of Phoskill (monocrotophos) after 4 hrs. of its application was detected during dry and wet seasons. It was below the detectable limit (0.001 ppm) after 4 hrs. of application. The residue of Cythion, Fenkill, Rogor on 5th day after application in dry season were found below the MRLs established by various international Organisations and countries (Table 23). While in case of Ekalux, it was on 7th day after application. The residue of Kelthane on 7th day during wet season (0.003 ppm) was found below MRLs but it was higher (2.834ppm) in dry season. The rate of degradation of cythion in dry season varies from 58.2 to 98% while 45.6 to 79.4% of kelthane was lost under similar condition. The rate of degradation in general during dry season was slower in comparison with wet season except in kelthane where percent dissipation till 5 days after application was faster in dry season (Table- 22)

The "half life" of insecticides on tea varies greatly. Pyrethroid pesticide (Fenkill) had very similar half life in dry and wet season while the half life of organo phosphate (Cythion and Rogor) vary from 13 hrs. to 26 hrs. in dry season and 6 to 21 hrs. in wet season respectively. The half life of Quinalphos (Ekalux) in wet season was recorded high (2.73 days) while in kelthane (Dicofol) was 0.4 (10 hrs.) and 1.2 (29 hrs) drys in dry season respectively.

.3 Bio-Efficacy and Phytotoxicity of organic pesticides on Tea Pests (DTRC/PP/12)

The experiment was initiated with the following objectives-

i) To study the bio-efficacy of organic pesticides against specific pests in comparison with conventional pesticides (Nuvacron)

ii) To evaluate organic pesticides in respect of yield and pest control.

The details of experiment are as follows-

Location - DTRC Farm

Design - R.B. D.

Replication - 3

Treatments -

T1 = Control
T2 = Pestoneem @ 0.25% + Teepol 0.25%
T3 = Pestoneem @ 0.5% + Teepol 0.25%
T4 = Neemolin plus @ 0.33% + Teepol 0.25%
T5 = Neemolin plus @ 0.5% + Teepol 0.25%
T6 = Margosom @ 0.25% + Teepol 0.25%
T7 = Margosom @ 0.5% + Teepol 0.25%
T8 = Allitin @ 0.25% + Teepol 0.25%
T9 = Allitin @ 0.5% + Teepol 0.25%
T10 = Margo Econeem 0.5% + Teepol 0.25%
T11 = Nuvacron @ 0.25%

It is evident from the figure 5,6,7, and 8 that Among all the treatments T11 i.e. Nuvacron @ 0.25% concentration proved best in respect of pest control as well as yield, while among organic pesticides T9 Allitin @ 0.5% concentration found best followed by pestoneem (T3), Margosom (T7) and Margo - econeem (T10) @ 0.5% concentration on an average of two years data and so on. All the treatments proved their worthiness significantly superior over control plot. During 1997 yield recorded lowest because it was the LP year (Fig.- 8).No phytotoxic effect on the crop has been observed so far at the applied doses.

4.4 Bio-Efficacy of certain weed extracts against tea pests (DTRC/PP/13)

The experiment was initiated with following objectives-

i) To study the bio-efficacy of plant extracts against sucking pest.

ii) To find out the best substitute of chemical pesticides in relation to yield and pest control.

The details of the experiment are as follows-

Location	-	DTRC Farm
Design	-	R.B.D.
Replication	-	3
No. of treatments	-	10
Total No. of plots	-	30
Plot size	-	30 sq.m.

The data presented in Table 23 revealed that lowest population of pest recorded in Nuvacron (0.25%) treated plot and also recorded highest yield. The control of pest among different plant extracts applied at different concentration does not control effectively but showed their efficacy significantly superior over the control plot. No adverse effect on the morphology of plant has been recored, so far.

Eelworm Analysis :

122 Soil samples received from tea estates were tested for eelworm count.

TABLE - 17

EFFECT OF ORGANIC, INORGANIC FERTILISERS AND GREEN MANURE CROP ON THE YIELD AND PEST POPULATION

Treatments	Dose	Yield Kg/ha (Made Tea)	Mean population of Aphids, Jassids / quadrate 30 X 30 cm	Mean population of Thrips / 10 buds
T1	Control	134.00	13.33	15.77
T2	Crotalaria	167.70	12.27	17.17
T3	Crotalaria + 80:30:53 kg NPK/ha	234.40	17.40	18.53
T4	Neem cake @ 1 MT/ha	191.00	9.60	12.20
T5	Neem cake 0.5 MT + 80:30:53 Kg NPK/ha	238.70	16.67	16.60
T6	Vermicompost (Biogold) 1MT/ha	230.33	15.67	15.20
T7	F.Y.M.	237.30	14.60	18.20
T8	90:45:80 Kg NPK/ha	202.30	25.93	21.30
T9	120:45:80 Kg NPK/ha	254.30	26.27	22.97
T10	150:45:80 Kg NPK/ha	270.00	28.20	24.43
T11	Mushroom compost @1 MT/ha	184.00	15.20	15.87
	C.D. at 5%	63.53	5.96	6.61

* population of insect recorded at monthly interval.

TABLE - 18 : RESIDUE OF CYTHION 50% EC IN PROCESSED TEA.

Day after application	Residues in ppm (µg/gm)	
	Dry season @ 1:400	Wet season @ 1:400
0 (4 hours)	0.552	0.011
3	0.231 (58.2)	>0.001 (BDL)
5	0.017 (96.9)	>0.001 (BDL)
7	0.011 (98.0)	>0.001 (BDL)
BDL - Below detectable limit (minimum detectable limit 0.001 ppm.)		
Figure in parenthesis are % dissipation.		
Regression equation	Y = 3.84 - 0.54x	Y = 1.05 - 0.35x
T½	0.56 days	0.86 days

TABLE - 19 : RESIDUE OF FENKILL 20% EC IN PROCESSED TEA.

Day after application	Residues in ppm (µg/gm)	
	Dry season @ 1:400	Wet season @ 1:400
0 (4 hours)	0.552	3.115
3	1.074 (58.0)	1.283 (58.8)
5	0.0987 (96.66)	0.062. (98.0)
7	0.020 (99.2)	0.030 (99.1)
BDL - Below detectable limit (minimum detectable limit 0.001 ppm.)		
Figure in parenthesis are % dissipation.		
Regression equation	Y = 3.60 - 0.32x	Y = 3.64 - 0.31x
T½	0.94 days	0.97 days

TABLE - 20 : RESIDUE OF ROGOR 30% EC IN PROCESSED TEA.

Day after application	Residues in ppm (µg/gm)	
	Dry season @ 1:400	Wet season @ 1:400
0 (4 hours)	0.035	0.024
3	0.017 (51.4)	0.010 (58.4)
5	0.005 (85.7)	>0.001 (BDL)
7	0.011 (98.0)	>0.001 (BDL)
BDL - Below detectable limit (minimum detectable limit 0.001 ppm.)		
Figure in parenthesis are % dissipation.		
Regression equation	Y = 2.07 - 0.28x	Y = 4.13 - 1.25x
$T^1/_2$	1.07 days	0.24 days

TABLE - 21 : RESIDUE OF EKALUX 20% AF IN PROCESSED TEA.

Day after application	Residues in ppm (µg/gm)	
	Dry season @ 1:400	Wet season @ 1:400
0 (4 hours)	1.280	0.004
3	0.630 (50.8)	0.003 (25.0)
5	0.197. (84.6)	>0.001 (BDL)
7	>0.001 (BDL)	>0.001 (BDL)
BDL - Below detectable limit (minimum detectable limit 0.001 ppm.)		
Figure in parenthesis are % dissipation.		
Regression equation	Y = 3.59 - 0.41x	Y = 0.54 - 0.11x
$T^1/_2$	0.73 days	2.73 days

TABLE - 22 : RESIDUE OF KELTHANE 10.5% EC IN PROCESSED TEA.

Day after application	Residues in ppm (µg/gm)	
	Dry season @ 1:400	Wet season @ 1:400
0 (4 hours)	13.773	2.278
3	7.494 (45.6)	1.283 (43.7)
5	3.308 (76.0)	0.620 (72.8)
7	2.834 (79.4)	0.030 (98.7)
BDL - Below detectable limit (minimum detectable limit 0.001 ppm.)		
Figure in parenthesis are % dissipation.		
Regression equation	Y =6.59 - 0.76	Y = 3.62 - 0.25x
$T^1/_2$	0.40 days	1.20 days

TABLE - 23 : MAXIMUM RESIDUE LIMIT (MRL) OF SOME PESTICIDES COMMONLY USED IN TEA PLANTATION

Pesticides	Maximum resideu limit (ppm)								
	1	2	3	4	5	6	7	8	9
Monocrotophos	-	-	5	-	0.05	0.2	-	-	0.1
Malathion	-	-	3	-	8	0.5	1	-	0.1
Fenvalerate	-	-	-	-	-	-	2	-	0.1
Dimethoate	-	-	1	0.05	1	0.5	0.1	-	0.2
Quinalphos	-	-	0.2	-	-	-	0.2	-	0.1
Dicofol	5	45	2	5	2	2	-	5	0.1

1. Codex Alimentaries, UK
2. Environmental Protection Agency, USA
3. Germany
4. The Netherlands
5. Italy
6. Swizerland
7. People Republic of China
8. FAO/WHO
9. European Community (EC)

Table - 24 : Bio-efficacy of certain weed extracts against tea pests during 1997

Name of plant	Concentr-ation	Mean population of Jassid/quadrate (30x30 cm)				Mean population of Thrips/10 buds				
		Before spray	3 DAS	5 DAS	7 DAS	Before spray	3 DAS	5 DAS	7 DAS	Made tea yield Kg/ha*
Control	--	4.07	7.93	8.60	9.80	26.67	35.67	41.00	47.33	82.3
Artimisia Vulgaris	1.5	5.60	2.67	2.13	1.60	29.33	20.33	16.33	15.00	122.4
Artimisia Vulgaris	1.0	4.20	3.33	2.67	3.67	29.33	24.33	20.00	30.33	103.2
Eupatorium glandulosum	1.5	3.93	2.00	1.73	1.67	22.00	13.67	11.67	20.33	110.3
Eupatorium glandulosum	1.0	4.27	2.67	1.87	3.27	30.00	25.00	20.67	32.00	101.8
Urtica dioica	1.5	6.27	3.33	2.47	1.73	27.00	19.00	16.00	17.33	121.18
Urtica dioica	1.0	4.73	4.27	2.80	3.53	29.67	24.33	21.30	32.00	112.0
Polygonum runcinetum	1.5	4.07	2.73	2.20	1.47	30.67	20.33	17.30	17.67	114.6
Polygonum runcinetum	1.0	5.20	3.80	2.93	4.20	26.00	23.00	18.00	32.30	109.7
Nuvacron	0.25	4.25	0.00	0.00	0.13	33.67	1.33	0.00	2.67	148.0
C.D. at 5%	--	NS	0.82	0.95	1.07	NS	5.49	4.73	6.60	16.67

* - L.P. Year.

DAS - Day after spray

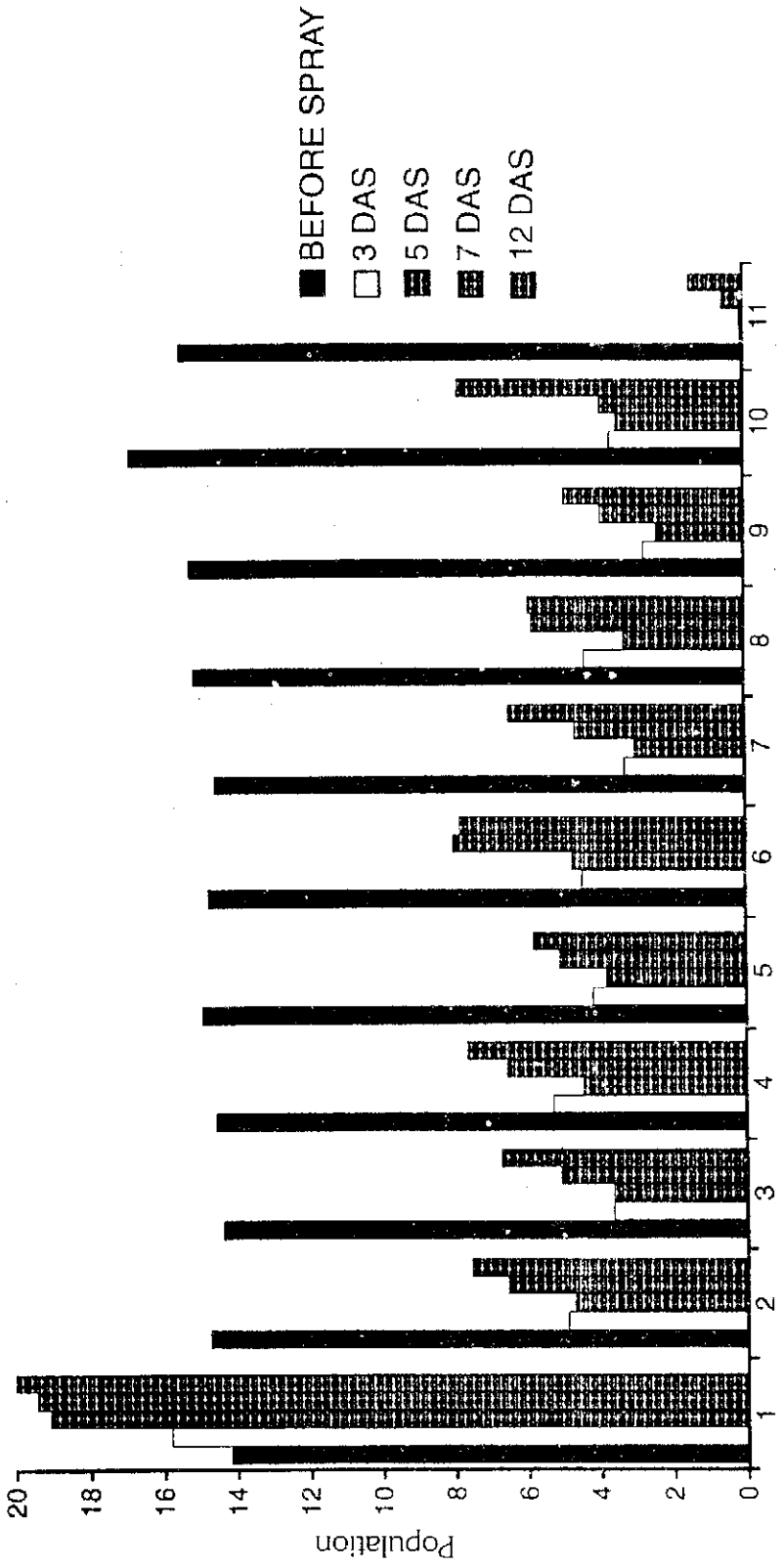

Fig. 5 # Bioefficacy of organic pesticides against Jassid.

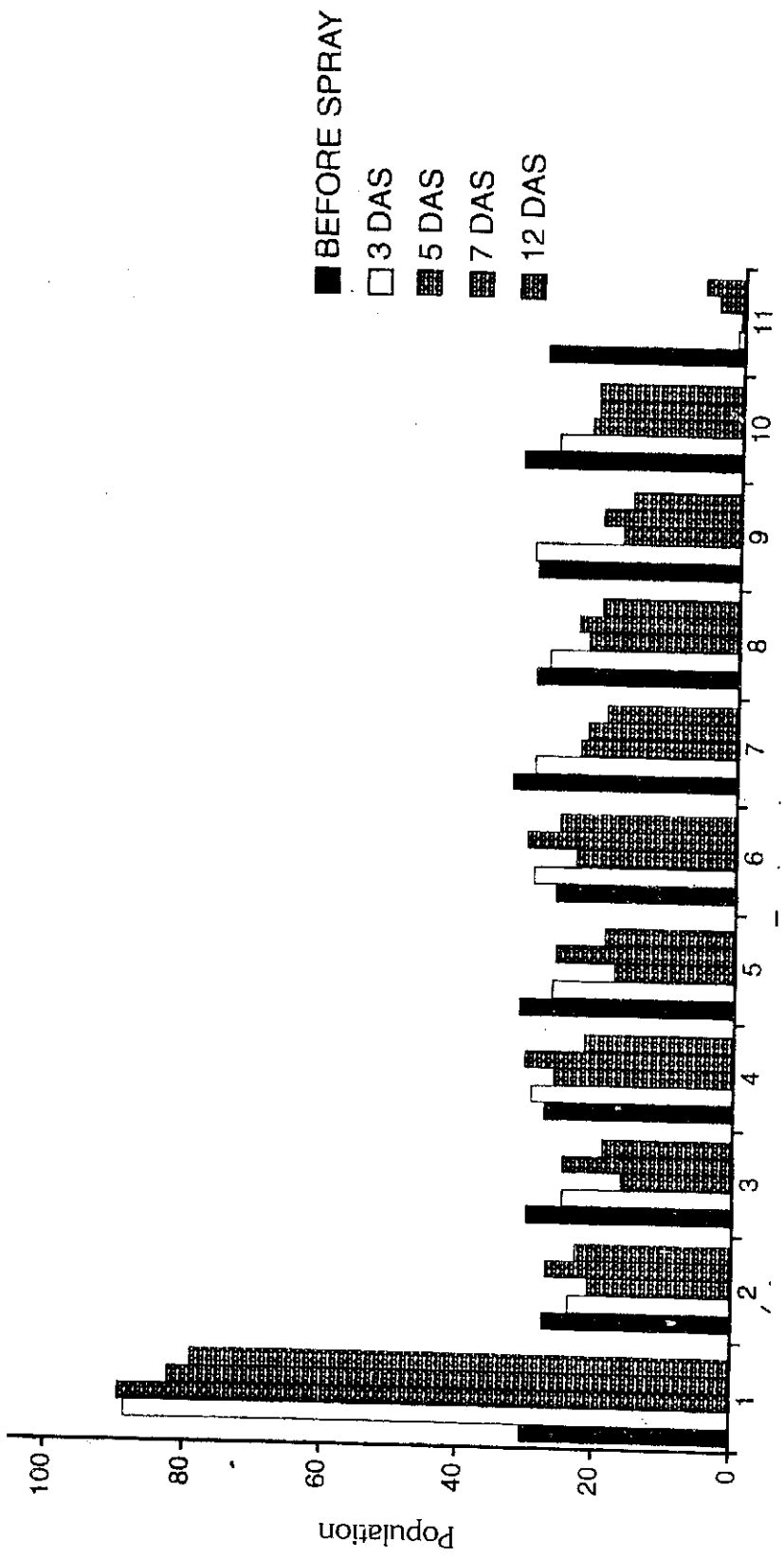

Fig. 6 # Bioefficacy of organic pesticides against Thrips.

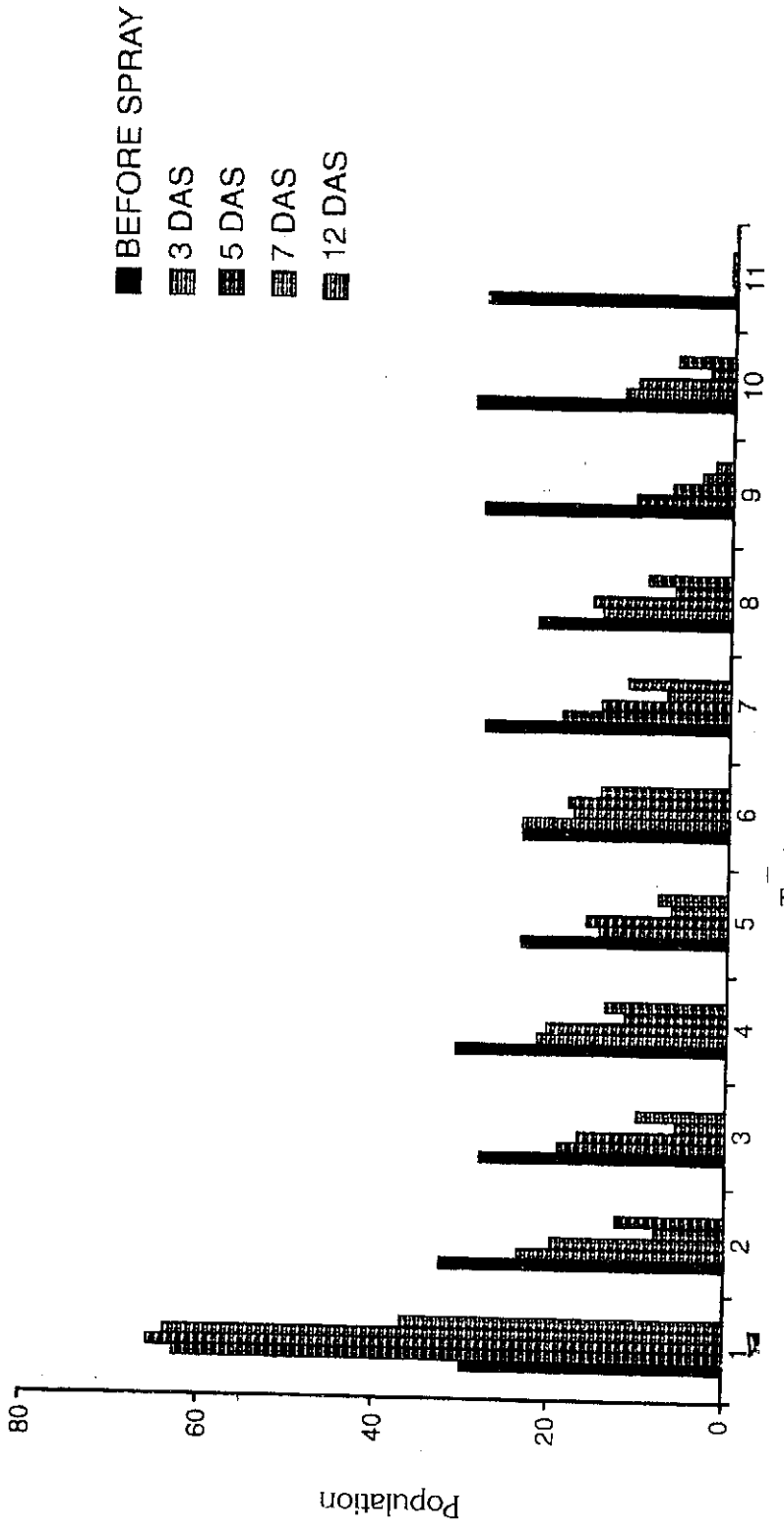

Fig. 7 # Bio-efficacy of organic pesticides against Tea Aphids.

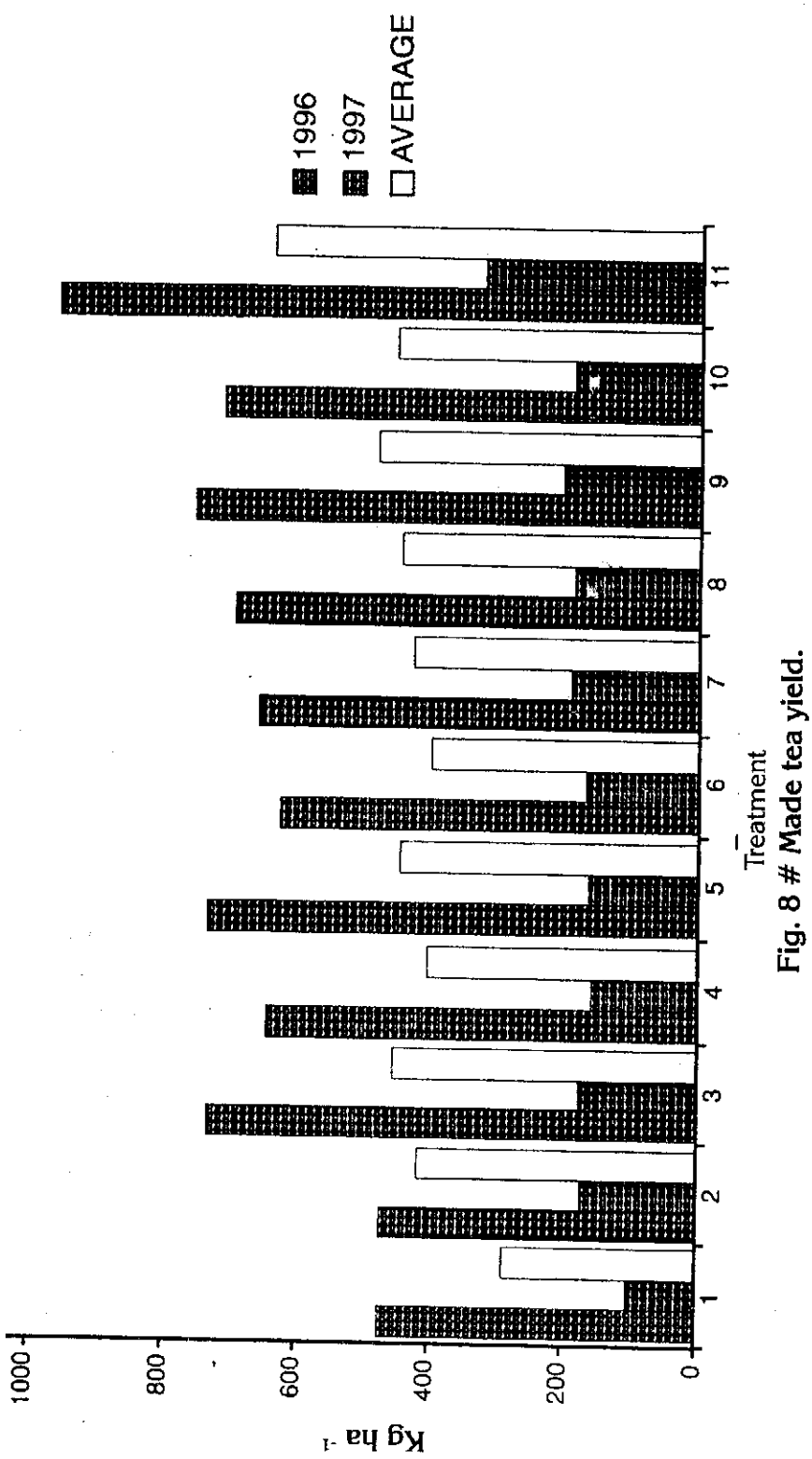

Fig. 8 # Made tea yield.

Library

During the year 17 Indian books has been acquistioned.
6 Indian journals has been received 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 certian 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/3	Phosphate fixation studies in Darjeeling tea soils.	*Ongoing*
		DTRC/S/8	Effect of organic and inorganic forms of fertilisers on long term yield and soil fertility.	*Ongoing*
		DTRC/S/9	Effect of different levels of nitrozen (Basal and split) on the long term tield 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.	
		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

N. Ghosh Hajra, M.Sc. Ph.D	*Project Manager*

Soil Science

R. Saha, M.Sc(Ag), Ph.D., P.D. Fellow	*Junior Soil Scientist*
Ms. S. Rai	*Laboratory Assistant*

Biochemistry

N. Kumar, M.Sc	*Senior Scientific Assistant*
R. Rai, B.Sc	*Junior Scientific Assistant*
T. Choudhury, B.Sc	*Laboratory Assistant*

Farm Management (Botany and Agronomy)

R. Kumar, M.Sc. (Ag)	*Junior Scientific Assistant*

Nursery and Development

P. Chhetri, M.Sc.	*Inspector (Development)*

Plant Protection

M. Singh, M.Sc. (Ag)	*Senior Scientific Assistant*
J. S. Bisen, M.Sc. (Ag)	*Junior Scientific Assistant*

The total staff of the centre is seventeen which includes 2 scientists, 7 scientific assistants and 7 administrative personnel.