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Short Communications

Abstracts of Ph.D. Thesis

Intercropping in Irrigated Cotton G. Cot. Hy. 6

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ABSTRACT

Field experiments were undertaken from 1987-88 to 1989-90 at Main Cotton Research Station, Gujarat Agricult-ural University, Surat with a view to study the compatibility of different pulse and oil seed crops as intercrops in cotton G.Cot.Hy.6 under irrigated conditions. Seed cotton yield did not get reduce due to different intercrops in two years of experimentation out of three years as well as in pooled analysis. Cotton intercropped with Soyabean (G.1), Uridbean (Zandewal) and Mungbean (G.2) gave an additional profit of Rs. 1057/-, Rs. 748/- and Rs. 708/- per hectare than cotton alone in pooled analysis, respectively.

(Received on 19th Aug. 1993)

INTRODUCTION

The initial growth of cotton is very slow so space between two crop rows remained fallow for at least 2 to 2½ months. Cotton being a long duration crop normally planted widely which provides ample scope for growing an intercrops. Now a days short duration, compact and quick growing varieties of pulses and oil seed crops are available. Saxena (1973) and Singh and Yadav (1977) have also advocated intercropping of short duration crops with wide spaced crops. Mungbean (Sucha Singh and Rajendrasingh, 1973), Uridbean (Sanandachari, *et al.* : 1980) and Groundnut (Patel, 1964), (Rao and Rao, 1961) were found suitable crops for intercropping in cotton. Generally farmers of Gujarat State grow irrigated cotton particularly hybrid varieties keeping 120 to 150 cm distance between two rows. So to make the best use of space between two rows, an experiment was conducted to explore the possibilities of growing different pulses and oil seed crops as an intercrops and also to findout the suitable variety of inter crops for intercropping in cotton G. Cot. Hy. 6 under irrigated conditions of Surat during 1987-88, 1988-89 and 1989-90.

MATERIALS AND METHODS

A field experiment consisting of nine treatments viz. G.Cot.Hyb.6 as sole crop, Cotton + Groundnut (G. 2), Cotton + Groundnut (JL-24), Cotton + Soyabean (G.1), Cotton + Soyabean (G.2), Cotton + Mungbean (K-851), Cotton + Mungbean (G.2), Cotton + Uridbean (T-9) and Cotton + Uridbean (Zandewal) was laidout Randomized Block Design with three replications from 1987-88 to 1989-90

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at Main Cotton Research Station, GAU, Surat. The soil of the experimental field was clayey with 7.6 pH, 220 kg/ha available N, 21.5 kg/ha available P_2O_5 and 778 kg/ha available K. The sowing of cotton was done on previously prepared ridges at 120 x 45 cm apart. One row of different intercrops was sown between two rows of cotton. The sowing of cotton and different intercrops was done on 15th June, 16th June and 30th June in the respective years. Cotton crops was fertilized with 320 kg N/ha in four equal splits i.e. 25% N at basal, 25% N at squaring, 25% N at flowering and 25% N at first boll bursting stages. Different intercrops were fertilized with 25 kg N and 50 kg P_2O_5/ha. as basal application.

RESULTS AND DISCUSSION

Seed cotton yield

The data presented in Table-1 reveal that differences in seed cotton yield due to different intercrops and cotton alone were found to be not significant during the year 1987-88, 1989-90 as well as in pooled analysis indicating that seed cotton yield did not get reduce by growing different intercrops. The yield obtained from cotton alone and cotton intercropped with Mungbean was also reported by Giri and Upadhyay (1979). During the year 1989-90, numerical increase in seed cotton yield by 97 kg/ha was observed when one row of Mungbean (G. 2) grown in between two rows of cotton as compared to cotton alone. Substantial increase in seed cotton yield by growing one row of Mungbean in between two rows of normally sown cotton was also reported by Kairon and Singh (1972). Non significant reduction in seed cotton yield when cotton intercropped with uridbean was also observed by Bavale and Vyahalkar (1981) at Nanded.

During the year 1988-89, differences in seed cotton yield was found to be significant. Indicating that seed cotton yield get reduced by growing different intercrops as compared to cotton alone. However, significant reduction in seed cotton yield was observed when cotton intercropped with Soyabean (G.2), Groundnut (G.2) and JL-24 and Uridbean (T-9) whereas seed cotton yield remained unaffected when cotton intercropped with Mungbean (K-851 and G.2), Soyabean (G.1) and Uridbean (Zandewal). Reduction in seed cotton yield by growing Soyabean as an intercrop was also reported by Giri and Upadhyay (1979). Verma and Kanke (1969) and Suchasingh and Rajendrasingh (1993). Rao (1982) reported that seed cotton yield get reduced when intercropped with Uridbean. This clearly indicates that not particular crop but specific genotype of crops only suitable for intercropping in cotton.

Cotton equivalent

Seed yields of different intercrops were converted in to cotton equivalent based on the prevailing prices of different crops in respective years. The perusal of data given in Table-2 indicate that the differences in cotton equivalent due to different intercrops and cotton alone were found to be non significant during all the three years as well as on pooled analysis base. This clearly indicates that whatever significant or non significant reduction in yield of seed cotton observed in individual years compensated by yield of intercrops. The pooled analysis of data further reveal that cotton intercropped with Soyabean (G.1), Uridbean (Zandewal) and Mungbean (G.2) gave numerically 141 kg, 108 kg and 100 kg/ha more seed cotton yield (cotton equivalent) than cotton alone respectively.

Economics

The data given in Table-3 indicate that differences in net monetary returns were also

TABLE I

Yearwise seed cotton yield (kg/ha) and yield of intercrop (kg/ha) as influenced by different treatments.

Sr. No.	Treatments	1987-88		1988-89		1989-90		Pooled	
		Seed cotton yield	Yield of inter-crop	Seed cotton yield	Yield of inter-crop	Seed cotton yield	Yield of inter-crop	Seed cotton yield	Yield of inter-crop
1.	G. Cot. Hy.6 as sole crop	2011	—	2065	—	1426	—	1834	—
2.	C + Groundnut (G.2)	1759	204	1784	291	1460	242	1668	246
3.	C + Groundnut (JL-24)	2037	351	1828	323	1290	280	1718	318
4.	C + Soyabean (G.1)	2003	146	1890	228	1179	613	1691	329
5.	C + Soyabean (G.2)	1881	204	1660	554	1135	642	1559	467
6.	C + Mungbean (K-851)	1955	526	2009	176	1256	224	1740	306
7.	C + Mungbean (G.2)	1893	526	1995	152	1523	158	1804	278
8.	C + Uridbean (T-9)	1980	357	1803	140	1309	392	1698	294
9.	C + Uridbean (Zandewal)	1922	292	1962	296	1297	338	1727	309
	S. Em. ±	93.11	—	77.34	—	136.6	—	60.79	—
	C. D. at 5%	N.S	—	231.8	—	N.S	—	N.S	—
	C. V. %	8.32	—	7.09	—	17.94	—	10.64	—

TABLE 2

Yearwise cotton equivalent (kg/ha) as influenced by different treatments.

Sr. No.	Treatments	1987-88	1988-89	1989-90	Pooled
1.	G. Cot. Hy.6 as sole crop	2011	2065	1426	1834
2.	C + Groundnut (G.2)	1862	1969	1558	1796
3.	C + Groundnut (JL-24)	2212	2034	1435	1894
4.	C + Soyabean (G.1)	2048	1973	1905	1975
5.	C + Soyabean (G.2)	1944	1861	1681	1828
6.	C + Mungbean (K-851)	2157	2095	1436	1896
7.	C + Mungbean (G.2)	2095	2054	1654	1934
8.	C + Uridbean (T-9)	2115	1921	1647	1894
9.	C + Uridbean (Zandewal)	2034	2212	1578	1942
	S. Em. ±	90.24	77.34	132.42	64.25
	C. D. at 5%	N.S	N.S	N.S	N.S
	C. V. %	7.61	6.63	14.42	9.42

TABLE 3

Yearwise net monetary return (Rs/ha) as influenced by different treatments.

Sr. No.	Treatments	1987-88	1988-89	1989-90	Pooled
1.	G. Cot. Hy.6 as sole crop	16719	14715	7682	13039
2.	C + Groundnut (G.2)	13686	13263	8742	11897
3.	C + Groundnut (JL-24)	18246	13978	7385	13203
4.	C + Soyabean (G.1)	16234	13399	12655	14096
5.	C + Soyabean (G.2)	14874	12171	10187	12411
6.	C + Mungbean (K-851)	17867	14741	7496	13368
7.	C + Mungbean (G.2)	17053	14294	9894	13747
8.	C + Uridbean (T-9)	17317	12835	9813	13322
9.	C + Uridbean (Zandewal)	16264	16036	9062	13787
	S. Em. ±	1170.0	850.0	1460.0	743.0
	C. D. at 5%	N.S	N.S	N.S	N.S
	C. V. %	12.33	10.57	27.38	15.55

found to be non significant during all the three years as well as in pooled analysis. However, cotton intercropped with Soyabean (G.1), Uridbean (Zandewal) and Mungbean (G.2) gave numerically Rs. 1057, Rs. 748 and Rs. 708/ha more net monetary returns than cotton alone in pooled analysis, respectively. Hence, these crops not only provided an additional net profit per unit area but over and above there are indirect advantages of taking Soyabean, Uridbean and Mungbean as an intercrops as they enrich the soil fertility by fixing the nitrogen in the soil from atmosphere, increase the availability of soil phosphorous by solubilizing fixed phosphorous in the soil as well as improve the soil physical condition. Though there was reduction in seed cotton yield but increase in additional profit by intercropping of Mungbean over sole crop of cotton was also reported by Rao (1982) at Sirsa (Haryana), Jain *et al.* (1982) also observed reduction in seed cotton yield but obtained higher net returns when cotton intercropped with Mungbean and Soyabean under Indore (M.P.) condition. Swami and Hosmani (1978) also reported higher net profit in mixed stand of cotton with Soyabean than pure crop of cotton. These results confirmed the results obtained by Suchasingh *et al.* (1973) who reported that intercropping of cotton with Mungbean in 1:1 ratio was found more advantageous than 1:2 ratio. Sanandachari *et al.* (1980) reported higher gross income when cotton intercropped with Blackgram (Uridbean). Birajdar and Nankar (1978) found Cotton + Mungbean and Cotton + Uridbean being par and were better than the sole crop of cotton under Parbhani (Maharashtra) condition. Similar results have been reported from Tamilnadu and in additional saving of 15 kg N/ha. (Sankaran and Balasubramaniam, 1982).

Based on the three years experimental results it can be concluded that for securing higher net profit, farmers growing irrigated hybrid cotton should adopt intercropping of one row of Soyabean (G. 1) or Uridbean (Zandewal) or Mungbean (G. 2).

REFERENCES

Bavale, B. L. and G. R. Vyahalkar, 1981. Studies on planting pattern, intercropping and nitrogen economy in NHH-I (Godavri), hybrid cotton under rainfed condition. *Cotton Development* **11**(1) : 1-3.

Birajdar, J. M. and J. T. Nankar, 1978. Effect of planting pattern and intercrops on the yield of seed cotton and monetary return of H-4 cotton under irrigated condition presented at National Symp. on non-monetary inputs on field crop production, held at H.A.U., Hissar on 11th and 12th Feb., 1978.

Giri, A. N. and U. C. Upadhyay, 1979. Studies on planting pattern, intercropping and economy of H-4 cotton under rainfed conditions. *Indian J. Agron.* **25**(1) : 71-76.

Jain, S. C., K. S. Yadav and V. N. Shroff, 1982. Yield and economic parameters of hybrid cotton in mixed biomass and monocurved geometrical systems. *Cotton Dev.* **12**(1/2): 17-21. Kairon, M.S. and A. Singh, 1972. Intercropping of cotton with legumes and its residual effect on wheat. *Cotton Dev.* **2**(1) : 1-5.

Patel, T. N., 1964. Mixed cropping bring rich dividends to Saurashtra farmers. *Indian Cotton Gr. Rev.* **18**(1) : 31-34.

Rao, M. H., 1982. Intercropping in cotton. *Cotton Dev.* **12**(1/2): 33-34.

Rao, V. D. and M. D. Rao, 1961. A note on the trials of groundnut cotton mixed cropping for central tract. *Indian Cott. Gr. Rev.* **15**(5) : 318-321.

Sanandachari, A., G. R. Padaki and P. Appa Rao, 1980. Intercropping rice fallows cotton with pulses. *Cotton Dev.* **10** (1/2) : 5-6.

Sankaran, S. and N. Balasubramaniam, 1982. Intercropping of cotton. *Cotton Dev.* **12**(1/2) : 23-27.

Saxena, M. C., 1973. Concept of parallel multiple cropping. Multiple Cropping Bulletin, Ind-Soc. Agron., New Delhi pp. 32-35.

Singh, C. and B. S. Yadav, 1977. Production potential of Mungbean and gaps limiting its productivity in India. Proceeding of 1st international Mungbean Symposium held between August 16-19, 1977 at the Uni. of Philippines, Los Banos pp. 28-32.

Singh, S., R. Singh and O.S. Tomar, 1973. Intercropping cotton with summer legume in Punjab. *Cotton Dev.* **2**(4) : 9-13.

Sucha Singh and Rajendra Singh, 1973. Intercropping cotton with mung and cowpea. *J. Res. (P.A.U.)* **10** (3) : 280-284.

Swami, A.S.K. and M.M. Hosmani, 1978. Intercropping in Varalaxmi cotton. *Mysore J. agril. Sci.* **12** (2) : 212-16.

Verma M. P. and M.S.S.R. Kanke, 1969. Selection of intercrops for cotton in India. *Exp. agric.* **5**(3) : 223-30.

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Effect of Sources and Levels of Nitrogen on Yield and Quality of Bidi Tobacco

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ABSTRACT

The experiment was conducted from 1985-86 to 1988-89 to evaluate the efficiency of sources (Ammonium sulphate, super granule urea and urea) and levels of nitrogen (135, 180 and 225 kg N/ha) on yield and quality of bidi tobacco under middle Gujarat soil condition at Bidi Tobacco Research Station, Anand. The results indicated that different sources of nitrogen did not affect cured leaf yield, however ammonium sulphate recorded maximum yield. The spangle score was significantly higher under ammonium sulphate. Among levels of nitrogen, 180 kg N/ha being at par with 225 kg N/ha recorded significantly higher yield than 135 kg N/ha. Neither sources nor levels of nitrogen significantly influenced the chemical composition of tobacco leaf.

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INTRODUCTION

Among different sources of nitrogenous fertilizers ammonium sulphate was found to be better but it being in short supply and its cost being relatively higher, farmers are compelled to use urea, however, its efficiency is reported to be about 8 per cent less than ammonium sulphate (Patel and Patel, 1978). Super granule urea (SGU) is a new source of nitrogenous fertilizer. The present investigation was undertaken to find out better source and optimum level of nitrogen among AS, SGU and Urea for bidi tobacco under middle Gujarat condition and thereby reduce the fertilization cost.

MATERIALS AND METHODS

The experiment was conducted at the Bidi Tobacco Research Station, Anand from 1985-86 to 1988-89. All the combinations of three sources (ammonium sulphate (AS), super granule urea (SGU) and urea (U) and three levels of nitrogen (135, 180 and 225 kg/ha) were tried in a randomised block design with four replications. The test variety was GT 5.

The nitrogen was applied (90% basal + 10% top dressing 10-12 days after planting) a week before planting.

Tobacco was transplanted at 90 cm x 60 cm spacing and cultural practices in vogue were followed. The leaf length, leaf width and spangle score were studied by selecting three plants at random from each plot. Five leaves from the middle of the selected plants were used for this purpose. Spangle and growth scores were given on the scales of 0 to 5 and 0 to 10, respectively on net plot basis. Leaf lamina samples

TABLE 1

Effect of sources and levels of nitrogen on yield and economics.

Treatment	*Cured leaf yield (kg/ha)*					*Economics on the basis of pooled date (Rs./ha)*			
	1985-86	*1986-87*	*1987-88*	*1988-89*	*Pooled*	*Gross realization*	*Treatment cost*	*Net realization*	*CBR*
Source of nitrogen (S)									
AS	2648	3289	2576	2719	2808	19796	6591	13205	1:2.00
SGU	2583	3423	2331	2582	2730	19247	5978	13269	1:2.22
Urea	2631	3420	2322	2521	2723	19197	5934	13263	1:2.24
S.Em.	81	84	82	43	39	–	–	–	–
C.D. 0.05	NS	NS	NS	187	NS	–	–	–	–
Levels of nitrogen (N)									
135 kg N/ha	2640	3461	2194	2395	2672	18838	5877	12961	1:2.21
180 kg N/ha	2695	3352	2443	2767	2819	19874	6152	13722	1:2.23
225 kg N/ha	2527	3321	2572	2659	2770	19529	6429	13100	1:2.04
S.Em.	81	84	92	43	39	–	–	–	–
C.D.0.05	NS	NS	269	127	114	–	–	–	–
C.V. %	10.8	8.6	13.2	5.8	9.8	–	–	–	–

Note : 1. Price of tobacco : 7.05 Rs./kg.

2. Price of super granule urea and urea was considered equal

3. NS : Non significant

TABLE 2

Yield attributes as influenced by sources and levels of nitrogen.

Treatment	Growth score (0-10)	Spangle mark (0-5)	Plant height (cm)	Leaf length (cm)	Leaf width (cm)
Sources of nitrogen (S)					
AS	5.7	2.6	75.0	51.6	23.9
Super granule urea	5.3	2.4	74.2	51.5	23.7
Urea	5.3	2.4	74.4	51.1	23.8
S.Em.	0.18	0.06	0.42	0.39	0.22
C.D. 0.05	NS	0.17	NS	NS	NS
Levels of nitrogen (N)					
135 kg N/ha	5.3	2.4	74.0	50.5	23.4
180 kg N/ha	5.5	2.5	74.6	51.4	23.8
225 kg N/ha	5.6	2.5	75.0	52.4	24.2
S.Em.	0.18	0.06	0.42	0.39	0.22
C.D.0.05	NS	NS	NS	1.10	0.63
C.V. %	12.0	17.2	3.9	5.3	6.5

NS : Non significant

TABLE 3

Chemical constituents on pooled basis.

Treatment	Per cent oven dry basis			
	Nitrogen	Nicotine	Reducing sugars	Chloride
Sources of nitrogen (S)				
Ammonium sulphate	3.10	7.06	3.26	2.40
Super granule urea	3.09	6.78	3.56	2.26
Urea	3.09	6.85	3.47	2.36
S.Em.	0.04	0.09	0.10	0.08
C.D. 0.05	NS	NS	NS	NS
Levels of nitrogen (N)				
135 kg N/ha	3.03	7.00	3.47	2.32
180 kg N/ha	3.10	6.85	3.44	2.33
225 kg N/ha	3.16	6.84	3.38	2.36
S.Em.	0.06	0.89	0.10	0.07
C.D. 0.05	NS	NS	NS	NS
C.V. %	7.70	8.00	10.80	16.3

were analysed for total nitrogen, nicotine, reducing sugars and chloride contents.

RESULTS AND DISCUSSION

Results of the trial conducted in the year 1988-89 indicated (Table 1) that ammonium sulphate gave significantly higher yield and spangle score than other sources, while during remaining years sources of nitrogen did not significantly influence cured leaf yield. The pooled results also did not show significant differences among sources of nitrogen for cured leaf yield, however, ammonium sulphate recorded maximum yield. The spangle score was significantly higher under ammonium sulphate than super granule urea and urea. Similar results for the cured leaf yield of VFC tobacco were reported by Sree Ramamurty and Gopalachari (1985).

Among levels of nitrogen 180 and 225 kg N/ha while being at par, gave significantly higher yield over 135 kg N/ha in 1988-89. In the year 1987-88 application of 225 kg N/ha proved significantly superior to 135 kg N/ha, but it was at par with 180 kg N/ha in respect of yield. The pooled results indicated that the differences in cured leaf yield and yield attributes except for growth score, spangle score and plant height were significant due to different levels of nitrogen, wherein 180 kg N/ha being at par with 225 kg N/ha, recorded significantly higher cured leaf yield than 135 kg N/ha. The increase in yield could be attributed to increased leaf dimensions (Table-2).

Neither sources nor levels of nitrogen significantly influenced the chemical composition of tobacco leaf (Table-3).

The comparison of economics of different treatments (Table-1) indicated that there was not much difference in net realizations due to sources of nitrogen. Among levels of nitrogen 180 kg N/ha gave maximum net realization of Rs. 13722/ ha and CBR of 1:2.23. Therefore, bidi tobacco under middle Gujarat soil conditions is to be fertilized with ammonium sulphate or super granule urea at 180 kg N/ha to realize maximum economic advantage.

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REFERENCES

Patel, G. J. and A. S. Patel 1978. Fractional application of urea in bidi tobacco. *Tob. Res.* **4**(2) : 31-34.

Sreeramamurty, C. H. and N. C. Gopalachari. 1985. Influence of sources of nitrogen on the yield, protein and non-protein nitrogen status of flue-cured tobacco at different stages of plant growth. *Tob. Res.* **11**(1) : 39-45.

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Effect of Extra Early Variety of Pigeonpea (Prabhat) Grown Singly and Intercropped with Short Duration Grain and Fodder Legumes on the Fertilizer N Requirement of a *Rabi* Cereal (Wheat)

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ABSTRACT

An experiment was conducted at Indian Agricultural Research Institute, New Delhi during 1977-78 and 1978-79 to study the performance of pigeonpea grown as sole and intercropped with other short duration *kharif* legumes and their residual effect on the succeeding wheat crop. The results revealed that growing of pigeonpea in solid stand or intercropped with other legumes in rotation with wheat was profitable than cereal-cereal crop rotation. Although yield of pigeonpea tends to get lowered by growing intercrops, the total production from the intercropping systems was higher than a pure stand of pigeonpea. Groundnut, cowpea (fodder), blackgram and greengram appear to be compatible intercrops with pigeonpea. Moreover, there was a distinct residual effect of pigeonpea grown as pure crop or intercropped with other short duration legumes on the following wheat crop in nitrogen economy. A saving in fertilizer nitrogen to the tune of 60 kg N ha^{-1} was recorded with legumes like cowpea (fodder) and groundnut as intercrops with pigeonpea.

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INTRODUCTION

Grain legumes are the chief source of proteins in vegetarian diet in our country. The development of short duration varieties of pigeonpea have fitted very well in rotation with wheat. Besides, being dwarf, it is possible to grow short duration pulses as intercrops with these varieties. Intercropping of other legumes with pigeonpea is relatively a new development (Saxena and Yadav, 1975). The most significant property of legumes lies in their unique ability to enrich the soil through fixation of atmospheric nitrogen.

With the advent of high yielding varieties of wheat, the cropping intensity under irrigated conditions has increased tremendously. Such an intensive agriculture demands maintainance of high soil fertility by adopting proper crop rotation with legumes and judicious use of fertilizers, especially nitrogen. Thus, information on quantity of nitrogen left behind by legumes in pigeonpea-wheat crop rotation would be useful to economise the use of nitrogen from the normal recommended fertilizer schedule for wheat crop.

MATERIALS AND METHODS

An experiment was conducted at the Indian Agricultural Research Institute, New Delhi during 1977-78 and 1978-79 to study the performance of pigeonpea grown singly or intercropped with

other short duration *kharif* legumes and to assess the residual effect of different cropping systems on succeeding wheat crop in terms of nitrogen economy. In *kharif*, eight cropping systems consisting of pigeonpea alone and intercropped with greengram, blackgram, cowpea (grain), cowpea (fodder), groundnut and soybean with sole crop of sorghum fodder were arranged in a randomised block design with three replications. In winter, wheat crop was superimposed on these eight cropping systems as main plots and three levels of nitrogen (0, 60, 120 kg N ha^{-1}) applied to wheat was taken as sub plots in split plot design with three replications. Before sowing *kharif* crops, diammonium phosphate (18-46-0) was applied @ 100 kg ha^{-1}. To the succeeding wheat crop, phosphorus @ 40 kg $P_2 0_5 ha^{-1}$ as single super phosphate was applied. The soil was sandy loam in texture and was well drained. The soil was low in organic carbon (0.27-0.32%) and available phosphorus (7.6 - 7.8 kg P_2O_5 ha^{-1}) but medium in available potash (160.3-160.4 kg $K_2 0$ ha^{-1}) with PH 8.0. The *kharif* crops were sown in the month of June and were harvested on attainment of maturity. The following wheat crop was sown in the month of November and was harvested in April during both the years.

RESULTS AND DISCUSSION

The results presented in Table 1 indicated that pigeonpea intercropped with other legumes recorded higher values of pigeonpea equivalent yield ranging from 13.0 to 24.1 q/ha as compared to solid stand of pigeonpea. Sorghum fodder recorded the lowest value. Thus inclusion of various grain and fodder legumes with pigeonpea increased the productivity in *kharif* season due to better utilization of land and sunlight. The results are in agreement with Reddy *et al.* (1977), Saraf *et al.* (1978) and Singh *et al.* (1979).

Effect on succeeding wheat crop

Pigeonpea grown as a pure crop or intercropped with different legumes proved superior to sorghum (fodder) as a preceding crop to wheat The grain yield of wheat after legumes was 7 to 94 per cent higher in comparison to wheat grown after sorghum fodder. Among the intercrops growth with pigeonpea, cowpea (fodder) and groundnut showed distinct superiority over other treatments, especially when wheat crop was grown without nitrogen or received low dose of 60 kg N ha^{-1}. The beneficial effect of these two legumes on the following wheat crop reflected very much in the response of wheat crop to nitrogen. Thus, the yield of wheat following these two intercrops with pigeonpea (cowpea, fodder and groundnut) with 60 kg N ha^{-1} was as good as yield recorded at 120 kg N ha^{-1}. In the other treatments, significant response to nitrogen was obtained with the increasing levels of nitrogen ranging from 0 to 120 kg N ha^{-1}. Sorghum (fodder) as a preceding crop to wheat had a significant depressing effect when compared with any legume crop or pure crop of pigeonpea. Among the legume intercrops, pigeonpea intercropped with soybean proved inferior. This is in accordance with Brar *et al.* (1976, Singh *et al.* (1977), Lal *et al.* (1978) and Giri and De (1979).

Economics of crop rotation

The highest net returns of Rs. 9392 ha^{-1} was obtained with pigeonpea + groundnut - wheat rotation, followed by wheat grown after pigeonpea + blackgram, pigeonpea + cowpea (fodder), pigeonpea + greengram, pigeonpea + cowpea (grain), sole crop of pigeonpea and pigeonpea + soybean. The lowest value of Rs. 4980 ha^{-1} was recorded with sorghum (fodder) - wheat rotation. Thus, all the intercropping systems with pigeonpea except pigeonpea + soybean found economically

TABLE 1

Effect of intercrops on grain yield of pigeonpea, their residual effect on yield of succeeding wheat under different levels of nitrogen and economics of crop rotation.

Treatment	Pigeonpea equivalent in terms of grain (q ha^{-1})		Grain yield of wheat (q ha^{-1}) Nitrogen levels (kg ha^{-1})						Net returns of whole rotation (pooled)
			1977-78			1978-79			
	1977-78	1978-79	0	60	120	0	60	120	(Rs/ha)
Pigeonpea alone (Prabhat)	19.7	13.1	31.4	39.3	47.0	26.4	37.4	41.4	7758
Pigeonpea + greengram	24.1	14.4	33.2	41.0	46.1	28.6	39.0	42.8	8647
Pigeonpea + black gram	23.2	13.6	34.2	44.8	49.6	30.01	40.5	44.0	8843
Pigeonpea + cowpea (grain)	23.2	13.0	33.0	36.7	45.6	28.5	39.3	42.3	7945
Pigeonpea + cowpea (fodder)	23.5	14.1	38.1	45.4	47.8	32.1	43.9	42.4	8734
Pigeonpea + soybean	22.1	13.1	28.9	40.7	42.3	19.6	33.4	40.2	7438
Pigeonpea + groundnut	23.2	16.1	36.7	49.2	49.0	33.1	44.1	42.5	9392
Sorghum (Fodder) alone	6.6	9.5	22.7	39.3	46.2	13.4	31.0	37.9	4980
For comparing N means at the same level of cropping system means	S.Em ±			1.4				1.7	
	CD (5%)			3.8				4.9	
For comparing cropping system means at the same level of N means	S. Em ±			1.6				2.0	
	CD (5%)			3.2				4.1	

TABLE 2

Effect of cropping systems and nitrogen levels (applied to wheat) on the total nitrogen percentage of the soil (0-30 cm depth).

Cropping systems	*Total Nitrogen percentage of the soil (0-30 cm)*									
	1977-78					*1978-79*				
	After harvest of kharif crops	*After harvest of rabi crops N levels (kg/ha)*				*After harvest of kharif crops*	*After harvest of rabi crops N levels (kg/ha)*			
		0	*60*	*120*	*Mean*		*0*	*60*	*120*	*Mean*
Pigeonpea alone	0.037	0.031	0.033	0.035	0.033	0.034	0.030	0.031	0.033	0.031
Pigeonpea + greengram	0.039	0.035	0.038	0.040	0.038	0.037	0.032	0.034	0.035	0.034
Pigeonpea + black gram	0.039	0.032	0.035	0.038	0.035	0.038	0.032	0.033	0.034	0.033
Pigeonpea + cowpea (grain)	0.035	0.032	0.035	0.037	0.035	0.038	0.031	0.033	0.034	0.032
Pigeonpea + cowpea (fodder)	0.040	0.034	0.036	0.039	0.036	0.040	0.034	0.034	0.036	0.035
Pigeonpea + soybean	0.038	0.030	0.033	0.034	0.032	0.036	0.031	0.033	0.033	0.032
Pigeonpea + groundnut	0.040	0.035	0.037	0.038	0.037	0.039	0.033	0.034	0.036	0.034
Sorghum (fodder) alone	0.030	0.029	0.032	0.034	0.032	0.029	0.028	0.030	0.032	0.030
Initial total N content (%)				0.031					0.029	

viable as compared to pure crop of pigeonpea in legume - cereal or cereal-cereal rotation.

Effect on nitrogen status of the soil

The data in Table-2 revealed that the total N content in the upper 30 cm soil layer after harvest of *kharif* crops was increased considerably during both the years. The total nitrogen in soil under intercropping treatments was generally higher than that under pure crop of pigeonpea. Sorghum (fodder) failed to bring any improvement in the nitrogen status of the soil.

REFERENCES

Brar, Z. S.; Gill, J. S. and Singh, M. (1976). T-21, a new *arhar* for Punjab. *Indian Fmg.*, **16** (3) : 28-29.

Giri, G. and De, R. (1979). Effect of preceding grain legumes in dryland pearl millet in north west India. *Exptl. Agric.* **15** (2) : 169-172.

Lal, R. B.; De, R. and Singh, R. K. (1978). Legume contribution to the fertilizer economy in legume-cereal rotations *Indian J. agric. Sci.*, **48** (7) : 419-424.

Reddy, R. P.; Tarhalkar, P. P. and Rao, N. G. P. (1977). Improved pigeonpea varieties for mono and intercropping. *Indian Fmg.* **17** (9) : 3-5.

Saraf, C. S.; Singh, A. and Ahlawat, I. P. S. (1978). Studies on intercropping of compatible crops with pigeonpea. *Indian J. Agron.* **20** (2) : 127-130.

Saxena, M. C. and Yadav, D. S. (1975). Multiple cropping with short duration pulses. *Indian J. Genet.*, **35** (2) : 194-208.

Singh, J. P.; Singh, N. P. and Jha, D. (1977). Rotational considerations in fertilizer use. *Fert. News*, **22** (5) : 34-36.

Singh, M.; Singh, K.; Singh, R. K. and Saumitra, B. S. (1979). Effect of intercrops on the growth and yield of pigeonpea. *Indian J. agric. Sci.*, **49** (2) : 100-104.

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Use of Poultry Manure in Bidi Tobacco Cultivation

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ABSTRACT

An experiment was conducted from 1983-84 to 1988-89 to evaluate the efficacy of poultry manure, an alternate source of organic manure to supply 45 kg N/ha out of 180 kg N/ha. Poultry manure was comparable to castor cake or sunnhemp green manuring with respect to yield and beneficial for improving leaf nicotine and management of root-knot nematodes under endemic soil conditions of middle Gujarat.

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INTRODUCTION

Bidi tobacco, an important cash crop of Kheda, Vadodara and Panchmahals districts of Gujarat, occupies about 80 per cent of total hectarage under tobacco. It has been established that part of the nitrogen should be supplemented through organic manure (FYM, castor cake or sunnhemp green manuring) to get desired leaf quality (Patel, 1972) and it also helps in increasing the ability of the soil to hold moisture and store the nutrients for the crop (Sheldow, 1975). With development of poultry farming in tobacco growing belt, an alternate source of organic manure has become available in considerable quantity.

It has been found advantageous under nursery conditions, however, information on field crop was lacking hence present investigation was undertaken.

MATERIALS AND METHODS

The trial was conducted for six years from 1983-84 to 1988-89 at Bidi Tobacco Research Station, Gujarat Agricultural University, Anand. The treatments were (i) Green manuring through sunnhemp + 180 kg N/ha from ammonium sulphate (GM + AS 180), (ii) 45 kg N/ha from poultry manure + 135 kg N/ha from ammonium sulphate (PM_{45} + AS_{135}) and (iii) 45 kg n/ha from castor cake + 135 kg N/ha from ammonium sulphate (CC_{45} + As_{135}), tried with eight replications in a randomised block design. Poultry manure and castor cake in the respective treatments were given on the day of green manuring. Ninety per cent of N from ammonium sulphate was given as a basal dose and remaining 10 per cent as a top dressing 10-12 days after transplanting.

TABLE 1

Cured leaf yield and economics.

Treatment	Cured leaf yield (kg/ha)							Economics on the basis of pooled data (Rs./ha)			
	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	Pooled	Gross realization	Treatment cost	Net realization	Net CBR
GM* + AS_{180}	2385	2081	1880	2920	2337	2449	2353	16589	6239	10350	1:1.66
PM_{45} + AS_{135}	2241	2478	2138	3139	2178	2273	2394	16878	5479	11399	1:2.10
CC_{45} + AS_{135}	2025	2371	1976	2873	2243	2244	2292	16159	6303	9856	1:1.50
S.Em.	119	122	115	93	87	303	64	–	–	–	–
C.D. 0.05	ns	ns	ns	ns	ns	ns	ns	–	–	–	–
C.V. %	15.2	14.8	15.3	8.8	10.9	12.8	19.0				

* GM : Through green manuring about 20 kg N/ha is added.

NB : Price of tobacco : Rs. 7.05/kg

Manurial cost for T_1 - 2561 Rs./ha

T_2 - 1801 Rs./ha

T_3 - 2625 Rs./ha

TABLE 2

Yield attributes and root-knot index on pooled basis.

Treatment	Growth score (0-10)	Spangle score (0-5)	Leaf length (cm)	Leaf width (cm)	Plant height (cm)	Root-knot index (0-5)
GM + AS_{180}	5.8	2.0	46.7	20.5	65.5	1.66
PM_{45} + AS_{135}	6.1	2.0	47.3	20.3	66.5	1.44
CC_{45} + AS_{135}	5.7	1.9	45.5	19.7	64.5	1.62
S.Em.	0.21	0.10	0.46	0.28	0.74	0.08
C.D. 0.05	ns	ns	1.28	ns	ns	ns
C.V. %	12.3	18.1	6.6	9.4	8.0	9.0

TABLE 3

Chemical quality of bidi tobacco on pooled basis.

Treatment	*Per cent oven dry basis*			
	Nitrogen	*Nitcotine*	*Reducing Sugar*	*Chloride*
GM + Am. Sul. 180	2.84	6.24	3.95	2.11
PM_{45} + AM. Sul. 135	2.74	6.48	4.11	2.02
CC_{45} + Am. Sul. 135	2.77	6.31	4.32	2.12
S. Em.	0.04	0.06	0.08	0.03
C.D.0.05	ns	0.17	ns	ns
C.V. %	10.7	6.5	11.5	9.2

Bidi tobacco variety Anand 119 was transplanted in the second fortnight of August. All the recommended agronomic practices were followed. Observations on leaf length, leaf width and growth score were made after 90 days of transplanting, while spangle score and plant height were recorded at maturity. Root-knot index was taken after harvesting of crop. The leaf lamina samples were analysed for nitrogen, nicotine, reducing sugars and chloride.

RESULTS AND DISCUSSION

Results of individual years, as well as on the pooled basis indicated nonsignificant differences for cured leaf yield. However, maximum yield was obtained under PM_{45} + As_{135} treatment. More yield under this treatment may be due to greater values of yield attributes viz., growth score, leaf length and plant height which are important yield contributing components.

Yield attributes viz., growth score, spangle score, leaf width and plant height were not influenced significantly except leaf length which was superior under PM_{45} + AS_{135} treatment. This shows favourable effect of poultry manure on leaf development. It has also been reported that poultry manure at higher levels enhanced seedling growth at the early stage of growth (Anon., 1981).

Chemical constituents data (Table 3) indicated non - significant differences for nitrogen, reducing sugar and chloride contents for manurial treatments. However, treatment involving PM_{45} + As_{135} gave significantly higher nicotine content over other treatments, which indicates its superiority from quality as higher nicotine content is related with better quality of bidi tobacco leaf (Patel *et al.*, 1989).

Although data on root-knot disease index showed non-significant differences, the lowest disease index was observed under poultry manure application. This might be due to release of fatty

acids, gases and phenolic compounds which will have inhibitory effects on root-knot nematodes. Thus, poultry manure in long run may help in bringing down the root-knot nematode population in endemic pockets of middle Gujarat.

From economic point of view PM_{45} + AS_{135} treatment gave maximum net realization of Rs. 11399/ha with CBR of 1:2.10. It has been also reported earlier that highest return per rupee invested on manuring could be obtained by applying poultry manure @ 15 t/ha in tobacco nursery (Anon., 1981).

Thus, poultry manure, is a better alternate source of organic manure from the yield and economics as well as management of root-knot nematodes under endemic soil conditions of middle Gujarat.

REFERENCES

Anonymous 1981. Poultry manure in tobacco nursery. Tobacco Research Report, Bidi Tobacco Res. Station, G.A.U., Anand 1980-81, pp. 34-38.

Patel G. J. 1972. Bidi Tobacco Research in India. *Indian Farming* **22** (6) : 91-93.

Patel K. K., Patel, B. K. and L. M. Ghelani. 1989. Chemical quality parameters for evaluation of bidi tobacco. *Tob. Res.* **15** (1) : 37-42.

Sheidow, N. W. 1975. Organic manure must be maintained. *Can. Tob. Grow.* **23** (1) : 28-29.

Chemical Composition of Chlorotic and Healthy Groundnut Plants - A Survey

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ABSTRACT

Chlorosis in groundnut is of a common occurrence. Therefore, in order to study the chemical composition of soil and groundnut plants (40-50 days old), soil and plant samples both from the chlorotic and healthy crop fields were collected from the 11 talukas comprising 29 villages of groundnut growing region of Saurashtra. The results revealed that the interveinal chlorosis in groundnut is not due to deficiency of either Fe or S or Zn or Mn in the soil but presumably due to imbalance of nutrients leading to inactivation of P, Ca, Mg, Fe, Zn and Cu in the plant system, particularly in younger parts i.e.. upper leaves. This inactivation of the nutrients appeared to be predominantly in the veins of younger leaves. To establish the real cause of the chlorotic syndrome in groundnut, further indepth investigations with tracer technique are needed.

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INTRODUCTION

Interveinal chlorotic syndrome is of a common occurrence in the groundnut crop grown on calcareous soils of Saurashtra region in Gujarat. This syndrome generally appears on *kharif* and summer groundnut canopy after 35 to 50 days of sowing. The syndrome becomes more acute under prolonged cloudy weather, drizzling rains and excess soil water situations in *kharif* crop and when it is irrigated in summer with water having moderate to high content of bicarbonate ions coupled with high lime content in soil. In the case of excess moisture condition, provision of drainage followed by interculturing help recover the crop, while in other situation spraying of 1 per cent ferrous sulphate in 0.1 per cent citric acid solution effectively controls the syndrome.

The information on the chemical composition of chlorotic and healthy groundnut plants so also of soil from these fields is lacking. Hence, a survey was conducted to achieve the objective and understand the syndrome in a better way.

MATERIALS AND METHODS

The soil and plant samples were collected from 11 talukas comprising 29 villages of groundnut growing region of Saurashtra. The samples were collected at 40-50 days after sowing of *kharif*

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groundnut. The soil and plant samples were collected from the two spots i.e., chlorotic and healthy plants of the same field. After necessary processing, the soil samples were analysed for water soluble HCO^-_3, $CaCO_3$, organic carbon, Olsen's P, available S (heat soluble) and DTPA extractable micronutrient cations by standard methods (Jackson, 1967 and Black, 1965). The plant samples were partitioned into three parts viz., lower leaves, upper leaves and shoots. The separated plant samples were oven dried at 65°C and ground to fine powder using stainless steel grinder. Nitrogen was estimated separately from the plant samples by micro Kjeldahl method (Warnke and Barber, 1974). While rest of the elements were estimated after diacid digestion.

The methods employed for estimation of different elements were colorimetric for P and S, flame photometric for K, versanate titration for Ca and Mg and atom absorption spectrophotometry for micronutrient cations (Black, 1965). The data thus obtained were subjected to statistical analysis.

RESULTS AND DISCUSSION

Soil analysis

From fertility point of view, soils under chlorotic as well as healthy plant locations were sufficient in available nutrient contents (Table 1). However, the contents of organic carbon and DTPA extractable Fe in healthy plant locations were significantly higher as compared to those in chlorotic plant locations. On the other hand, mean DTPA extractable Mn content in soil collected from chlorotic plant location was exceptionally higher (71%) than that of healthy plant location. The available nutrient status of the present survey samples suggests that the cause of interveinal chlorosis in groundnut is not a deficiency of any nutrient in the soil but it seems to be due to imbalance in availability of nutrients as a result of soil water saturation. Place (1969) reported higher availability of Mn by reductive process sooner than Fe availability inducing Mn toxicity or Fe deficiency leading to chlorosis in rice plant. The induction of Mn toxicity seems to be a major cause of chlorosis in groundnut as this syndrome invariably occurs after heavy rain or during prolonged cloudy weather coupled with drizzling rains resulting in excess water situation in soil.

Plant analysis

The differences between nutrient content in chlorotic and healthy plant parts (Tables 2 and 3) were significant barring the N, K, S, Fe, Cu and Mn content in shoot; P, K, Fe and Mn content in lower leaves and only Mn content in upper leaves. The concentration of Mg and Zn in the shoot of healthy plant was considerably higher than in the shoot of chlorotic plant, while reverse was true for the P and Ca content in the shoot. In case of the lower leaves, the content of N, Ca, Mg, S, Zn and Cu was significantly higher in the healthy plant than in the chlorotic plant samples. Similar trend was also observed for N, K and S content in the upper leaves. Contrary to this, the content of P, Ca, Mg, Fe, Zn and Cu was significantly more in the upper leaves of the chlorotic plant than in the same leaves of the healthy plant. The magnitude of increase in concentration of P, Ca, Mg, Fe, Zn and Cu in the upper leaves of chlorotic plant was 16.7, 17.1, 34.8, 41.9, 32.0 and 24.7 per cent, respectively over healthy plant leaves. The higher contents of these elements in the upper leaves (younger leaves) of chlorotic plant indicate that the availability of nutrients is not a problem but physiologically inactivation of the nutrients on account of nutrient imbalance in the plant system particularly in the veins of

TABLE 1

Some chemical parameters of the soil samples collected from chlorotic and healthy groundnut plant locations.

Sr. No.	*Parameter*	*Chlorotic plant location*	*Healthy plant location*	*'t' value*	*Increase (+) or decrease (-)over chlorotic location*
1.	HCO_3 me/100 g	0.49 (0.28 - 0.80)	0.52 (0.30-1.15)	NS	+ 6.1
2.	$CaCO_3$ (%)	19.50 (1.00 - 51.00)	18.60 (3.50-75.00)	NS	– 4.6
3.	Organic Carbon (%)	0.73 (0.18 - 1.47)	0.94 (0.45-1.65)	2.5*	+28.8
4.	Available P (kg/ha)	15.80 (3.38-53.68)	18.00 (5.58-67.77)	NS	+13.8
5.	Heat soluble S (ppm)	12.30 (4.5 - 54.0)	13.30 (4.5-42.0)	NS	+8.1
6.	DTPA extractable cations (ppm)				
	Fe	11.60 (7.8-18.2)	12.10 (8.0-22.1)	2.48*	+4.3
	Zn	4.10 (1.5-9.7)	3.80 (1.6-9.2)	NS	–7.3
	Cu	4.50 (2.6-9.8)	4.50 (2.9-8.9)	NS	0.0
	Mn	208.3 (97-406)	60.4 (27-165)	8.91**	–71.0

Data in parenthesis are range values.

NS = Not Significant.

* and ** Significant at 5 and 1 per cent levels, respectively.

TABLE 2

Content of the major nutrients in the chlorotic and healthy groundnut plants.

Sr. No.	*Element (%)*	*Plant Part*	*Chlorotic plant*	*Healthy plant*	*'t' value*	*% increase (+) or decrease (–) over chlorotic plant*
1.	N	Shoot	1.46 (0.14-3.28)	1.74 (1.20-4.20)	NS	+ 19.2
		Lower leaves	2.33 (1.62-3.08)	2.66 (2.30-3.36)	3.30**	+ 14.2
		Upper leaves	2.30 (1.54-3.28)	3.74 (2.77-4.79)	10.29**	+ 62.6
2.	P	Shoot	0.18 (0.12-0.25)	0.12 (0.05-0.23)	8.16**	- 33.3
		Lower leaves	0.15 (0.01-0.30)	0.13 (0.06-0.21)	NS	- 13.3
		Upper leaves	0.18 (0.07-0.34)	0.15 (0.07-0.23)	2.57*	- 16.7
3.	K	Shoot	1.49 (0.47-2.79)	1.65 (0.59-3.32)	NS	+ 10.7
		Lower leaves	1.19 (0.74-1.95)	1.28 (0.65-2.13)	NS	+ 7.6
		Upper leaves	1.58 (0.58-4.17)	2.02 (1.32-3.24)	4.24**	+ 27.8
4.	Ca	Shoot	1.50 (0.88-2.64)	1.01 (0.48-1.56)	6.39**	- 32.7
		Lower leaves	2.30 (1.56-4.48)	2.73 (1.32-5.20)	2.20**	+ 18.7
		Upper leaves	1.91 (0.64-3.40)	1.57 (1.24-4.60)	2.46*	- 17.1
5.	Mg	Shoot	0.41 (0.05-0.83)	0.79 (0.38-1.20)	3.74**	+ 92.7
		Lower leaves	0.87 (0.10-1.99)	1.03 (0.72-2.16)	2.29*	+ 18.4
		Upper leaves	1.15 (0.05-3.74)	0.75 (0.12-1.27)	3.20**	- 34.8
6.	S	Shoot	0.098 (0.042-0.162)	0.095 (0.018-0.156)	NS	- 3.3
		Lower leaves	0.094 (0.024-0.210)	0.230 (0.120-0.360)	9.44**	+ 144.7
		Upper leaves	0.148 (0.012-0.288)	0.216 (0.096-0.372)	3.86**	+ 45.8

Data in parenthesis are range values.
NS = Not Significant. *and** = Significant at 5 and 1 per cent levels, respectively.

TABLE 3

Content of micronutrient elements in the chlorotic and healthy groundnut plants.

Sr. No.	*Element (ppm)*	*Plant part*	*Chlorotic plant*	*Healthy plant*	*'t' value*	*% increase (+) or decrease (-) over chlorotic plant*
1.	Fe	Shoot	451 (62-2083)	567 (129-2554)	NS	+ 25.7
		Lower leaves	895 (547-2216)	815 (488-1809)	NS	- 8.9
		Upper leaves	592 (191-943)	344 (233-549)	6.15**	+ 41.9
2.	Zn	Shoot	18.6 (1-53)	38.6 (22-56)	8.01**	+ 107.5
		Lower leaves	32.1 (8-70)	48.6 (3-215)	2.53*	+ 51.4
		Upper leaves	55.9 (6-109)	38.0 (8-73)	5.17**	- 32.0
3.	Cu	Shoot	25.0 (1-111)	24.0 (11-62)	NS	- 4.0
		Lower leaves	15.6 (1-30)	21.3 (11-51)	3.33**	+ 36.5
		Upper leaves	24.3 (4-55)	18.3 (6-32)	2.09*	- 24.7
4.	Mn	Shoot	64.9 (37-139)	66.4 (34-102)	NS	+ 2.8
		Lower leaves	130.4 (65-207)	141.5 (80-232)	NS	+ 8.5
		Upper leaves	148.0 (42-298)	160.0 (89-382)	NS	+ 8.1

Data in parenthesis are range values.
NS = Not Significant.
* and ** = Significant at 5 and 1 per cent levels, respectively.

younger leaves seems to be a problem. This was also evident from the sufficient available nutrient status of the soil.

The data further revealed that the content of most of the elements was higher in the upper leaves of chlorotic plant than that of healthy plant leaves. However, this was not the case with the shoot and lower leaves. Considering this trend, it can be inferred that the process of physiological inactivation is more pronounced in the younger leaves and ultimately leading to interveinal chlorosis in groundnut. Carter (1980) also reported higher content of Na, Ca, K, Fe and Mn in needles of chlorotic scot pines than that of green needles. Whereas, Mehta and Singh (1979) attributed the chlorosis in *mung* grown on calcareous soil to inactivation of Fe due to S deficiency.

From the foregoing discussion, it seems that the interveinal chlorosis in groundnut is not due to deficiency of either Fe or S or Zn or Mn in the soil but might be credited to the imbalance in availability of certain elements leading to the inactivation of P, Ca, Mg, Fe and Cu in younger leaves. The remedial measure(s) to be advocated under such circumstances should have dual objectives i.e. (i) creating the conditions for activation of inactivated nutrients and (ii) foliar application of the nutrient in question. In order to understand the real cause of the syndrome, further indepth investigations with tracer technique are warranted. This will certainly enable to pin-point the cause and ultimately the package of corrective measures to be employed for counteracting the syndrome.

REFERENCES

Black, C. A. (1965). Methods of Soil Analysis, Part II, Agronomy 9, Am-Soc. Agron. Inc. Madison, USA.

Carter, M. R. (1980). Association of cation and organic anion accumulation with iron chlorosis of scot pine on Prairie soils. *Plant Soil*, **56** : 293-300.

Jackson, M. L. (1967). Soil Chemical Analysis. Prentice-Hall of India Pvt. Ltd., New Delhi.

Mehta, U. R. and Singh, H. G. (1979). Response of green gram to sulphur on calcareous soils. *Indian J. Agric. Sci.* **49** (9) : 703-706.

Place, G. A. (1969). Relationship of iron, manganese and biocarbonate to chlorosis of rice grown in calcareous soil. Report series : 175, Agril, Expt. Station, Div. Agri. Univ. Arkansas, Fayetteville.

Warnke, D. D. and Barber, S. P. (1974). Root development and nutrient uptake by corn grown in solution culture. *Agron. J.* **66** : 514-517.

Studies on Relationship Between EC at Different Soil : Water Ratios and EC_E in Soil Series of South Gujarat

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ABSTRACT

One hundred soil samples, representing 18 soil series placed under Ustochrepts, Chromusterts, Halaquepts and Ustopsamments great groups of Bharuch, Surat and Valsad districts of south Gujarat, were analysed for EC_E and EC at 1:1, 1:2, 1:2.5 and 1:5 soil: water dilutions and correlation and regression equations for computing EC_E at different dilutions were workedout. All the dilutions showed highly significant positive relationship with EC_E and the regression equations developed were, (1) $EC_E = 2.1416 \times EC_{1:1} - 0.3267$ (ii) $EC_E = 3.1790 \times EC_{1:2} - 0.1482$ (iii) $EC_E = 3.4290 \times EC_{1:2.5} + 0.2041$ and (iv) $EC_E = 5.8839 \times EC_{1:5} + 0.3409$. The measured and computed EC_E values were in agreement.

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INTRODUCTION

For diagnosing salt affected soils and for knowing the response of plant species growing in saline media, the EC_E has been considered as an important criterion. The measurement of EC_E requires preparation of saturated paste and extraction through suction pump, particularly in clayey soils. This is a cumbersome procedure and requires relatively large amount of soil. The measurement also becomes difficult when one is dealing with limited amount of soil. A large area in South Gujarat is covered under Ukai-Kakrapar irrigation project and is likely to increase further after functioning of Daman-Ganga irrigation project. The area under irrigation will be further extended after inception of Narmada irrigation project. Around 78,000 ha are under salinity in South Gujarat (Annon. 1989a, 1989b) and it may increase further with inception of irrigation projects if proper water management is not practiced. Under the circumstances, monitoring for checking the development of soil salinity becomes an important task. The measurement of soil pH is done at a soil : water ratio of either 1:2 or 1:2.5 in most of the soil testing laboratories. If relationship is established between EC at different soil : water dilutions and EC_E, it will be easy to translate the values of EC to EC_E, it which in turn, would throw a light on response of plant species growing in the media and would save time and labour. Agarwal *et al.* (1961), Singhla *et al.* (1974) and Sen and

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TABLE 1

Ranges of EC values at different soil : water ratios in prominent soil series of South Gujarat.

Sr. No.	*Soil series*		*Texture*	*Measured EC_E ($ds\ m^{-1}$)*	*Ranges of EC at different soil : water dilutions ($ds\ m^{-1}$)*			
					1:1	*1:2*	*1:2.5*	*1:5*
				Great group Ustochrepts				
1.	Kabilpor	(3)	cl	1.10-2.30	0.55-0.90	0.40-0.68	0.35-0.45	0.14-0.30
2.	Sisodra	(6)	c	0.83-5.00	0.42-2.70	0.30-1.79	0.28-1.41	0.10-0.74
3.	Jalalpor	(15)	c	0.68-2.30	0.54-1.69	0.24-0.90	0.19-0.78	0.10-0.40
4.	Gadat	(3)	cl	0.66-0.90	0.56-0.85	0.26-0.57	0 21-0.35	0.11-0.18
5.	Baldha	(3)	l	0.96-6.90	0.74-3.10	0.35-2.50	0.35-2.20	0.13-1.31
6.	Billimoda	(3)	sicl	0.40-1.26	0.25-1.05	0.17-0.52	0.14-0.37	0.09-0.22
7.	Vadhawania	(2)	sic	0.89-0.90	0.52-0.66	0.30-0.31	0.26-0.27	0.09-0.16
8.	Ankhi	(23)	scl	0.56-8.60	0.27-5.10	0.16-3.90	0.14-3.42	0.10-1.75
			Range	0.40-8.60	0.25-5.10	0.16-3.90	0.14-3.42	0.09-1.75
				Great group Chromusterts				
9.	Eru	(3)	c	0.86-3.00	0.60-2.10	0.33-1.42	0.14-1.20	0.10-0.71
10.	Mulad	(5)	c	0.95-2.00	0.60-1.28	0.40-0.80	0.38-0.65	0.17-0.35
11.	Vyaval	(2)	sic	0.90-1.05	0.60-0.67	0.34-0.38	0.25-0.27	0.12-0.13
12.	Haldar	(11)	c	0.74-2.60	0.57-2.00	0.24-1.20	0.21-0.98	0.11-0.51
13.	Dehgam	(3)	c	0.81-2.14	0.46-1.24	0.26-0.73	0.22-0.62	0.14-0.37
			Range	0.74-3.00	0.46-2.10	0.24-1.42	0.14-1.20	0.10-0.71
				Great group Halaquepts				
14.	Dandi	(2)	c	1.62-17.10	0.88-7.10	0.44-3.80	0.35-3.60	0.23-2.50
15.	Att	(7)	cl	0.75-2.50	0.60-1.87	0.28-1.00	0.24-0.87	0.15-0.38
16.	Onjal-I	(5)	c	18.0-28.00	7.90-13.70	5.80-8.20	3.90-8.00	2.50-4.80
17.	Balota	(2)	c	0.90-1.66	0.84-0.94	0.45-0.53	0.37-0.44	0.22-0.24
			Range	0.75-28.00	0.60-13.70	0.28-8.20	0.24-8.00	0.15-4.80
				Great group Ustopsamments				
18.	Onjal-II	(2)	(Cl)	1.03-1.30	0.68-0.70	0.40-0.58	0.30-0.38	0.17-0.30
			Range	1.03-1.30	0.68-0.70	0.40-0.58	0.30-0.38	0.17-0.30
			Overall mean	3.32	1.71	1.10	0.92	0.51

Note : (i) The numbers given in parentheses with names of series indicate nos. of villages from where the samples were collected (ii) The abbreviations cl, c, l, sic, sicl and scl, respectively indicate, clay loam, clay, loam, silty clay loam, silty clay and sandy clay loam textural classes.

TABLE 2

The relationship of EC measured at different soil : water ratios and EC_E and the corresponding regression equations.

Sr. No.	*Soil:water ratios*	*'r' value*	*Regression equation*
1.	1:1	+ 0.98**	$EC_E = 2.1416 \times EC_{1:1} - 0.3267$
2.	1:2	+ 0.97**	$EC_E = 3.1790 \times EC_{1:2} - 0.1482$
3.	1:2:5	+ 0.95**	$EC_E = 3.4290 \times EC_{1:2.5} + 0.2041$
4.	1:5	+ 0.94**	$EC_E = 5.8839 \times EC_{1:5} - 0.3409$

** Significant at 1% level.

Bandyopadhyay (1985) have established such relationships, respectively for the soils of Uttar Pradesh, Haryana and West Bengal. However, such relationship has not been established for prominent soil series of South Gujarat covered under intensive irrigation. Hence, it was thought worth to undertake the studies on establishment of relationship between EC at different soil : water ratios and EC_E.

MATERIALS AND METHODS

The soil samples from plough layer were collected from one hundred villages, covering 18 soil series scattered in the districts of Bharuch, Surat and Valsad. Of the samples, 58 belonged to the great soil group Ustochrepts, 24 to Chromusterts, 16 to Halaquepts and 2 to Ustopsamments. The EC from these samples was measured at soil : water ratios of 1:1, 1:2, 1:2.5 and 1:5 and the EC_E was also measured (Jackson, 1965). The name of the series, the texture as well as EC values at different soil: water ratios are given in table 1.

RESULTS AND DISCUSSION

The samples (Table 1) had loam, sandy clay loam, silty clay loam, silty clay, clay loam and clayey textures. The EC values ranged from 0.25 to 5.10, 0.16 to 3.90, 0.14 to 3.42 and 0.09 to 1.75 dsm^{-1} in the great group Ustochrepts, respectively at soil: water ratios of 1:1, 1:2, 1:2.5 and 1:5. In case of Chromusterts, the ranges were 0.46 to 2.10, 0.24 to 1.42, 0.14 to 1.20 and 0.10 to 0.71 dsm^{-1} and in Halaquepts, they were 0.60 to 13.70, 0.26 to 8.20, 0.24 to 8.0 and 0.15 to 4.80 dsm^{-1} at the corresponding dilutions. The Ustopsamments showed a variation between 0.68 and 0.70, 0.40 and 0.58, 0.30 and 0.38 and 0.17 and 0.30 dsm^{-1}. In general, the soil samples showed large degree of variation in values of EC. The EC_E values varied

TABLE 3

The EC_E values and ranges of computed EC_E values at different soil:water ratios in prominent soil series of South Gujarat.

Sr. No.	*Soil series*	*Measured EC_E ($ds\ m^{-1}$)*	*Computed EC_E values ($ds\ m^{-1}$)*			
			1:1	*1:2*	*1:2.5*	*1:5*
		Great group Ustochrepts				
1.	Kabilpor	1.10-2.30	0.85-1.60	1.12-2.01	1.40-1.75	1.16-2.11
2.	Sisodra	0.83-5.00	0.57-5.45	0.80-5.54	1.16-5.03	0.92-4.69
3.	Jalalpor	0.68-2.30	0.83-3.29	0.61-2.71	0.85-2.87	0.92-2.69
4.	Gadat	0.66-0.90	0.87-1.49	0.68-1.66	0.92-1.40	0.98-1.40
5.	Baldha	0.96-6.90	1.26-6.31	0.96-7.79	1.40-7.74	1.10-8.04
6.	Billimoda	0.40-1.26	0.21-1.92	0.39-1.50	0.68-1.47	0.87-1.63
7.	Vadhawania	0.89-0.90	0.79-1.08	0.80-0.93	1.08-1.13	0.87-1.28
8.	Ankhi	0.56-8.60	0.25-10.59	0.36-12.24	0.68-11.90	0.92-10.63
	Range	0.40-8.60	0.21-10.59	0.36-12.24	0.68-11.90	0.87-10.63
		Great group Chromusterts				
9.	Eru	0.86-3.00	0.96-4.17	0.90-4.36	0.68-4.32	0.92-4.51
10.	Mulad	0.95-2.00	0.96-2.41	1.12-2.39	1.51-2.43	1.34-2.40
11.	Vyaval	0.90-1.05	0.96-1.10	0.93-1.05	1.06-1.13	1.04-1.10
12.	Haldar	0.74-2.60	0.84-3.95	0.61-3.66	0.92-3.56	0.98-3.34
13.	Dehgam	0.81-2.14	0.65-3.32	0.68-2.17	0.75-2.33	1.16-2.51
	Range	0.74-3.00	0.65-4.17	0.61-4.36	0.68-4.32	0.92-4.51
		Great group Halaquepts				
14.	Dandi	1.62-17.10	1.55-14.87	1.25-11.90	1.40-12.55	1.69-15.0
15.	Att	0.75-2.50	0.95-3.68	0.74-3.03	1.03-3.18	1.22-2.56
16.	Onjal-I	18.00-28.00	16.59-29.00	18.20-25.90	13.50-27.60	15.00-28.50
17.	Balota	0.90-1.66	1.47-1.68	1.28-1.53	1.47-1.71	1.63-1.75
	Range	0.75-28.00	0.95-29.00	0.74-25.90	1.08-27.60	1.22-28.50
		Great group Ustopsamments				
18.	Onjal-II	1.03-1.30	1.13-1.17	1.12-1.69	1.28-1.51	1.34-2.11
	Range	1.03-1.30	1.13-1.17	1.12-1.69	1.28-1.51	1.34-2.11
	Over all mean	3.32	3.36	3.33	3.31	3.32
	't' Test (P=0.05)	—	NS	NS	NS	NS

between 0.40 and 8.60, 0.74 and 3.00, 0.75 and 28.00 and 1.03 and 1.30 dsm^{-1}, respectively in great groups Ustochrepts, Chromusterts, Halaquepts and Ustopsamments. These EC values were related with values of EC_E measured from each samples and corresponding regression equations were developed (Table 2).

Although, a decrease in the 'r' values was observed with rise in dilution, all the values were positively highly significantly related with EC_E. From the developed regression equations, the EC_E values were computed (Table 3) for respective dilutions. Although, slight variation was observed between measured EC_E and computed EC_E values, on an average, there was good agreement. The mean computed values were 3.36, 3.33, 3.31 and 3.32 dsm^{-1}, respectively at dilutions of 1:1, 1:2, 1:2.5 and 1:5 while the actual EC_E value was 3.32 dsm^{-1}. The 't' test between measured EC_E and computed EC_E values for each dilution was also not significant. Hence, the equations developed could satisfactorily be used for computing EC_E values at given soil : water ratio.

REFERENCES

Agarwal, R. P.; Das, S. K. and Mehrotra, C. L. 1961. Interrelationship between EC of 1:5 and saturation extract and TSS. *Indian J. agric Sci.* **31**.

Anonymous, 1989 a. Status Report of National Agricultural Research Project for South Gujarat Heavy Rainfall Agroclimatic Zone, Guj. Agril. Uni., Navsari Campus, pp. 199.

Anonymous, 1989 b. Status Report of National Agricultural Research Project for South Gujarat Agroclimatic Zone. Guj. Agril. Uni., Navsari Campus, pp. 181.

Jackson, M. L. 1965. Soil Chemical Analysis, Prentice Hall Inc. Englewood Chiff, New Jersey, USA.

Sen, H. S. and Bandyopadhyay, B. K. 1985. Determination of soil solution electrical conductivity for different soil textures. Annual Report of Central Soil Salinity Research Institute, Karnal. P, 127.

Singhla, S. K. Bhargava, G. P. and Gupta, I. C. 1974. Relationship between certain diagnostic indices of salt affected soils of Indo. Gangetic alluvial region. Annals of Arid Zone, 13, p, 225-30.

Nitrogen Transformation and Its Utilization by Rice as Influenced by Application of Some Organic Chemicals

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ABSTRACT

A greenhouse experiment was carried out to see the effect of organic chemicals viz., 2,4-dinitropheny1 hydrazone (C_1) and naphthy1 ethylene diamine (C_2) application (10 mg kg^{-1} soil) in conjunction with N application (60, 120, 180 mg kg^{-1} soil) on N transformation and its utilization by rice (*Oryza sativa* L. var. Pusa 2-21) on a Typic Ustochrept. The chemicals were effective in maintenance of higher mineral N content over no-chemical treatment. The effect of the chemicals was clearly noticeable as was evidenced by significantly higher yield. Plant N uptake and fertilizer N recovery data. The increase in grain and total dry matter production with C_1, C_2 and C_{1+2} over C_0 was 13, 23, 14 and 8, 6, 15 per cent, respectively. Similarly the chemicals have led to higher N uptake by the crop and thereby apparent N recovery.

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INTRODUCTION

Seldom more than half of the applied N is recovered by crops (Allison, 1966; Cooke, 1982; Bosewell *et al.*, 1985), whereas the average value for rice may be 30-40 per cent only (De Datta and Buresh, 1989). When fertilizer N is applied to the soil, it undergoes various transformations and the portion of the fertilizer N gets incorporated into soil organic matter which becomes increasingly stable with time, is not readily mineralized or subject to leaching (Allen *et al.*, 1973). Use of organic chemicals having photo active sites may affect the N transformation processes leading to an increase in N use efficiency. The present investigation was undertaken to see the effect of such chemicals viz., 2, 4-dinitrophenyl hydrazone and naphthyl ethylene diamine application on mineral nitrogen changes and N utilization by rice under greenhouse studies.

MATERIALS AND METHODS

A greenhouse experiment was carried out in *kharif* season of 1990 on soil belonging to Mehrauli series (Typic Ustochrept) having following characteristics : loam texture, organic C 0.34%, pH 8.18, EC 0.25 dSm^{-1}, CEC 9.25 cmol (p^+) kg^{-1}, inorganic N 32 mg kg^{-1} soil. The soil sample was ground to pass through 2 mm sieve and

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3.5 kg of soil was filled in glazed pots of 4 kg capacity. Total sixteen treatments were kept comprising of four levels of N (N_0, N_1, N_2 and N_3 i.e. N application @ 0, 10, 120 and 180 mg kg^{-1} soil, respectively) and four levels of chemicals (C_0, C_1, C_2 and C_{1+2} i.e. no chemical, 2,4-dinitrophenyl hydrazone @ 10 mg kg^{-1} soil, naphthyl ethylene diamine @ 10 mg kg^{-1} soil and C_1 + C_2 @ 5 mg kg^{-1} soil each, respectively). The chemicals were applied in the form of solution at the time of transplanting. The experiment was conducted in factorial completely randomized design with three replications.

Nitrogen application was done in three splits i.e. 1/2, + 1/4 + 1/4. The first half was applied at the time of transplanting alongwith the full dose of P_2O_5 and K_2O @ 30 mg kg^{-1} soil, each in the form of aqueous solutions and rest two splits were applied at 30 and 55 days after transplanting (DAT). Twenty five days old seedlings of rice (*Oryza sativa* L. var. Pusa 2-21) were transplanted keeping six plants (3 hills) in each pot. The pots were irrigated as and when required.

Soil samples from each pot were taken at 20, 50, 75 and 95 DAT. The samples were then subjected to 2 M KCL extraction and analyzed for inorganic form of nitrogen (NH_4^+ - N + NO_3^- -N) contents using Bremner and Kenney (1966) method by auto-analyzer, Fiaster Model. The crop was harvested at 95 DAT. the straw and grain samples were analyzed for N content by wet digestion with H_2SO_4 following Kjeldahl method according to the procedure of Buresh *et al.* (1982).

RESULTS AND DISCUSSION

Changes in inorganic N content

The overall changes in the content of inorganic N (NH_4^+-N + NO_3^--N) showed that the application of chemicals alone or in association with N levels maintained higher level of inorganic N then that of no chemical (C_0) treatment. Inorganic N contents of the soil under different treatments dropped markedly at 20 DAT from initial content of 32 mg kg^{-1} soil. With the passage of time, the fluctuation in the inorganic contents was small upto 75 DAT; and thereafter the contents decreased to a minimum at the final stage i.e. at 95 DAT, in respective of the treatments (Fig. 1). The average higher inorganic N content in the soil with chemicals and in conjunction with N application might be due to their synergistic influence on the mineralization of soil nitrogen. The chemicals might have exerted a mineralizing action by providing energy to rupture some of the inert N bonding resulting into its release in the soil due to photoactive nature of the chemicals used in the investigation.

Rice yield

The control (N_0C_0) produced the lowest grain and straw yield (Table 1) which may be attributed to the presence of lower amounts of inorganic N content in the soil (Fig. 1) whereas the availability of higher inorganic N caused by the chemicals led to significantly higher grain and total dry matter production. The yield was found increased further when fertilizer N was applied alongwith the chemicals. The narrowing of the straw to grain ratio with increase in the level of N application might be attributed to the nature of the grown rice variety in responding the higher N application towards yield. The effect of C_1, C_2 and C_{1+2} in increasing the rice grain yield was reflected by 13, 23 and 14 per cent increase over C_0 (11.56 g pot^{-1}) treatment. The beneficial effects of organic chemicals through their action on N transformation processes have also been reported by several workers (Wang *et al.*, 1991; Kakhadze and Menagarishvili, 1988).

TABLE 1

Straw and grain yield of rice (g pot^{-1}) as affected by chemicals and different levels of nitrogen application.

N levels	*Rice Straw*					*Rice Grain*				
	C_0	C_1	C_2	C_{1+2}	*Mean*	C_0	C_1	C_2	C_{1+2}	*Mean*
N_0	6.88	7.18	9.45	7.93	7.86	4.62	5.24	6.63	6.49	5.79
N_1	11.00	11.79	10.78	12.09	11.41	9.15	12.27	10.74	10.08	10.56
N_2	11.70	12.89	12.58	13.89	12.77	12.58	14.80	15.10	17.09	15.02
N_3	16.42	15.99	20.24	19.65	18.08	19.89	19.91	24.12	19.25	20.79
Mean	11.50	11.96	13.26	13.39		11.56	13.05	14.27	13.23	
	N	C	N X C			N	C	N X C		
S. Em. ±	0.39	0.39	0.79			0.34	0.34	0.69		
C.D. at 5%	1.15	1.15	NS			1.00	1.00	2.01		

TABLE 2

Nitrogen uptake and N recovery by rice as affected by chemicals and different levels of nitrogen application.

N levels	*N uptake (mg pot^{-1})*									
	Grain					*Total dry matter at harvest*				
	C_0	C_1	C_2	C_{1+2}	*Mean*	C_0	C_1	C_2	C_{1+2}	*Mean*
N_0	46.4	52.8	65.9	63.2	57.1	75.8	83.5	103.4	96.2	89.7
N_1	103.6	143.2	127.3	118.4	123.1	151.3	191.5	177.1	177.5	173.8
	(27.25)	(46.12)	(38.52)	(34.28)	(36.54)	(35.96)	(55.13)	(48.26)	(47.50)	(46.71)
N_2	175.2	213.8	226.1	237.9	213.3	234.5	277.0	283.5	301.8	274.2
	(30.69)	(39.86)	(42.88)	(45.60)	(37.97)	(37.80)	(47.90)	(49.50)	(53.83)	(47.26)
N_3	287.8	283.9	356.1	281.3	302.3	373.1	360.4	457.1	383.3	393.5
	(38.40)	(37.72)	(49.16)	(37.31)	(40.65)	(47.20)	(45.20)	(60.53)	(48.83)	(50.44)
Mean	153.3	173.4	193.9	175.2		208.7	228.1	255.3	239.2	
	(32.11)	(41.23)	(43.50)	(39.06)		(40.34)	(49.41)	(52.76)	(50.05)	
	N	C	N X C			N	C	N X C		
S. Em. ±	4.4	4.4	8.8			5.5	5.5	11.0		
	(1.31)	(1.52)	(2.64)			(1.43)	(1.66)	(2.87)		
C.D. at 5%	12.7	12.7	25.4			15.9	15.9	31.8		
	(3.85)	(4.45)	(7.71)			(4.20)	(4.85)	(8.40)		

Figures in parenthesis are per cent N recovery.

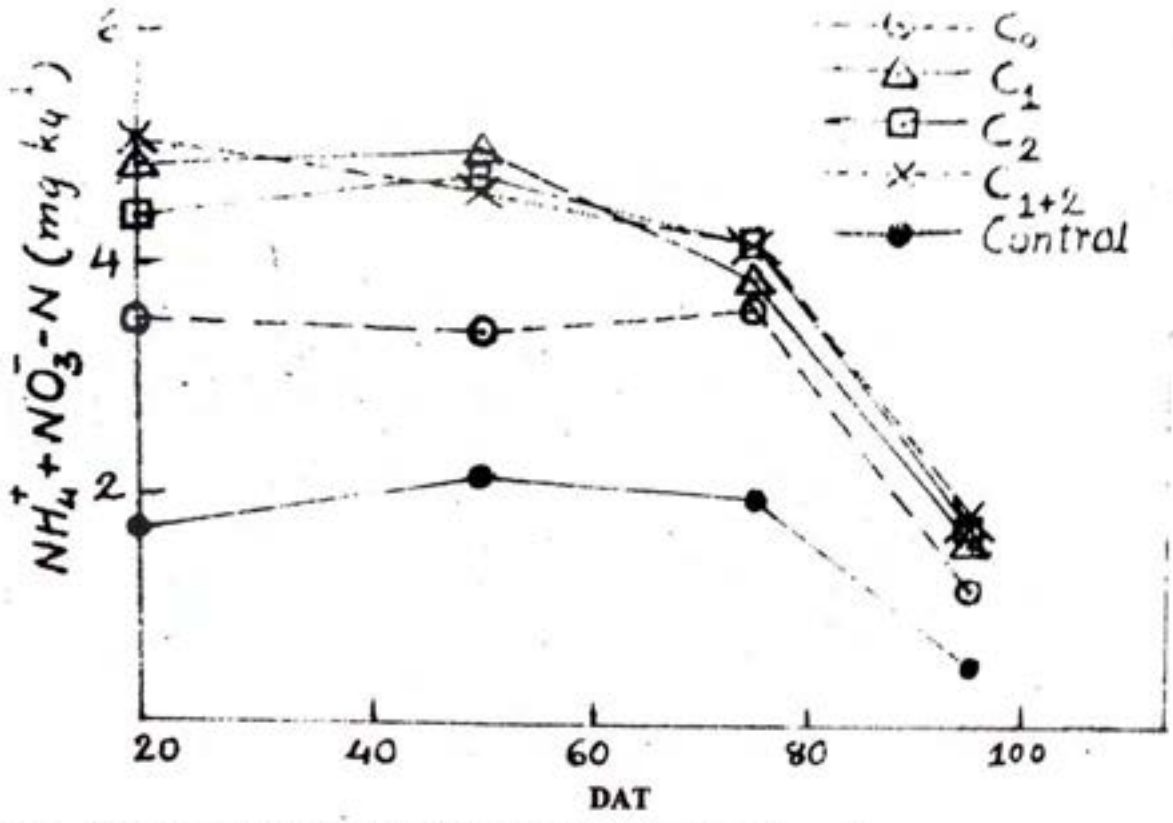

Fig.1. Effect of chemicals on inorganic N content of the soil.

Nitrogen uptake and N recovery

The chemicals used in the investigation have led to higher N uptake by the crop (Table 2). The beneficial effect may be ascribed to their mineralizing action to mobilize native soil N as pointed out earlier. The per cent fertilizer N recovery computed by difference method in rice grain ranged from 32.1 to 40.5 per cent with C_0 and C_2 treatments, respectively. Higher N recovery figures with chemicals are suggestive of efficiency of these chemicals for augmenting N utilization by the crop as the fertilizer N recovery in grain with C_1, C_2 and C_{1+2} was higher by 28, 35 and 22 per cent, respectively over no chemical application.

ACKNOWLEDGEMENT

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REFERENCES

Allen, A. L., F. J. Stevenson and L. T. Kurtz, 1973. Chemical distribution of residual fertilizer nitrogen in soil as revealed by nitrogen-15 studies. *J. Environ. Qual.*, **2** : 120-124.

Allison, F. E. 1966. The rate of nitrogen applied to soils. *Adv. Agron.*, **18** : 219-258.

Bosewell, F. C., J. J. Meisinger and N. L. Case, 1985. Production, marketing and use of nitrogen fertilizers. In : Fertilizer Technology and

Use, 3rd ed. SSSA, Madison Wis., USA, pp. 229-292.

Bremner, J. M. and D. R. Keeney, 1966. Determination and isotope ratio analysis of different forms of nitrogen in soils : 3. Exchangeable ammonium, nitrate and nitrite by extraction - distillation methods. *Soil Sci. Soc. Am. Proc.*, **30** : 577-582.

Buresh, R. J., E. R. Austin and E. T. Craswell, 1982. Analytical methods in research. *Fert. Res.*, **3** : 37-62.

Cooke, G. W. 1982. In : Fertilizing for maximum yields. 3rd ed. Granuda, London.

De Datta, S. K. and R. J. Buresh, 1989. Integrated nitrogen management in irrigated rice. *Adv. Soil Sci.*, **10** : 143-165.

Kakhadze, D. I. and L. V. Menagarishvili, 1988. The nitrogen balance in subtropical podzolic soil. *Agrokhimiya*, **6** : 15-21.

Kowalenko, C. G. and D. R. Cameron, 1978. Nitrogen transformation in soil-plant system in three years of field experiments using tracer and non-tracer methods of an ammonium fixing soil. Can. *J. Soil Sci.*, **58** : 195-208.

Wang, Z., Van Cleenput, Van., P. Demeyer and L. Baert, 1991. Effect of urease inhibitors on urea hydrolysis and ammonia volatilization. *Biol. Fertil. Soils*, **11** : 43-47.

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Assessment of Empirical Formulae for Determination of Evapotranspiration in Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

An experiment was conducted during the years 1986 to 1988 to assess the reliability of the estimates of evapotranspiration for groundnut (*Arachis hypogaea* L.) Average seasonal evapotranspiration was found to be 426 mm with the use of lysimeters. Pan evaporation method, modified Penman and Radiation methods were found to over estimate the evapotranspiration; however the average value of the estimates by Pan evaporation method were only 88 mm higher than the average lysimetric value. The time trend in evapotranspiration indicated that the Pan evaporation method gave the estimates nearest to the actual evapotranspiration except during the early crop establishment and maturity stages. Seasonal crop-coefficients of 0.60, 0.55 and 0.81 were obtained with the methods of modified Penman, Radiation and pan evaporation respectively.

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INTRODUCTION

Successful crop production requires adequate soil moisture supply throughout its growing season. Due to erratic rainfall 2-4 supplemental irrigations are usually given to grow groundnut (*Arachis hypogaea* L.) successfully. Little or no quantitative information is available on the actual evapotranspiration (AET) from groundnut in the middle Gujarat region. Several empirical methods have been proposed for determining the potential evapotranspiration (PET) (Doorenbos and Pruitt, 1977). Such empirical estimates have been used by several workers as an alternative to direct method to estimate evapotranspiration. However the estimates by different empirical methods, in the past have rarely agreed for recommending the best approach. Van Bavel (1961) stated that lysimeters are more precise to measure evapotranspiration directly. The present study was undertaken to obtain reliable measurements of evapotranspiration from groundnut (*Arachis hypogaea* L.) by using lysimeters and to compare the results of measurements with estimated value obtained from selected empirical formulae during three seasons.

MATERIALS AND METHODS

The field experiment was conducted during the rainy seasons (kharif) of 1986, 1987 and

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1988 with 'JL-24' groundnut, on sandy loam soil at Anand with 6 June 1986, 3 July 1987 and 7 July 1988 as the respective dates of sowing on centrally placed 2 weighing type lysimeters of size 1.3 m x 1.3 m x 0.9 m each and having the weighing accuracy of 0.12 mm water loss each.

The fetch area for both the lysimeters was 25 m. The AET was measured daily from 2 lysimeters from sowing to harvesting and the mean of the two measurements was taken as equal to daily loss of water by evapotranspiration (AET).

The crop was harvested on 10 October 1986, 12 November 1987 and 19 November 1988. Potential evpotranspiration (FAO 1977) values for the crop were estimated using the modified Penman, radiation and Pan-evaporation methods (Doorenbos and Pruitt 1977) and were compared with the corresponding actual evapotranspiration values as measured by the lysimeters on weekly basis. Potential evapotranspiration referred to here is the reference potential evapotranspiration.

RESULTS AND DISCUSSION

The average weekly actual evapotranspiration (AET) remained low during the first 4 weeks after sowing and increased thereafter steadily to the maximum value of 4-6 mm/day at the 13th week during 1986 and 1987 and the 9 weeks after sowing in 1988 (Figs. 1 to 3). The period after the 12th week is the period of pod development stage. Thereafter the AET value declined to 1-2 mm/day at the time of harvesting. The seasonal actual evapotranspiration approached 399, 522 and 357 mm in 1986, 1987 and 1988 respectively (Table-1). The water demand by the crop during 1987 was high due to torrential rain and prevalence of higher temperature during flowering stage of the crop (7th week after sowing). As against this in 1988, there was heavy rainfall during the start of flowering stage (5th week after sowing) and in 1986, the total seasonal rainfall was very low but the prevalence of cloudy weather reduced the loss of water by evapotranspiration. On an average the AET was 426 mm which was in close agreement with the water requirement of groundnut crop reported by Maheshgiri *et al.* (1983).

The values of the average weekly reference potential evapotranspiration for the crop growing season during 1986, 1987 and 1988 (Figs. 1 to 3) showed that there were large differences in the values of the actual evapotranspiration as obtained by lysimeters and those of the potential evapotranspiration estimated by different methods during the first 5 weeks and after the 15th week after sowing. These could be attributed to the low leaf area in the beginning and dropping of leaves at maturity which resulted in low AET in lysimeters. During this period, transpiration loss was comparatively less and most of the evapotranspiration comprised evporation from soil surface. After five weeks of sowing and with further development of the crop, the difference between AET and the corresponding evapotranspiration estimated by pan-evaporation method was smaller than that by the other two methods, which ranked as modified Penman and Radiation method in increasing order of the values of differences. The lysimetric values were lower than corresponding evapotranspiration values estimated by other methods, but were nearer to evapotranspiration estimated by pan-evaporation method, based on the data of the whole season. The actual evapotranspiration towards the maturity of the crop again remained lower than potential evapotranspiration estimated

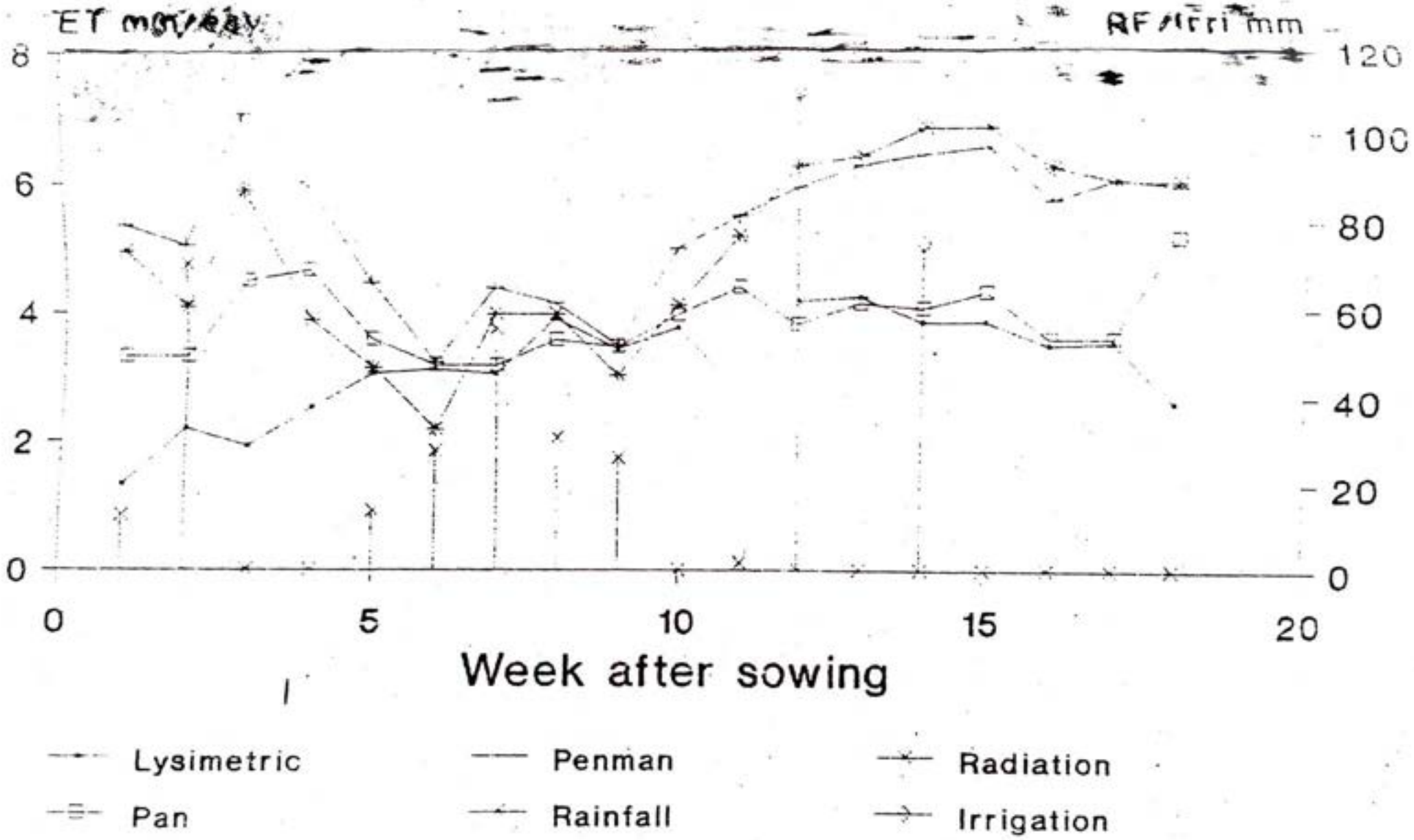

Fig.1 : Average weekly ET by different method during 1986

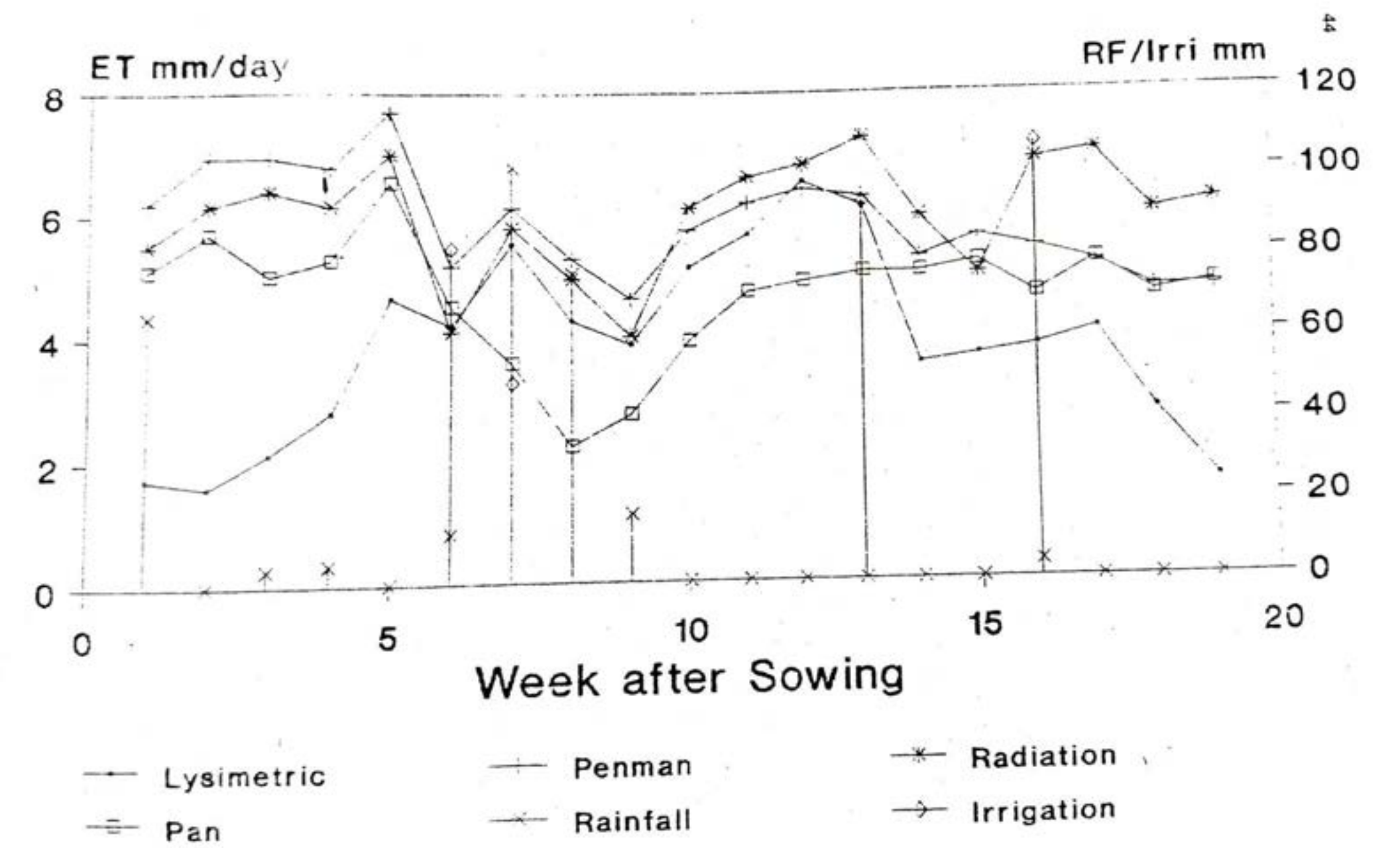

Fig.2 : Average weekly ET by different method during 1987

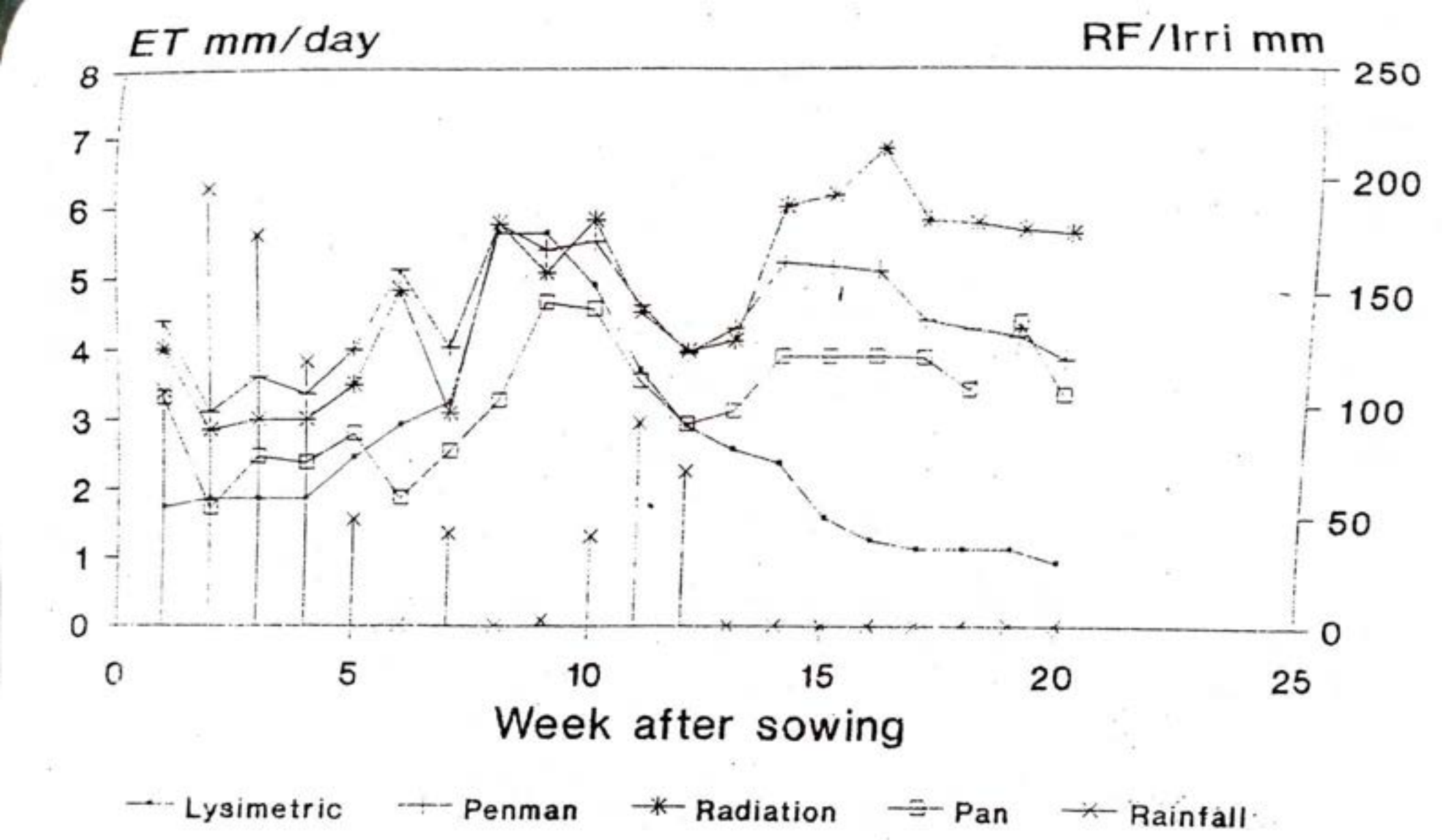

Fig.3 : Average weekly ET by different method during 1988

TABLE 1

Evapotranspiration (mm) parameters and water use efficiency for groundnut.

Parameters	*Crop Season*			*Mean*
	1986	*1987*	*1988*	
Seasonal AET (mm) by lysimeters	399	522	357	426
PET (mm) by Penman methods	676	779	628	694
Radiation method	625	796	671	696
Panevaporation Method	442	620	480	514
Rainfall (mm)	285	424	1000	–
Irrigation (mm)	100	200	–	–
Groundnut pod yield (kg/ha)	1617	1784	1535	1645
Total dry matter (kg/ha)	4906	5437	5105	5149
Water-use efficiency (kg/ha/mm) for pod	4.05	3.41	4.29	3.86
Water-use efficiency (kg/ha/mm) for total dry matter	12.29	10.41	14.29	12.08

TABLE 2

Crop stage-wise co-efficient (Kc) by different methods.

Crop stage	*Potential evapotranspiration estimated by*			
	Modified Penmen method	*Radiation method*	*Pan evaporation method*	*No. of weeks*
Emergence to flowering	0.46	0.55	0.65	6
Pegging	0.89	0.94	1.15	2
Pod development	0.66	0.62	0.85	6
Physiological maturity to harvesting crop	0.46	0.38	0.55	3-4
Crop season	0.60	0.55	0.81	

by all the methods but the differences with PET by pan-evaporation method were smaller, due to reduced transpirational loss caused by senescence of the leaves. After the 5th week of the crop growth, significant correlations were observed between the actual evapotranspiration and the PET by pan-evaporation methods (r=0.94 to 0.98) during the three seasons of the study. Similar results in maize crop for these two methods were also reported by Jana and Puste (1985) as well as by Hundal and Sandhu (1989). The 't' test for the actual evapotranspiration and corresponding PET by pan-evaporation method for all the seasons was carried out and the differences were found to be non-significant. However, potential evapotranspiration estimated by modified Penman and Radiation methods was found over estimated during all the growth periods of crop (Figs. 1 to 3) and also estimated with respect to the total of AET for the growing season as a whole (Table-1). The estimated and actual values were tested by 't' test and the results are significant. Average potential evapotranspiration by pan-evaporation method exceeded the measured AET by 88 mm for the entire crop growing season.

The stage of pegging (6-9 weeks after sowing) is very critical for water demand. During this stage, there was sudden rise in AET in all the seasons (Figs. 1 to 3). Thus the demand of water by the crop at the pegging stage being high, application of light irrigation helped in increasing the pod yield, if it did not rain in this phase. This also helped in avoiding excessive hardening of the soil during this stage.

On the whole, the crop coefficient values yielded by different methods during different crop stages were less than unity each (Table-2) except that given by pan-evaporation method for the pegging stage. The crop coefficients (Kc) were the highest during the pegging stage and were followed by those for the pod development stage. The Kc value of more than 1.0 indicated that the actual evapotranspiration exceeded the PET. The average Kc values for the crop season as a whole were 0.81, 0.60 and 0.53 by pan- evaporation modified Penman and Radiation methods respectively. The time trend in average weekly AET and PET (Figs.1-3) showed reduction in AET (by lysimeter) during the crop maturity stage, but such a trend was not predicted by other methods, since, the empirical estimates are based solely on the meteorological parameters and neglect the crop and soil conditions. They tend to overestimate evapotranspiration during the senescence and maturity of the crop. Inspite of all these anamolies, the evapotranspiration estimated by pan-evaporation method gave higher correlation with AET by lysimeter and the differences in the corresponding values were nonsignificant. Evaporimeter values represent the integrated effect of the meteorological factors and therefore evaporation-pan method could be used to estimate evapotranspiration from groundnut crop as described by Doorenbos and Pruitt (1977), to meet the evapotranspiration need of the groundnut crop under Anand conditions. The experimental results suggested that the crop required at least 3 irrigation each of 5 cm to obtain higher yields, if it did not rain during the pegging and pod development stages.

REFERENCES

Doorenbos, J. and Pruitt, W.O. 1977. Guidelines for predicting Crop Water Requirements pp 50-3. Irrigation and Drainage Paper 24, FAO, Rome (revised).

Hundal, S. S. and Sandhu, B. S. 1989. Actual evapotranspiration from maize (Zea mays) compared with potential evapotranspiration and pan evaporation in Punjab. *Indian J. Agril. Sci.* **39** (10) 645-9.

Jana, P. K. and Puste, A. N. 1965. Effect of soil moisture tension on yield, evapotranspiration and water use efficiency of winter maize. *Indian J. Agron.* **30** : 353-7.

Maheshgiri, M. Reddy, Y. M. and Rami Reddy, S. 1983. Reliability of empirical formulae for the determination of crop water requirements. *Andhra Agril. J.* **30** (2) : 160-165.

Rajwant, Singh and Hundal, S. S. 1989. Direct and indirect methods of evapotranspiration in wheat (*Triticum aestivum*) *Indian J. Agril. Sci.* **59** (8) : 506-514.

Ramkrishna Rao, G. and Bharambe, P. R. 1985. A rational approach irrigation sheduling based on evapo-transpiration, *Indian J. Soil Cons.* **1** (1) : 1-6.

Nitrogen Assimilation in Pearl Millet Hybrids and Parents

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ABSTRACT

Various important enzymic components of nitrogen assimilatory pathway were analysed in the shoots of three bajra hybrids (BJ-104, CJ-104 and BK-560) and their parents. The enzymes estimated were *in vivo* nitrate reductase (NR), *in vitro* nitrate reductase, nitrite reductase (NiR), glutamate dehydrogenase (GDH), glutamate synthase (GOGAT), glutamate oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT). No enzyme individually exhibited universal heterosis except GPT, where remarkable negative heterosis was seen in all the three hybrids. Except *in vitro* NR in CJ-104 and BJ-104, and *in vivo* NR and GOGAT in BK-560, where mid parental heterosis and/or sometimes better parental heterosis was recorded, all other components over all displayed no heterosis; and the hybrids followed mostly the mid - parental values. The agronomic heterosis of these hybrids might be based on the concept that the intermediate nature of these enzymic components of nitrate assimilatory system represented a balanced status producing an optimum level of reduced leaf N which is responsible for the enhanced efficiency of photosynthetic system and in turn productivity and yield.

In most of the parameters male parent was the better parent and nowhere a distinct better parental heterosis was seen. A need is realized for the improvement of male sterile lines (female parent).

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INTRODUCTION

The role of nitrogen in plant growth and development is of paramount importance and it has been shown that nitrogen can affect photosynthetic activity through its effect on leaf size (Dale 1972), on chloroplast structure and composition (Baszyski *et al.* 1972) and on leaf proteins (Blenkinsop and Dale, 1974), suggesting thereby that an adequate N supply is essential in the establishment of maximum sink capacity and maintaining an effective photo-synthetic apparatus which should be conducive to vegetative development and sustained grain filling (See Sherrard *et al.* 1984).

Most of the nitrogen assimilated in the plants is through the absorption of nitrate from the soil and its subsequent reduction by a series of enzymes viz., nitrate reductase (NR), nitrite reductase (NiR), glutamate dehydrogenase (GDH), glutamate synthase (GOGAT), glutamate oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT) reactions. In view of above, these enzymic reactions were analysed

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in three hybrids of *Pennisetum americanum* (L.) Leeke and their parents in relation to heterosis. Heterosis in some components of photosynthesis and auxin metabolism has already been established (Joshi *et al.* 1986 a, b).

MATERIALS AND METHODS

Culture procedure : The seedlings were cultured in Sand pots as described earlier (Joshi *et al.* 1986 a). The seeds of pearl millet (*Pennisetum americanum* L. Leeke) F_1 hybrids (CJ-104, BJ-104 and BK-560) alongwith their parents (5054A, 5141A, J-104 and K-560-230) were surface sterilized with 0.1% mercuric chloride for 10 minutes and thoroughly washed with tap water followed by three rinses of distilled water. Seeds were presoaked for 30 min. and sown at a depth of 1 cm in sterilized sand in plastic pots (1 kg/pot) initially irrigated with 300 ml of nutrient medium (Arnon and Hoagland 1940). The pots were exposed to temperature controlled growth room (30° + 2° C) where seedlings emerged after two and a half days. After two more days plants were thinned to 15 seedlings per pot. Every alternate day plants were fed with 40 ml of either KNO_3 (0.01 M) or the nutrient medium. The excess medium, if any, was drained out. Three days onwards, every alternate day (upto 11 days) plants were analyzed for different enzyme activities. The experiment was carried out once, and all the determinations were done in three individual replicates. The individual replicate consisted of known number of shoots which were chilled, crushed and thoroughly mixed for the preparation of enzyme medium used as the enzyme source. As the activities are expressed as per shoot basis neither protein not the specific activities were determined.

In vivo nitrate reductase : The method followed was a slight modification over Chanda *et al.* (1987). The assay mixture (10 ml) consisted of known amount of thoroughly chopped and mixed plant material, n-propanol (2.5% v/v), phosphate buffer (0.08 M, pH 7.4) and KNO_3 (0.05 M). Reduced nicotinamide adenine dinucleotide (NADH) was not added in the medium to know the relative limitation of endogenous NADH for the NR activity. The nitrite produced was measured as per Evans and Nason (1953). The activity is expressed as n moles nitrite produced min^{-1} $shoot^{-1}$.

***In vitro* nitrate reductase**

Extraction : The extraction medium consisted of 10 mM of Tris - HCl buffer (pH 7.8), 1 mM of cysteine and 0.3 mM of EDTA. The known number of shoots were crushed in extraction medium and centrifuged at 10000 g for 5 min. The supernatant served as the source of enzyme.

Assay : The assay procedure followed was that of Eck and Hageman (1974). The assay mixture (3.5 ml) consisted of 1 ml of enzyme medium, 57 mM of Na-phosphate buffer (pH 7.5), 0.2 mM of NADH and 14 mM of KNO_3. The activity is expressed as a moles of nitrite produced min^{-1} $Shoot^{-1}$. Nitrite reductase (*in vitro*).

Extraction : The extraction medium consisted of 50 mM of Tris - HCl buffer (pH 7.8), 1 mM of EDTA and 5 mM of mercaptoethanol. The known amount of shoots material was chilled, crushed and centrifuged at 10000 g for 5 min. The supernatant was further partially purified by acetone precipitation. The precipitated proteins were redissolved in the extraction medium to serve as the enzyme source.

Assay : The method followed was that according to Ramirez *et al.* (1966). The assay mixture (2 ml) consisted of 50 mM of phosphate buffer, 1 mM of $Na\ NO_2$, 0.5 mg of methyl viologen, 0.5 ml of enzyme medium and 15 mg of Sodium dithionite. The disappearance of the

nitrite from the medium was recorded as per Evans and Nason (1953) and the activity is expressed as m moles NO_2 reduced min^{-1} $shoot^{-1}$.

Glutamate dehydrogenase

Extraction : The extraction medium consisted of 300 mM Tris-HCl buffer (pH - 7.8), 1 mM EDTA and 5 mM mercaptoethanol. The chilled shoot material was crushed thoroughly and centrifuged at 20000 g for 20 min. The supernatant served as the enzyme source for GDH, GOGAT, GOT and GPT.

Assay : The assay procedure followed was essentially that of Bergmeyer (1962) with some modifications. The assay mixture (3 ml) consisted of 100 mM Tris HCl buffer (pH 7.8), 200 mM NH_4 Cl, 10 mM α Oxoglutarate, 0.14 mM NADH and 0.5 ml of enzyme medium. The activity is expressed as μ moles of NADH oxidized min^{-1} $shoot^{-1}$.

Glutamate synthase

Assay : A slightly modified method of Rigano *et al.* (1975) was followed for the enzyme assay. The reaction mixture (3 ml) consisted of 100 mM of Tris - HCl buffer (pH 7.8), 5 mM glutamine, 10 mM α - Oxoglutarate, 0.14 mM NADH and 0.5 ml of enzyme. The oxidation of NADH was observed spectrophotometrically. The activity is expressed as μ moles of NADH oxidized h^{-1} $Shoot^{-1}$.

Glutamate oxaloacetate transaminase

Assay : The method of Bergmeyer (1962) was followed with slight modifications. The reaction mixture (3 ml) consisted of 200 mM of Tris - HCl buffer (pH 7.8), 50 mM L - aspartate, 6.6 mM α oxoglutarate, 0.14 mM NADH and 0.5 ml of enzyme extract. The reaction was coupled with malic dehydrogenase (MDH). Endogenous MDH activity is manifold higher than that of GOT but to be at safer side 200 units of MDH (porcine heart) obtained from Sigma Chemicals Co., USA were added to the assay medium. The activity is expressed as μ moles of NADH oxidized min^{-1} $Shoot^{-1}$.

Glutamate pyruvate transaminase

Assay : The colorimetric assay procedure followed was that of Bergmeyer (1962). The activity is expressed as A_{546} min^{-1} $Shoot^{-1}$.

Statistical analysis : Students 't' test was employed for the comparison of values for hybrid (Hyb) versus parents viz. female (F), male (M) and mid parent (MP). The level of significance i.e. 1% or 5% is indicated in the results and discussion part.

RESULTS AND DISCUSSION

In vivo and *in vitro* estimation techniques of nitrate reductase activity have their own significance because an *in vivo* assay though gives inflated values, the results are better representation of *in Situ* nitrate reduction (Breteler and Hanisch ten cate 1980), while an *in vitro* assay is a better assessment of the true level of nitrate reductase enzyme protein as the reductant NADH in many tissues becomes rate limiting in *in vivo* assay (Chanda *et al.* 1987). In the present study both *in vivo* and *in vitro* methods of NR estimation expressed themselves differently in different hybrids (Fig. 1). The hybrid BK-560, though possessing low enzymic activity (as evident from *in vitro* activity - Fig. 1B - the differences between Hybrid (Hyb) versus Mid parent (MP) being significant mostly at 1% level) exhibited mid parental heterosis in *in vivo* activity (Fig. 1A - significance Hyb/MP mostly at 1%). While hybrids CJ-104 and BJ-104, though having more enzymic activity (heterotic levels in *in vitro* NR assay - Fig - 1B significance Hyb/MP mostly at 1% level) failed

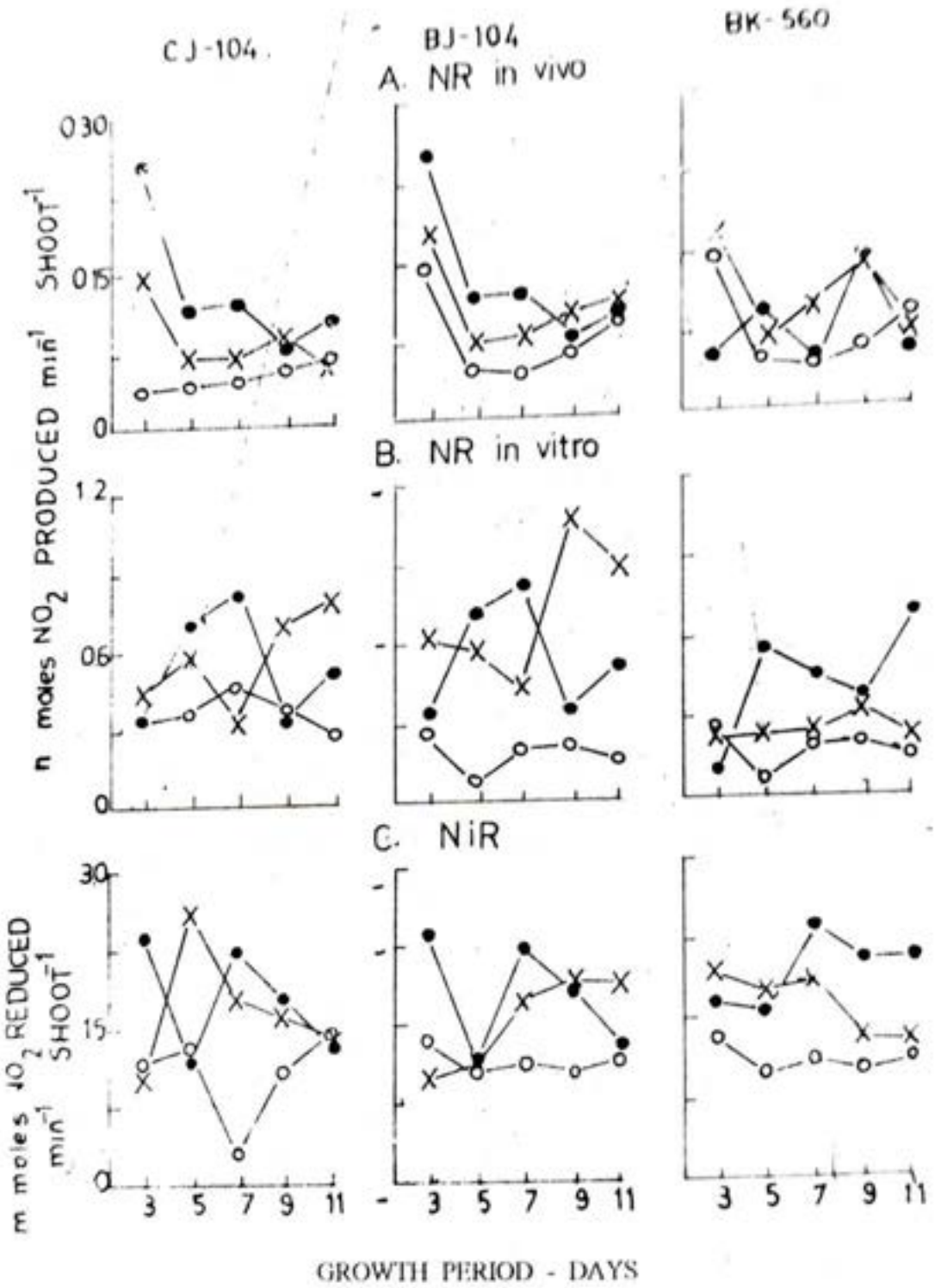

FIG. 1

Fig.1: The activities of (A) *in vivo* nitrate reductase (NR), (B) *in vitro* nitrate reductase (NR) and (C) nitrite reductase (NiR) in three sets of bajra hybrids (X – X) and their respective male (● - ●) and female (0 - 0) parents.

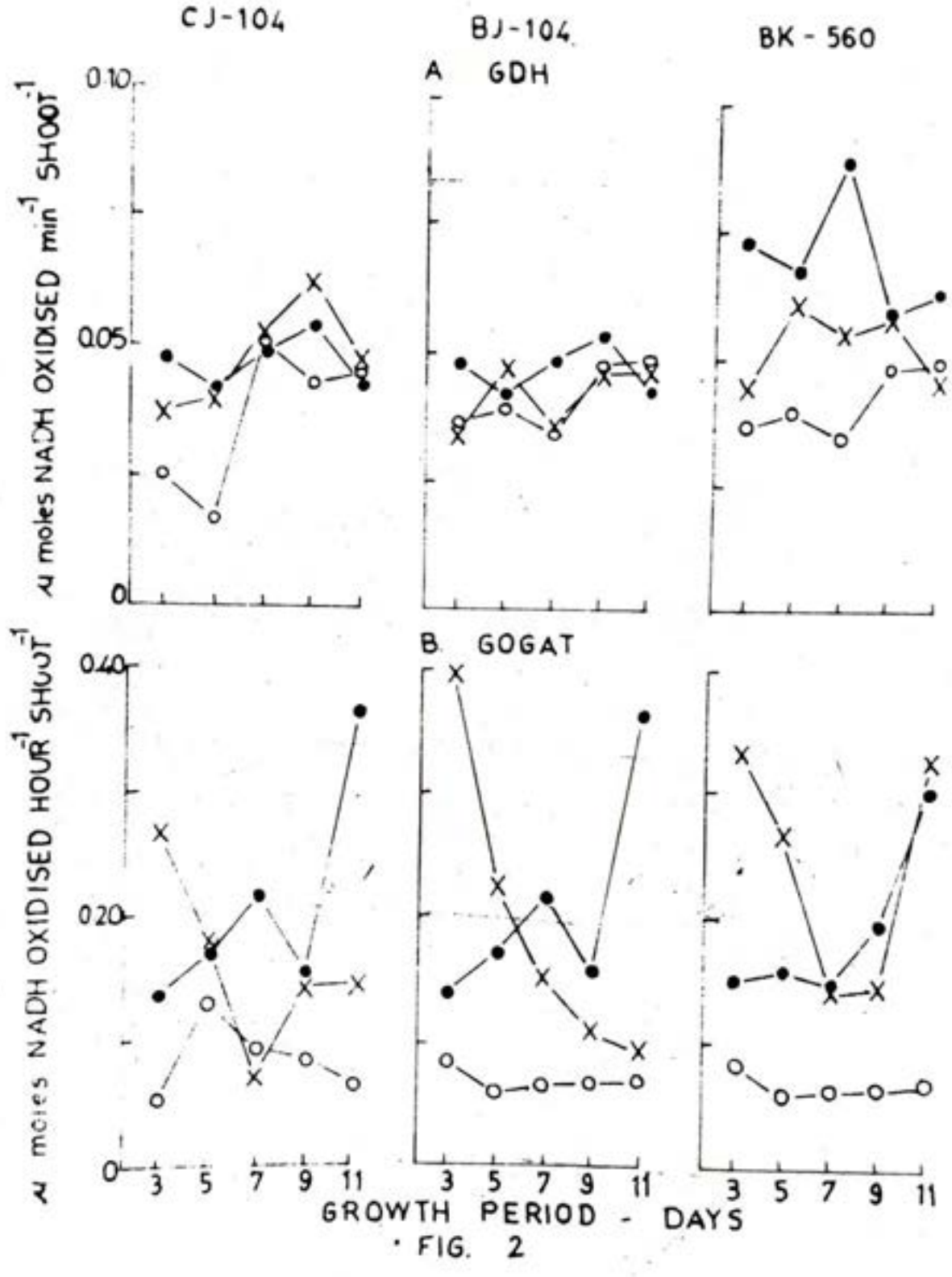

Fig.2: Changes in (A) glutamate dehydrogenase (GDH), and (B) glutamate synthase (GOGAT) in three bajra hybrids (X - X) and respective male (● - ●) and female (0 - 0) parents.

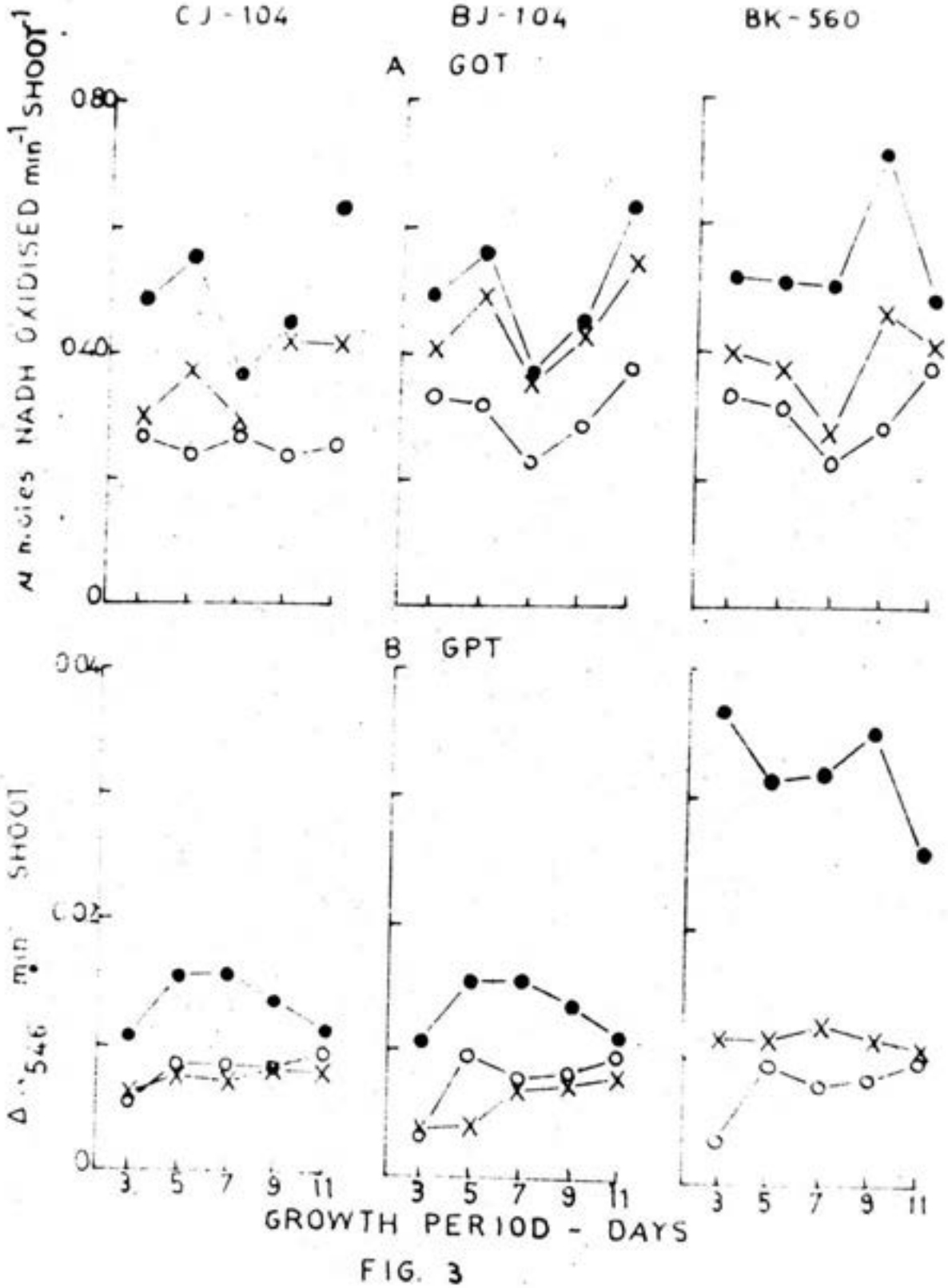

FIG. 3

Fig.3: Changes in (A) glutamate oxaloacetate transaminase (GOT) and (B) glutamate pyruvate transaminase in the three sets of bajra hybrids (X - X) and their respective male (● - ●) and female (0 - 0) parents.

to show any heterosis *in vivo* activity (Fig. 1A - differences Hyb/MP - mostly non-significant). It has however been suggested that under aerobic conditions mitochondrial respiration and nitrate reduction compete for reducing equivalents (NADH) and this might act as a regulatory mechanism (Naik *et al.* 1982). In any case, nitrate reductase activity could not exhibit heterosis in all the hybrids. Similar results were obtained by the Misra *et al.* (1981).

Nitrite reductase recorded intermediate levels and some times a meagre amount of mid-parental heterosis in these hybrids (Fig. 1 C). That NiR is not a rate limiting step can be inferred from the fact that its activity was several fold higher than the nitrate reductase activity. Similar conclusions have been drawn earlier by Hewitt and Edge (1978).

Both GDH and GOGAT, in general, recorded intermediate levels in the hybrids (Hyb/MP differences non-significant) except GDH in CJ-104 and GOGAT in BK-560 (where most of the values Hyb/MP significant at 1% and 5% P level), with the male parent as the better parent in all the cases (Fig. 2). The levels of GOGAT were very low, supporting the fact that NAD (P) H dependent activity is only 3% in green leaves (Wallsgrove *et al.* 1982).

Two important transaminases, GOT and GPT recorded intermediate trend in the hybrids and even pronounced negative heterosis was observed in GPT in which the hybrid followed the poor parent closely (Fig. 3 - where most of the values HY/MP significant at 1% level). Similar results have been obtained by Chanda *et al.* (1988 a). Thus the role of this enzyme in chlorophyll biosynthesis as proposed by Hedley and Stoddart (1971) was not apparent because these hybrids showed a pronounced heterosis in chlorophyll (Joshi *et al.* 1986a, Chanda *et al.* 1988 b).

All the enzyme's activities exhibited fluctuations over the growth period. These variations are attributed to the ontogenic differences.

In the present investigation an over all assessment of the nitrate assimilatory pathway in different hybrids revealed that hybrids followed an intermediate trend - a balanced status which may be capable of providing an optimum level of reduced N in leaf. Kishitani *et al.* (1972) have developed a model in *Oryza* species to predict optimal level of leaf nitrogen for maximizing photosynthesis rate of leaf canopies. Heterotic levels of photosynthetic components viz., Chlorophyll content and Hill activity have already been established in these agronomically heterotic hybrids of pearl millet (Joshi *et al.* 1986a). Moreover, the interdependence of photosynthesis and nitrogen assimilation has very well been documented (Hageman 1979, Ibragimov 1980, Srivastava 1980, Wallsgrove *et al.* 1982).

Further, so far these enzyme activities are concerned, female parent was always a poor parent and a need is realized for the improvement of male sterile lines, the female parent.

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REFERENCES

Arnon, D. I. and D. R. Hoagland, 1940. Crop production in artificial culture solutions and in soils with special reference to factor influencing yields and absorption of inorgenic nutrients, *Soil Sci.* **50** : 463.

Baszynski, T., J. Brand, R. Barr, D. W. Krogmann and F. L. Crane, 1972. Some biochemical characteristics of chloroplasts from mineral deficient maize, *Plant Physiol.* **50** : 410 - 411.

Bergmeyer, M. U., 1962. Methodon der Enzymatischen Analyse, Verlag Chemie, Gmbh, Weinheim Bergstr.

Blenkinsop, P. G. and J. Z. Dale, 1974. The effects of nitrate supply and grain reserves on Fraction I protein level in the first leaf of barley, *J. Exp. Bot.* **25** : 913 : 926.

Breteler, H. and C. H. Hahisch ten cate, 1980. Fate of nitrate during initial utilization by nitrogen deploted dwarf bean, *Physiol. Plant* **48** : 292 - 296.

Chanda, S. V., A. K. Joshi, P. N. Krishnan and Y. D. Singh, 1987. *In vivo* Nitrate reductase activity in leaves of pearl millet, *Pennisetum americanum* (L.) Leeke, *Aust. J. Plant Physiol.* **14** : 125-134.

Chanda, S. V., A. K. Joshi, P. P. Vaishnav and Y. D. Singh, 1988(a). Enzymes of ammonia assimilation and transmination in relation to hybrid vigour in pearl millet (*Pennisetum americanum* L. Leeke), *J. Agronomy & Crop Science* **160** : 125 - 131.

Chanda, S. V., A. K. Joshi, P. P. Vaishnav and Y. D. Singh, 1988 (b). Comparative analysis of photosynthetic parameters and its evaluation in pearl millet hybrid and parents. *J. Agronomy & Crop Science* **160** : 217 - 223.

Dale, J. E., 1972. Growth and photosynthesis in the first leaf of barley. The effect of time of application of N. *Ann. Bot.* **36** : 967 - 979.

Eck, H. V. and R. H. Hageman, 1974. Nitrate reductase activity in Sudan grass cultivars, *Crop Sci.* **14** : 283 - 287.

Evans, H. J. and A. Nason, 1953. Pyridine nucleotide nitrate reductase from extracts of higher plants, *Plant physiol.* **28** : 233-254.

Hageman, R. H., 1979. Integration of nitrogen assimilation in relation to yield. In Nitrogen assimilation of plants. Eds. Hewitt E. J. and C. V. Cutting, Academic press, New York 591-611.

Hedley, C. L. and J. L. Stoddart, 1971. Factors influencing alanine aminotransferase activity in leaves of *Lolium temulentum* L. I. photoperiodically induced variations, *J. Exp. Bot.* **22** : 239-248.

Ibragimov, M., 1980. Dependence of photosynthesis on nitrogen fertilizer doses and width of inter - row spacing, *Uzb. Biol. Zh.* **0** : 23-24.

Joshi, A. K., S. V. Chanda, P. M. Krishnan, P. P. Vaishnav and Y. D. Singh, 1986 (a). Chlorophyll content, Hill reaction and PEP case activity in relation to hybrid vigour in pearl millet during early seedling growth, *J. agronomy & Crop Science* **157** : 1-12.

Joshi, A. K., S. V. Chanda, P. N. Krishnan, P. P. Vaishnav and Y. D. Singh, 1986 (b). Seedling peroxidase and IAA oxidase activities in relation to hybrid vigour in pearl millet (*Pennisetum americanum* L. Leeke), *J. Agronomy & Crop Science* **157** : 156-168.

Kishitani, S., Y. Takano and S. Tsunoda, 1972. Optimum leaf area and nitrogen content of single leaves for maximizing the photosynthesis rate of leaf canopies : A simulation in rice. *Japan J. Breeding* **22** : 1-10.

Misra, S. P., S. K. Sinha and N.G.P. Rao, 1981. Genetic analysis of nitrate reductase activity in relation to yield heterosis in sorghum. *Z. Pflanzen.* **86** : 11-19.

Naik, M. S., Y. P. Abrol, T. V. R. Nair and C. S. Rama Rao, 1982. Nitrate assimilation - Its regulation and relationship to reduced nitrogen in higher plants, *Phytochem.* **21** : 495-504.

Ramirez, J. M., F. F. Del Campo, A. Paneque and M. Losada, 1966. Ferredoxin - nitrate reductase from spinach. *Biochem. Biophys. Acta.* **128** : 202-204.

Ricketts, T. R. and P. A. Edge, 1978. Nitrate and nitrite reductases in *Platymonas Striata* Butcher (Prasinophyceae), *Br. Phycol.* **13** : 167-176.

Rigano, C., G. Aliotta, V.D.M. Rigano, 1975. Observations on enzymes of ammonia assimilation in two different strains of *Cyanidium caldarium, Arch. Microbiol.* **104** : 297-299.

Sherrard, J. H., R. J. Lambert, M. J. Messmer, F. E. Below and R. H. Hageman, 1984. Search for useful physiological and biochemical traits in maize. In crop breeding : A contemporary basis. Pergamon press, Oxford 51-66.

Srivastava, H. S., 1980. Regulation of nitrate reductase activity in higher plants, *Phytochem.* **19** : 725-733.

Wallsgrove, R. M., P. J. Lea and B. J. Miflin, 1982. The development of NAD (P)H dependent and ferredoxin dependent glutamate synthase in greening pea and barley leaves, *Planta* **154** : 473 - 476.

Wallsgrove, R. M., A. J. Keys, P. J. Lea and B. J. Miflin, 1983. Photosynthesis, photorespiration and nitrogen metabolism, *Plant, Cell* and *environ.* **6** : 301-309.

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Line X Tester Analysis of Combining Ability in Egyption Cotton (*Gossypium barbadense* L.)

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ABSTRACT

Combining ability for nine quantitative attributes was studied through Line x Tester analysis involving 3 lines and 6 testers in *Gossypium barbadense* L. The estimates of σ^2gca, σ^2sca and average degree of dominance (σ^2sca/2 σ^2gca)½ indicated preponderance of additive gene effects for ginning percentage only, whereas, for the rest of the characters non additive gene effects were preponderant. General combining ability effects of the parents indicated that the female parents EL 664 and male parent SILS-9 were good general combiners for seed cotton yield and lint yield. The only cross EL 664 x SILS-9 recorded significantly high possitive sca effects for seed cotton yield. For lint yield, crosses EL 664 x SILS-9 and EL 664 x B.S. 38 recorded significant desired sca effects. The only hybrid EL 664 x B.S. 38 showed significant possitive sca effect for ginning per cent.

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INTRODUCTION

Constant efforts are being made to improve yield through hybridization, selection of the parents for hybridization programme is an important aspect in all crop improvement programmes. Therefore, in any sound breeding programme, the proper choice of parents based on their combining ability is a pre-requisite. As such studies/intended to determine the combining ability not only provide necessary information regarding the choice of parents but they also simultaneously illustrate the nature and magnitude of gene action involved. Accordingly, the present investigation was undertaken to have an idea of the nature of combining ability for yield and other important attributes in Egyption cotton with a view to identify good combiners which may be used to build up a population with favourable fixable genes for effective yield improvement Line X Tester is a useful for preliminary evaluation of genetic stock for use in hybridization programme.

MATERIALS AND METHODS

The experimental material consisted of 3 lines viz., EL 664, Stone Ville-53 and K 2262 which were used as seed parent and 6 varieties viz., H 51-3, Suvin, SILIS-9, 53-56 B, B.S. 38 and ERB 13758 as pollen parents, along with their 18 F_1 hybrids were studied in a randomised block design with three replications at Plant Breeding

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Farm, GAU, Anand during kharif 1987. Inter- and intra-row distance was 90 and 30 cm respectively. Five competitive plants selected at random from each treatment were used to record various observations (Table 1). Combining ability analysis was computed according to the model given by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among all the genotypes for all the characters indicating the presence of considerable amount of genetic variability (Table 1). The analysis of variance for combining ability revealed that the significant variances for females were observed for first fruiting node number, number of bolls per plant, seed cotton yield, lint yield and ginning percentage. Significant variances for males were observed for number of sympodia/plant, first fruiting node number, number of seeds per boll and ginning percentage. The mean squares due to males x females were highly significant for number of sympodia plant, seed cotton yield and lint yield.

Low average degree of dominance (σ^2 sca/ σ^2 gca)½ revealed predominantly additive type of gene effect for ginning percentage, this result is in accordance with findings of Krishnamurthy and Henry (1979), Prakash Kumar *et al.* (1974) and Bains *et al.* (1982). Greater average degree of dominance indicated that number of sympodia/ plant, first fruiting node number, number of bolls/ plant, number of seeds/boll, boll weight, seed yield/plant, lint yield/plant and mean halo length predominantly controlled by non-additive gene effects. These results are in agreement with findings of Singh *et al.* (1972 a), Singh *et al.* (1972 b), Bains *et al.* (1982) and Abo-EL-Zahab and Metwaly (1979).

The estimates of general combining ability effects, which are significant for various characters are presented in Table-2 alongwith their *per se* performance. None of the parents showed significant gca effects for mean halo length. Among female parents EL 664 was good general combiner for seed cotton yield, lint yield and ginning percentage, whose per se performance was also highest for all these three traits. Among pollen parents, the tester SILS-9 was good general combiner for seed cotton yield (126.49 gm mean yield), lint yield (37.46 gm mean yield) and number of seeds/boll (18.33 seeds/boll). Tester H 51-3 was good general combiner for boll weight (2.90 gm, mean value) and first fruiting node number (1.87 lowest mean value) but poor general combiner for number of seeds/boll (24.67 highest mean value) and number of sympodia/plant (23.67 mean value), whereas, the testers B.S. 38 was good general combiner for lint yield (35.69 gm. mean value) and ginning percentage (31.33% highest mean value). These parents are having more chances to produce transgressive segregants.

The estimates of specific combining ability effects, which are significant are presented in Table-3 alongwith their *per se* performance. The best cross combinations for various characters usually did not combine the respective best male and female parents. The only cross EL 664 x SILS-9 showed significantly possitive sca effect for seed cotton yield (292.65 gm. mean), whereas the cross combinations EL 664 x ERB 13758, Stone Ville x SILS-9 and K 2262 x B. S. 38 revealed negative sca effects for this trait.

For lint yield/plant, the hybrid EL 664 x SILS-9 (91.64 gm. mean value) and EL 664 x B. S. 38 (95.47 gm. mean value) showed significant sca effects, whereas the hybrids EL 664 x ERB 13758 and K 2262 x B. S. 38 had negative significant sca effects. The hybrid EL 664 x B. S. 38 revealed significant desired

TABLE 1

Analysis of variance and estimate of combining ability variance for nine characters in cotton.

Source	*d.f.*	*Mean squares*								
		No. of sympodia/ plant	*First fruiting node number*	*No. of bolls/ plant*	*No. of seeds/ boll*	*Boll. wt. (gm)*	*Seed cotton yield/plant*	*Lint yield/ plant (gm)*	*Ginning %*	*Mean halo length*
Replication	2	28.27*	1.77**	160.81	5.85	1.71*	2283.63*	136.02	3.40	11.566**
Genotype	26	23.66**	0.89**	250.95**	30.77**	0.85**	9096.04*	990.21**	13.33**	4.384**
Parents	8	25.47**	1.32**	521.33**	46.48**	1.11**	7666.68**	869.01**	6.89	2.914
Parents Vs hybrids	1	62.95**	2.88**	138.55	0.88	0.00	116344.80**	7315.27**	13.06	47.992*
Hybrids	17	20.49**	0.57*	130.33	25.14**	0.77*	3459.93**	557.54**	16.38**	2.510
Females	2	9.17	0.35**	418.94**	1.53	0.21	13133.63**	2001.04*	53.55**	4.883
Males	5	42.24**	1.67**	38.26	48.07*	1.31	2288.55	496.64	21.59*	1.148
Females x Males	10	11.88**	0.06	118.64	18.39	0.62	2110.88**	299.29*	6.34	2.716
Error	52	7.09	0.28	76.44	9.20	0.36	538.83	58.95	4.55	2.023
σ^2 gca		0.34	0.02	-0.106	0.21	3.83	51.34	10.40	0.43	-0.02
σ^2 sca		1.60	-0.07	14.07	3.06	8.49	524.02	80.11	0.60	0.23
Average degree of dominance (σ^2 sca/2 σ^2 gca) ½		1.53	1.32	8.15	2.70	1.05	2.26	1.96	0.84	2.40

*, ** Significant at 5% and 1% levels, respectively.

TABLE 2

General combining ability effects and *per se* performance of cotton parents.

Parents	Gca effect and per se performance							
	No. of sympodia/ plant	*First fruiting node number*	*No. of bolls/ plant*	*No. of seeds/ boll*	*Boll wt. (gm)*	*Seed cotton yield/plant*	*Lint yield/ plant (gm)*	*Ginning %*
Lines								
EL 664	0.07	-0.14	-5.40 *	0.23	-0.12	30.35 **	12.16 **	1.37 **
	(19.20)	(2.00)	(50.00)	(23.33)	(2.53)	(199.66)	(68.14)	(34.05)
Stone Ville	0.68	0.14	1.53	0.10	0.09	-8.95	-6.55 **	1.94 **
	(19.10)	(2.47)	35.40	(26.46)	(3.97)	(122.58)	(35.35)	(28.77)
K 2262	-0.74	0.00	3.87	-0.33	0.03	2-21.40 **	-5.61 **	0.57
	(19.93)	(2.73)	(37.60)	(26.20)	(3.50)	(169.24)	(52.65)	(31.11)
Testers								
H 51-3	-4.28 **	-0.79 **	-2.80	4.15 *	0.76 **	-1.25	-2.46	-0.97
	(23.67)	(1.87)	(23.00)	(24.67)	(2.90)	(166.48)	(49.78)	(30.14)
Suvin	1.14	0.30	-0.51	-0.99	-0.23	-6.17	-1.34	0.59
	(27.33)	(2.07)	(42.53)	(16.73)	(2.30)	(81.22)	(24.24)	(29.84)
SILS-9	0.01	0.39 *	2.84	-2.07 *	-0.08	23.01 *	6.62 *	-0.28
	(25.27)	(2.07)	(66.67)	(18.33)	(2.63)	(126.49)	(37.46)	(29.43)
53-56 B	1.63	0.19	0.22	-0.74	-0.23	-11.54	-5.05	-0.60
	(23.80)	(3.67)	(26.20)	(17.93)	(1.97)	(41.14)	(12.50)	(30.21)
B.S. 38	0.94	-0.15	-1.45	-1.52	-0.04	14.93	11.02 **	2.81 **
	(23.93)	(3.53)	(37.33)	(19.67)	(2.73)	(114.17)	(35.69)	(31.33)
ERB 13758	0.54	0.07	1.70	1.17	-0.19	-18.39	-8.79 **	-1.55 *
	(24.80)	(2.73)	(31.67)	(17.53)	(2.60)	(78.18)	(23.72)	(30.42)
S.E.								
Lines	0.63	0.13	2.06	0.71	0.14	5.47	1.81	0.50
Testers	0.89	0.18	2.92	1.01	0.21	7.73	2.46	0.71

Note : (1) *, ** Significant at 5 % and 1 % levels, respectively.

(2) Figure in parentheses shows mean value of the respective parent.

TABLE 3

Cotton crosses showing significant sca effects and their *per se* performance.

Characters	*Crosses*	*Sca effects*	*Mean Value*	*S.E.*
Number of seeds/boll	Stone Ville x ERB 13758	5.21 **	27.47	1.75
Seed cotton yield/plant (gm)	EL 664 X SILS-9	36.77 **	292.65	13.40
	EL 664 X ERB 13758	-33.97 **	180.52	
	Stone Ville x SILS-9	-29.33 **	187.25	
	K 2262 x B.S. 38	-35.93 **	160.13	
Lint yield/plant (gm)	EL 664 x SILS-9	12.38 **	91.64	4.43
	EL 664 x B.S. 38	11.82 **	95.47	
	EL 664 x ERB 13758	-10.38 **	53.46	
	K 2262 x BS. 38	-16.31 **	49.57	
Ginning %	EL 664 x B.S. 38	2.28 **	36.19	1.23

*, ** Significant at 5% and 1% levels, respectively.

sca effect (36.19% mean value) for ginning percentage. For number of seeds/boll, the cross Stone Ville X ERB 13758 revealed undesired significant sca effect.

The estimates of gca effects of the parents indicated that none of the parents proved to be good general combiner for all the traits studied, however, the female line EL 664 come out as good general combiner for important yield components viz., seed cotton yield, lint yield and ginning percentage. Specific combining ability effects revealed that high yielding crosses EL 664 x SILS-9 showing high sca effects for yield involved both good combining parents. High sca effect of this F_1 could be attributed to additive gene interactions which is fixable, such crosses are likely to yield good segregants. Performance of hybrids based on their sca effects revealed that the crosses between two high general combiners were best for their sca effects and these crosses would give good segregants. In the present study, both additive and non additive type of genetic variance is important with preponderance of non-additive genetic variance. Recurrent selection is a breeding system having some theoritical superiority over the standard system of continued self-pollination is more advantageous.

REFERENCES

Abo-EL-Zahab, A. A. and Metwaly N. H. (1979). Heterosis and combining ability in *G. barbadense* L. Cotton *Zeitschrift* for *pflenzenzuchtuna* 1:45-69 (Fide : *Pl. Breed. Abstr,* **60** : 4098).

Bains, S. S., Murthy B. R., Joshi A. B. and Nanda, G. S. (1982). Genetics of lint yield, boll weight, boll number and seed index in *G. hirsutum*. L. *Indian J. Genet.*, **42** : 134-139.

Kempthorne, C. (1957). An introduction to Genetical Statistics. Jhon Wiley and Sons., Inc., New York.

Krishnamurthy, R. and Henry S. (1979)., Line x tester analysis of combining ability and heterosis in *G. hirsutum* x *G. barbadense* crosses. *Indian J. Agric. Sci.*, **49** : 492-499.

Parkashkumar, Pathak, R. S. and Singh, R. K. (1974). Heterosis and combining ability in upland cotton. (*G. hirsutum* L.) *Indian J. Agric. Sci.*, **44** : 145-150.

Singh R. B., Dahiya R. P. and Jain D. K. (1972 a). Genetics of yield characters in upland cotton. *Indian J. Genet.*, **32** : 138-152.

Singh R. B., Jain D. K. and Dahiya, R. P. (1972 b). Genetic analysis of ginning and fibre characters in upland cotton (*G. hirsutum* L.) *Indian J. Genet.* **32** : 125-137.

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Combining Ability Analysis Over Environments in Okra (*Abelmoschus esculentus* (L) Moench)*

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ABSTRACT

Combining ability studies were made over three environments for fruit yield and its eight contributing characters using 9 x 9 parental diallel F_1 progenies in okra (*Abelmoschus esculentus* (L.) Moench). Both gca and sca were influenced by environments. It suggested that to have unbiased estimates of gca and sca, the material may be tested over a wide range of environments. Both additive and non-additive variances were important for all the characters studied. However, the variances due to gca were higher in magnitude than their respective sca counter parts for all the characters. The *per se* performance of the parents may give a good indication of their gca effects. The additive and non-additive variances may be exploited following intermating among the progenies within and between promising crosses in early segregating generations.

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INTRODUCTION

A number of studies on combining ability and its genetic control for yield and yield traits are reported in okra (Kulkarni *et al.* 1976 ; Partap and Dhankhar 1980; Partap *et al.* 1980, 1981; Patel 1988 and Patel *et al.* 1990). The scope of such studies was limited as they were mostly based on one year/locations of testing. The present paper is an attempt to analyse a nine parental diallel cross over three environments for combining ability x environment interactions, combining ability estimates on the data pooled over environments, and the genetic systems governing the expression of fruit yield and its contributing characters.

MATERIALS AND METHODS

Nine diverse genotypes of okra viz., Parbhani Kranti, White Velvet and Ankur (Maharashtra); Gujarat Okra-1, Padra 18-6 and Line No. 51 (Gujarat); Punjab Padmini (Punjab), Perkins Long Green (J & K) and Pusa Sawani (New Delhi), were selected for crossing in all possible combinations (without reciprocal). The 36 F_1 progenies along with nine parents were grown and evaluated in a randomized block design with three replications in three environments, i.e. Navsari *Kharif*, 1990 (E_1); Junagadh *Kharif*, 1990 (E_2) and Navsari summer, 1991 (E_3). Each treatment was represented by a single row plot of ten plants, spaced at 45 x 30 cm. Five random plants from each row were scored for nine characters (Table 1).

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TABLE 1

Analysis of variance for combining ability over environments in Okra.

Source	d.f.	Mean squares								
		Days to flowering	Nodes/ plant	Inter-nodal length	Plant height	Branches/ plant	Fruit length	Fruit girth	Fruits/ plant	Yield/ plant
Gca	8	49.43 **	13.89 **	5.72**	730.00 **	0.16 **	7.45 **	0.70 **	12.58 **	3402.20 **
Sca	36	4.31 **	1.90 **	1.49**	157.87 **	0.02 **	1.59 **	0.12 **	2.18 **	567.15 **
Environment	2	161.14 **	1429.72 **	0.11	144654.50 **	6.48 **	79.29 **	11.06 **	111.97 **	49690.00 **
Gca x E	16	8.65 **	2.99 **	1.14**	378.71 **	0.02 **	3.00 **	0.15 **	2.39 **	616.72 **
Sca x E	72	5.33 **	0.87 **	0.53**	67.55 **	0.02 **	1.05 **	0.06 **	0.94 **	235.69 **
Error	264	0.239	0.310	0.104	11.152	0.006	0.076	0.019	0.359	25.014
GCA : SCA		11.47	7.33	3.85	4.62	7.52	4.68	6.00	5.77	6.00

*, ** Significant at 5% and 1 % levels, respectively.

TABLE 2

Estimates of general combining ability effects and mean performance (in parentheses) of nine characters in Okra.

Parent	*Days to flowering*	*Nodes/ plant*	*Inter-nodel length*	*Plant height*	*Branches/ plant*	*Fruit length*	*Fruit girth*	*Fruits plant*	*Yield/plant*
Parbhani Kranti	-0.898	1.039**	-0.402**	0.455**	-0.067**	0.905**	-0.107**	0.758**	14.293**
	(47.1)	(18.1)	(9.2)	(133.8)	(1.5)	(11.7)	(4.9)	(12.3)	(135.2)
Pusa Sawani	-0.655**	-0.120	-0.267**	-1.894**	-0.036**	-0.203**	-0.014	-0.177	-4.474**
	(47.7)	(17.0)	(8.6)	(125.8)	(1.6)	(11.3)	(5.3)	(10.9)	(116.9)
Guj. Okra-1	0.153*	0.894**	-0.021	2.738**	0.096**	0.387**	0.060**	0.756**	12.738**
	(50.1)	(18.2)	(9.8)	(130.8)	(1.9)	(11.2)	(5.2)	(12.4)	(148.2)
Punjab Padmini	-0.868**	0.235**	-0.322**	-0.781	0.006	0.335**	-0.018	0.342**	8.322**
	(46.0)	(17.1)	(8.8)	(130.5)	(1.5)	(11.6)	(5.4)	(11.7)	(97.4)
Perking Long Green	2.456**	-0.773**	0.510**	0.349	0.122**	-0.613**	0.344**	-1.301**	-17.396**
	(53.8)	(16.6)	(9.6)	(134.6)	(1.8)	(10.9)	(5.8)	(9.0)	(117.9)
White Velvet	-0.060	0.776**	-0.254**	-6.392*	0.012	-0.007	-0.067**	-0.141	-3.123**
	(43.3)	(16.1)	(8.4)	(117.4)	(1.7)	(11.2)	(5.3)	(10.9)	(135.6)
Ankur	-0.342**	-0.142	-0.165**	-2.266**	-0.053**	-0.246**	0.024	-0.090	-0.697
	(48.7)	(17.7)	(9.1)	(131.4)	(1.5)	(10.7)	(5.1)	(11.7)	(125.4)
Padra 18-6	-1.272**	-0.442**	0.091	-4.419**	-0.074**	-0.494**	-0.060**	-0.179	-6.992**
	(45.6)	(17.3)	(9.2)	(125.9)	(1.5)	(10.6)	(5.3)	(11.3)	(128.9)
Line No. 51	1.486**	0.084	0.831**	3.210**	-0.005	-0.063	-0.163**	0.032	-2.670**
	(51.4)	(18.5)	(10.2)	(141.0)	(1.7)	(11.5)	(5.0)	(11.9)	(148.5)
SE (gi) ±	0.0751	0.0855	0.0494	0.05127	0.0115	0.0422	0 0210	0.0919	0.7678
r +	0.972	0.764*	0.729*	0.713*	0.903**	0.907**	0.860**	0.884**	0.882**

*, ** Significant at 5% and 1 % levels, respectively.

r+ Correlation coefficient between *per se* performance and gca of parents.

The progeny means were used for statistical analysis. The combining ability analysis was done according to Singh (1973) using method 2, model I of Griffing (1956).

RESULTS AND DISCUSSION

The analysis of variance for combining ability for the data pooled over environments (Table 1) revealed that mean squares due to general combining ability (gca) and specific combining ability (sca) were highly significant for all the characters. It indicated the importance of both additive and non-additive genetic components of variation for controlling these traits. However, the mean squares due to gca were higher in magnitude than their respective sca counterparts for all the characters which indicated greater role of additive variance in the inheritance of the characters. This was further supported by higher magnitude of GCA : SCA ratios in all the traits. Similar results have been reported by a number of workers in Okra (Partap and Dhankhar 1980, Partap *et al.* 1980, 1981).

Regarding the importance of combining ability and environment interactions, the environment had a significant role in the expression of almost all the characters. The mean squares due to gca x environment and sca x environment interaction were highly significant for all the characters with higher magnitude of former suggesting that the additive variance was more variable over environments as compared to the non-additive variance.

Perusal to the mean performance of the parents and their gca effects (Table 2) revealed that *per se* performance of the parents might give a good indication of their gca effects. It was also confirmed by positive and highly significant correlation coefficient between *per se* performance and gca effects of the parents. Further, gca effects revealed that none of the parents was good general combiner for all the characters studied. It also showed that parents Parbhani Kranti, Gujarat Okra-1 and Punjab Padmini were good general combiners for yield and for most of the other general characters, while Pusa Sawani and Ankur were found good general combiners for days to flowering and internodal length; Perkins Long Green for branches/plant and fruit girth; White Velvat for internodal length; Padra 18-6 for days to flowering and Line No. 51 for plant height only.

The sca effects of the crosses revealed that all possible combinations between good x poor combiners, i.e. good x good, good x poor and poor x poor, could give promising segregates. The crosses involving good x good combining parents, e.g. Parbhani Kranti x Gujarat Okra - 1 and Parbhani Kranti x Punjab Padmini could be of immense value for exercising single plant selection in advanced generations since in such hybrids high sca effects were due to additive and additive x additive type of gene effects which are fixable. The other crosses, namely, Gujarat Okra-1 x Ankur, Pusa Sawani x Punjab Padmini, Parbhani Kranti x White Velvet, Punjab Padmini x White Velvet, Parbhani Kranti x Line No. 51 and Parbhani Kranti x Ankur, which involved at least one good general combiner, may be exploited for isolating desirable transgressive segregates in F_2 if the additive genetic system present in the good combiner and the complementary epistatic effects in the F_1 acted in the same direction to maximise the desirable plant attributes. In present investigation, no cross combination exhibited consistently high sca effects for all the characters studied. Moreover, crosses having high sca effects for fruit yield may or may not have high sca effects for yield contributing characters. These findings are in agreement with Patel (1988).

The study identified parents, Parbhani Kranti, Gujarat Okra-1 and Punjab Padmini as superior general combiners for yield and most yield contributing characters over environments. It is, therefore, suggested that intermating of randomly selected progenies in early segregating generations (especially in F_2 and F_3) obtained by crossing these parents will release the hidden genetic variability through breakage of undesirable linkage involved in different characters. It may produce an elite population for selection of high yielding lines in advanced generations.

REFERENCES

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.*, **9** : 463-493.

Kulkarni, R. S., T. S. Rao and K. Virupakshappa. 1976. Gene action in bhindi. *Agril. Res. J. Kerala.*, **14** (1) : 13-20.

Partap, P. S. and B. S. Dhankhar, 1980. Combining ability studies in okra (*Abelmoschus esculentus* (L.) Moench) *Genetics Agraia* (Italy), **34** (1-2) : 67-73.

Partap, P. S., B. S. Dhankhar and M. L. Pandita. 1980. Genetics of yield and its components in Okra. *Indian J. agric Sci.*, **50** (4) : 320-323.

Partap, P. S., B. S. Dhankhar and M. L. Pandita. 1981. Genetics of some characters in Okra (*Abelmoschus esculentus* (L.) Moench). *Indian J. Hort.*, **38** : 223-228.

Patel, S. S. 1988. Heterosis and combining ability studies in Okra (*Abelmoschus esculentus* (L.) Moench). Unpublished M. Sc. (Agri.) thesis, MAU, Parbhani.

Patel, S. S.; U. G. Kulkarni and Y. S. Nerker. 1990. Gene action for green fruit yield and its components in Okra. *J. Maharashtra agric. Univ.*, **15** (3) : 331-332.

Singh, D. 1973. Diallel analysis for combining ability over several environments II. *Indian J. Genet.*, **33** : 469-481.

Heterobeltiosis in Relation to General and Specific Combining Ability in Okra*

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ABSTRACT

Highest heterosis of 27.32 per cent for fruit yield was observed over better parent. The hybrids exhibiting significant heterosis for fruit yield also exhibited heterosis for most of the characters studied. The best heterotic hybrids were not the cross combinations that exhibited maximum sca effects. Mean performance of the hybrids showed close association with sca effects, indicating that selection of the hybrids based on *per se* response is equally effective.

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INTRODUCTION

Exploitation of heterosis in crop plants is commercially exploited in array of economically important self as well as cross - pollinated crops. The presence of heterosis in okra has been reported by a large number of scientist (Joshi *et al.* 1958; Lal and Srivastava, 1973; Wankhade *et al.* 1991) and it revealed that number of fruits/ plant, fruit length, fruit girth, plant height and number of nodes/plant contribute maximum to fruit yield (Raman and Ramu, 1963; Raman, 1963; Lal and Srivastava, 1973; Singh and Singh, 1979).

An effective breeding programme would depend on these important attributes. The relative amount of gca and sca effects plays a pivotal role in planning and execution of most appropriate breeding programmes. In the present investigation heterobeltiosis in relation to gca and sca has been reported.

MATERIALS AND METHODS

Nine genetically diverse genotypes, namely, Parbhani Kranti, Pusa Sawani, Gujarat Okra-1, Punjab Padmini, Perkins Long Green, White Velvet, Ankur, Padra 18-6 and Line No. 51 of Okra (*Abelmoschus esculentus* (L.) Moench) were crossed in a diallel fashion, excluding reciprocals. Forty-five entries (9 parents and 36 F_1S) were grown in a randomized block design with three replications during *kharif*, 90 at Navsari and Junagadh and in summer, 91 at Navsari. Each entry was represented by a single row plot of ten plants, spaced at 45 x 30 cm. Observations were recorded on five randomly selected plants

* Part of the Ph.D. Thesis submitted by senior author to Gujarat Agricultural University, Sardar Krushinagar.

TABLE 1

Best three crosses selected on the basis of *per se* performance, heterotic effect and sca effects alongwith gca effects of parents involved (in parentheses) and correlation coefficient between *per se* performance and sca effects of hybrids.

Character	*Crosses*	*Mean per-formance*	*Hetero-beltiosis*	*gca*	*sca*	*'r'* Value*
1	*2*	*3*	*4*	*5*	*6*	*7*
Days to flowering	G.O.-1 x Ankur	46.6	- 4.34**	(P x G)	- 1.33**	0.57**
	P K x G.O.-1	45.2	- 4.01**	(G x P)	- 2.11**	
	P S x Ankur	46.4	- 2.58**	(G x G)	- 0.63**	
Nodes / plant	P K x G.O.-1	21.4	18.01**	(G x G)	1.57**	0.78**
	P S x P P	18.6	8.78**	(P x G)	0.56**	
	P S x G.O.-1	19.8	8.66**	(P x G)	1.13**	
Internodal length	P K x G.O.-1	8.1	- 12.04**	(G x A)	1.24**	0.75**
	P S x Padral 18-6	7.9	- 8.92**	(G x A)	- 1.66**	
	G.O.-1 x PLG	8.9	- 7.61**	(A x P)	- 0.71**	
Plant height	P K x G.O.-1	164.1	22.67**	(G x G)	15.78**	0.80**
	P K x PLG	159.5	18.51**	(G x A)	13.49**	
	P K x Ankur	150.1	12.19**	(G x P)	6.77**	
Fruit length	P K x G.O.-1	13.1	11.71**	(G x G)	1.61**	0.81**
	G.O.-1 x Ankur	12.4	10.17**	(G x P)	1.26**	
	Ankur x Padra 18-6	11.7	8.88**	(P x P)	0.22	
Fruit girth	P K x G.O.-1	6.1	17.36**	(P x G)	0.82**	0.74**
	G.O.-1 x Ankur	5.6	7.43**	(G x A)	0.17**	
	Ankur x Line No. 51	5.4	5.36**	(A x P)	0.16**	
Fruits / plant	P K x G.O.-1	16.2	30.77**	(G x G)	0.84**	0.74**
	G.O.-1 x Ankur	15.2	22.72**	(G x A)	1.47 **	
	P S x P P	14.2	21.03**	(A x G)	0.90**	
YVM incidence	P K x G.O.-1	1.0	-8.27*	(G x P)	- 0.32**	0.89**
	P K x Line No.51	1.2	-7.82	(P x P)	0.07**	
	P P x P L G	1.3	- 2.99	(P x P)	- 0.06*	
Yield / plant	P K x G.O.-1	188.5	27.32**	(G x G)	20.82**	0.74**
	P S x P P	174.1	25.72**	(P x G)	29.41**	
	P K x W V	168.9	25.01**	(G x P)	16.91**	

*, ** Significant at 5% and 1% levels, respectively.

*, 'r' Correlation between per se performance of hybrids and sca effects.

on nine characters. Combining ability analysis was carried out following method 2 Model 1 of Griffing (1956).

RESULTS AND DISCUSSION

The maximum heterobeltiosis was recorded for number of fruits/plant (30.77%) followed by yield/plant (27.32%), YVM incidence (23.29%), plant height (22.67%), nodes/plant (18.01%), internodal length (17.90%), fruit girth (17.36%), fruit length (11.71%), and days to flowering (-4.34%) (Table 1). Out of 36 hybrids 15 crosses showed significant heterobeltiosis for yield. The cross combination Parbhani Kranti X Gujarat Okra-1 registered the highest heterobeltiosis (27.32%). This particular hybrid also displayed significant heterobeltiosis for most of the characters studied.

Three best crosses were selected based on heterotic response and also on sca effect for yield and its components. The crosses which were superior in heterotic response also exhibited high sca effects. The correlation was computed between *per se* performance and sca effect and was found positive and significant for all the characters, indicating that *per se* performance can give the idea about sca effects. The crosses, namely, Parbhani Kranti x Gujarat Okra-1 and Parbhani Kranti x Punjab Padmini having high sca effects involved good x good combiners. The other superior cross combinations involved good x average; good x poor and poor x poor combiners. This clearly indicated that all type of gene interactions were involved in the expression of sca effects in this material for the characters studied. Thus crosses showing high sca effects or high heterotic response involving one good and one poor general combiner could produce desirable segregants if dispersal of alleles or genic interactions acted in the same direction to maximise desirable plant attributes. Therefore, some sort of intermating may be adopted to exploit heterosis for obtaining desirable segregants in such crosses.

The present study identified parents, Parbhani Kranti Gujarat Okra and Punjab Padmini as good general combiners for yield and most yield contributing characters. It is, therefore, suggested that intermating of randomly selected progenies in early segregating generations (especially in F_2 and F_3) obtained by crossing these parents will release the hidden genetic variability through breakage of undersirable linkages involved in different characters. It may produce an elite populations for selection of high yielding lines in advanced generations.

REFERENCES

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.*, **9** : 463-493.

Joshi, B. S.; H. B. Singh and P. S. Gupta. 1958. Studies in hybrid vigour - III bhindi. *Indian J. Genet.*, **18** (1) : 57-68.

Kulkarni, U. G.; S. S. Patel and Y. S. Nerker. 1991. Combining ability analysis and heterosis for green pod yield and other yield contributing characters in Okra (***Abelmoschus esculentus*** (L.) Moench). In Golden Jubilee Symposium on Genetic Research and Education; current trends and next fifty years. Abstr. Vol. II pp. 601.

Lal, S. and J. P. Srivastava, 1973. Hybrid vigour in Bhindi. *Indian J. Hort.*, **30** : 541-545.

Patel, S. S.; U. G. Kulkarni and Y. S. Nerker, 1990. Gene action for green fruit yield and its

components in Okra. *J. Maharashtra agric. Univ.*, **15** (3) : 331-332.

Raman, K. R. 1965. Studied in intervarietal crosses and hybrid vigour in bhindi (Syn. Okra, gumbo), (*Abelmoschus esculentus* (L.) Moench). *Abstr. Madras agric. J.*, **52** : 365.

Raman, K. R. and N. Ramu. 1963. Studied on intervarietal crosses and hybrid vigour in bhindi. *Madras agric. J.*, **50** : 90-91.

Randhawa, J. S. 1987. Genetics of economic characters in an intervarietal cross of Okra (*Abelmoschus esculentus* (L.) (Moench). *Indian J. agric. Sci.*, **59** (2) : 120-122.

Singh, S. P. and H. N. Singh. 1979. Hybrid vigour for yield and its components in Okra. *Indian J. agric. Sci.*, **49** (8) : 596-601.

Wankhade, R. V.; P. B. Kale and V. D. Dod. 1991. Combining ability studies in Okra. In Golden Jubilee Symposium on Genetic Research and Education : Current Trends and next fifty years. Abstr. Vol. II : pp. 601.

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Heterosis Studies in Sesamum (*Sesamum indicum* L.)

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ABSTRACT

Heterosis in sesamum was studied in a set of 10 x 10 diallel cross excluding reciprocals. Analysis of variance indicated highly significant difference for all the characters suggesting the presence of genetic variability in the material studied. The magnituded of heterosis was high for yield per plant, plant height, number of effective branches per plant and number of capsules per plant. Whereas days to flowering, days to maturity, 1000 seed weight and oil content had low heterosis. Hybrid RT-126 x OMT-3 manifested highest heterobeltiosis (101.59) for yield per plant.

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INTRODUCTION

Oil seeds play an important role in agricultural economy of India. Among the different oil seed crops grown in the country, sesamum (*Sesamum indicum* L.) ranks third after groundnut and mustard. It has high protein (19.3%) and high proportion of methionine (3.4%). The genetic studies made so far to improve yield potential of this crop are inadequate. Therefore, a study was undertaken to determine the magnitude of heterosis in sesamum.

MATERIALS AND METHODS

Ten genetically diverse genotype of sesamum, viz., Gujarat til 1 (g. til-1), Mrug-1, Phule til-1 (P.til-1), RT-126, AHT-38, AT-37, AT-46, K-1, OMT-3 and 59-827 were selected for the study. These were crossed in all possible combinations excluding reciprocals during *kharif* 1988. The resulting 45 F1 hybrids and their parents were sown in *kharif* 1989 in randomized block design with three replications in a single row plot of 20 plants spaced 15 cm apart, with row spacing of 45 cm. Five plants were randomly chosen from each treatment for recording data on days to flowering, plant height, number of effective branches per plant, number of capsules per plant, days to maturity, yield per plant, 1000-seed weight and oil content. Heterosis over better parent (heterobeltiosis) and over standard check (economic heterosis) was computed and its significance was tested by comparing their means with the help of appropriate standard errors.

RESULTS AND DISCUSSION

Significant differences among genotypes and hybrids were observed for all the characters studied (Table-1). Significant parental differences were

TABLE 1

Analysis of variances (mean squares for experimental design for different characters.

Characters	*Sources of variation*					
	Replications	*Genotypes*	*Parents*	*Hybrids*	*Parents Vs Hybrids*	*Error*
D. F.	2	54	9	44	1	108
Days to flowering	1.219	35.855**	49.806**	33.812**	0.203	0.616
Plant height	302.00**	1243.884**	2772.979**	933.298**	1147.750**	36.757
No. of effective branches/plant	0.107	0.457**	0.421**	0.431**	1.914**	0.123
No. of capsules/plant	46.648	128.169**	33.313	118.144**	1396.563**	28.995
Days to maturity	4.250	25.875**	33.194**	24.953**	0.635	3.023
Yield/plant	0.792	8.005**	4.661	5.755**	137.091**	2.492
1000 seed weight	0.010	0.128**	0.128**	0.127**	0.210**	0.008
Oil content	0.016	1.188**	2.750**	0.632**	11.594**	0.058

** Significant at 1% level of significance.

TABLE 2

The mean performance of ten parents, per cent heterosis over better parent and standard check for yield and yield contributing characters of heterotic crosses in sesamum.

Parents/ crosses	Days to flowering			Plant height			No. of effective branches per plant			No. capsules per plant			Days to maturity			Yield per plant			1000-seed weight			Oil content		
	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.	Mean	B.P.	S.C.
G.til-1	39.47			106.47			2.73			29.00			83.40			6.63			3.33			47.50		
Mrug-1	46.80			122.00			2.67			27.00			91.60			5.86			3.89			47.49		
P.til-1	45.87			183.93			2.47			25.60			91.73			4.58			3.59			47.61		
RT-126	40.27			112.53			2.40			20.20			90.07			4.61			3.76			48.33		
AHT-38	36.80			112.00			2.67			25.07			89.80			4.98			3.53			49.33		
AT-37	39.80			118.33			2.73			30.53			89.73			6.62			3.70			48.86		
AT-46	37.73			87.47			3.20			29.53			89.00			4.41			3.55			48.62		
K-1	36.13			117.71			3.20			30.80			82.93			6.33			3.44			30.80		
OMT-3	38.69			87.67			2.67			24.80			84.40			4.29			3.41			47.05		
59-827	33.80			70.20			1.93			24.40			89.30			2.75			3.26			46.38		
G.til-1 x AT 46	35.53	-5.83 **	-2.53 **	115.53	4.46	8.51 *	3.07	-4.16	12.45	49.07	66.14 **	69.2 **	86.87	4.16	4.16 **	9.33	48.72 *	40.72 *	3.80	7.04 *	14.1	49.30	1.40 **	3.79 **
Mrug-1x AHT-38	39.27	-6.71 *	-0.25	120.73	-1.04	13.39 **	3.00	12.50	9.89 *	30.00	11.11 **	3.4	88.93	-0.97	6.63 **	8.65	47.66 **	30.47 **	4.04	3.68	21.32	48.62	-1.44	2.36 **
Mrug-1x AT-46	38.80	2.84 **	-1.70 **	129.60	6.23 **	21.72 **	3.60	12.50	31.87	42.73	44.70	47.3	89.07	0.07 **	6.80 **	10.47	78.67 **	57.92	3.89	-0.11	16.81	48.47	-0.30 **	2.04 *
P.til-1x RT-126	47.27	17.38 **	19.76 **	168.60	-8.83 **	58.35 **	2.73	10.81	00.00	24.33	-4.95	16.1	92.80	3.03	11.27 **	7.50	62.88 *	13.12	3.84	2.21 *	15.31	47.95	-1.80 *	9.47 **
P.til-1x AHT-38	45.80	24.46 **	16.04 **	138.20	-24.86 **	29.80 **	2.87	7.50	5.13	31.07	21.35	7.1	91.07	1.41 **	9.20 **	8.00	63.48 **	20.66	3.75	4.55 **	12.61	48.80	1.08 **	2.74 **
P.til-1x AT-46	45.07	19.45 **	14.19 **	131.67	-28.42	23.67 **	2.93	-8.33	7.33	34.53	16.93	19.00	92.00	3.37 **	10.31 **	8.63	88.42 *	30.16 *	3.91	9.01 **	17.41	48.06	-1.15 *	1.18 **
P.til-1x K-1	42.80	18.46 **	8.44 **	176.33	4.13 **	65.61 **	2.80	-12.50	2.56	38.73	25.76 *	33.5	90.60	9.25	8.63	9.38	48.16 *	41.48	3.93	9.56 *	18.01	48.51	1.88	2.13
P.til-1x OMT-3	45.13	16.71 **	14.34	145.86	-20.70 **	36.99 *	3.20	11.63	17.22	36.47	42.45	25.7	85.33	1.10	2.31 **	7.84	70.98 *	18.25	3.24	9.75	-2.70	47.30	-0.65 **	0.42 **
P.til-1x 59-827	39.87	17.95 **	1.02	122.93	-33.16	15.46	2.87	16.22	5.12	31.93	24.74	10.1	88.13	-1.31	5.67 **	6.74	17.05 *	1.66	3.63	1.20	9.00	48.36	1.58 *	1.81 *
RT-126x AHT-38	38.60	4.89 **	2.20	109.87	-2.37 **	3.19 **	2.93	9.76 **	7.33 *	31.20	24.45 **	7.5	90.33	0.59	8.31 **	8.12	65.94 *	22.74 **	3.79	8.08	13.81	47.88	-0.91	2.9 **
PT-127x AT-37	37.73	-5.20	-4.41	132.33	11.83	24.29	3.53	29.27	29.30	43.73	43.89	51.4	88.53	-1.33	6.15 **	10.38	56.71 *	56.56	3.71	-1.82	11.41	48.68	0.37	2.71 **
RT-126x AT-46	38.13	1.06	-3.39	100.33	-10.84 **	-5.77 **	3.27	2.09	19.78	33.93	16.22 **	17.0	88.73	-0.30 **	6.39 **	7.37	60.05 *	11.16 *	3.79	0.80 **	13.81	48.96	0.27	1.07 **
RT-126x OMT-3	39.53	2.74	0.15 *	135.47	20.38 *	27.24	3.20	11.63	17.22	43.00	73.39	48.2	90.27	6.95	8.23 **	9.29	101.59 **	40.12	3.17	-15.69 **	-4.80	48.85	0.03	2.84 **
AHT-38x AT-46	37.60	2.17	-4.74 *	100.46	-10.30 **	5.64	2.87	-10.42	5.12	39.07	32.28	34.7	89.27	0.30	7.04 **	8.67	77.11 **	30.77	3.77	6.00	13.21	49.45	0.24 **	4.11
AT-46x OMT-3	37.60	-0.34	-4.74	115.73	32.02	8.70	3.20	00.00	17.22	39.93	35.21	37.6	87.20	3.32	4.56	8.18	85.48	23.38	3.58	0.75	7.50	47.76	-1.77	0.55
S. Em ± for Mean	0.45			3.50			0.20			3.10			1.00			0.91			5.30			0.13		
S.Em ± for H.P.		0.64			4.95			0.29			4.41			1.42			1.29			0.07			0.20	

*, ** Significant at 5% and 1% probability, respectively.

also observed for all the characters except number of capsules per plant and yield per plant. Parents vs. hybrids variances were significant for all the characters except days to flowering and days to maturity.

The mean performance of ten parents and per cent heterosis over better parent and standard check for yield and yield contributing characters of heterotic crosses are presented in Table-2. Those crosses having desirable significant heterobeltiosis over better parent for yield per plant were discussed only for brevity purpose.

For days to flowering, three crosses exhibited negative significant heterosis over better parent, while standared heterosis was also observed in three crosses. The hybrid Mrug-1 x AHT-38 showed highest heterobeltiosis (-6.71) followed by G.til-1 x AT- 46 (-5.83) and AT-46 x OMT-3 (-4.74). In case of days to maturity none of the hybrids manifested desirable and significant heterobeltiosis and economic heterosis. These results are in accordance with Fatteh (1978) and Tyagi and Singh (1981).

For plant height only two hybrids exhibited positive significant heterobeltiosis and ten crosses depicted positive significant economic heterosis. Tallness is considered as desirable attribute but most of the crosses in the study have expressed negative heterosis over their respective better parents. In case of number of effective branches per plant only one hybrid showed positive significant heterobeltiosis and two hybrids manifested positive significant standard heterosis.

High magnitude of heterosis was observed for number of capsules per plant. The hybrid RT-126 x OMT-3 exhibited highest heterobeltiosis (73.39) followed by G.til-1 x AT-46 (66.14) and Mrug-1 x At-46 (44.70). Similar results were reported by Shrivas and Singh (1981) and Godawat and Gupta (1985).

In case of seed weight, seven hybrids exhibited positive significant heterobeltiosis but none of these showed economic heterosis for this trait. With regard to oil content only three crosses showed positive significant heterobeltiosis but most of the crosses manifested positive and significant economic heterosis. The highest standard heterosis was recorded by P.til-1 x RT-126 (9.47) followed by AHT-38 x AT-46 (4.11).

For yield per plant, fifteen cross combination exhibited significant positive heterobeltiosis. The hybrid RT-126 x OMT-3 depicted highest heterotic value (101.59). High heterobeltiosis was also reported by Satani (1982) and Shrivastava and Singh (1968). Five crosses showing significant positive heterosis also exhibited significant positive heterobeltiosis. Most of the crosses showed positive heterobeltiosis indicating that dominance variance is responsible for the yield per plant, hence simple selection would be effective for improvement of the high yielding lines of sesamum.

The expression of heterosis for yield per plant in the hybrids might be due to heterosis found in important yield contributing characters, viz. number of effective branches per plant and number of capsules per plant.

REFERENCES

Chavan, A. A., V. G. Makne and P. R. Chopeda, 1982. Components of heterosis and inbreeding depression in sesamum (*Sesamum indicum* L.) *Maharashtra agric. J.* 7 : 15-16.

Fatteh, U. G. 1978. Studies on combining ability and heterosis in sesamum (*Sesamum indicum* L.) Unpublished M. Sc. (Agri.) thesis. Gujarat Agricultural University, Sardar Krushinagar.

Godawat, S. L. and S. C. Gupta, 1985. Inheritance of grain yield and its components in sesame. *J. Oilseeds Res.*, **2** : 260-267.

Satani, M. M. 1982. Combining ability and heterosis studies in sesamum (*Sesamum indicum* L.) Unpublished M. Sc. (Agri.) thesis, Gujarat Agricultural University, Sardar Krushinagar.

Shrivas, S. R. aand S. P. Singh, 1981. Heterosis and combining ability in sesamum. *Indian J. Genet.*, **41** : 1-4.

Srivastava, D. P. and S. N. Singh, 1968. Heterosis in sesamum. *J. Indian Bot. Soc.*, **47** : 79-88.

Tyagi, B. P. and H. G. Singh, 1981. Heterosis in sesame. *Indian J. agric. Sci.*, **51** : 849-852.

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Graphical Analysis of Some Economic Characters in Pigeonpea (*Cajanus cajan* L.) Millsp.

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ABSTRACT

The nature of gene action involved in the inheritance of pod length, branches per plant, number of pods per plant and seeds per pod were studied in Pigeonpea (*Cajanus cajan* (L.) Millsp.). Graphical analysis revealed the prevalance of additive gene action for number of pods per plant, whereas non-allelic interactions for the other traits. Overdominance was observed for the inheritance of branches per plant and number of pods per plant, whereas partial dominance was predominant for pod length and number of seeds per pod. Both additive and non-additive gene effects may be simultaneously exploited through recurrent selection for improvement of these traits.

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INTRODUCTION

Pigeonpea occupies an important place in Indian Agriculture. Improvement in yield can be achieved if information is obtained about the genetic system controlling the various characters and planing of further breeding programme to exploit the fixable gene effects. Information on the graphical analysis in pigeonpea is meagre and hence the present investigation was undertaken to know the genetic architecture for important characters.

MATERIALS AND METHODS

Ten early maturing pigeonpea cultivars viz., ICPL 269, Pusa Sweta-2, ICPL 87, GAUT 82-99, H 76-208, ICPL 312, ICPL 151, ICPL 8306, BDN 31 and BWR 245 and their half diallel 45 F_{2}'s were evaluated in randomized block design with four replications at College Farm, Gujarat Agricultural University, Sardar Krushinagar during *kharif* 1989. Each entry was planted in four row plots each 4m long, spaced at 60 x 15 cm. Data were recorded on 10 randomly selected plants from each of parents and F_2's. The means were utilized for graphical analysis following the technique of Hayman (1954).

RESULTS AND DISCUSSION

All the assumptions of diallel analysis were found to hold true as the t^2 value was found to be non-significant for all the characters studied. The graphs for pod length, branches per plant, pods per plant and seeds per pod are presented in figure 1, 2, 3 and 4 respectively.

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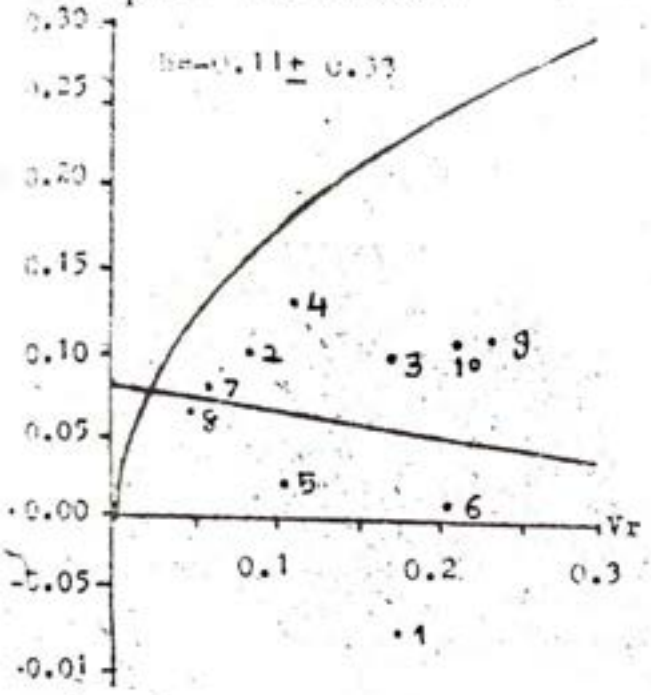

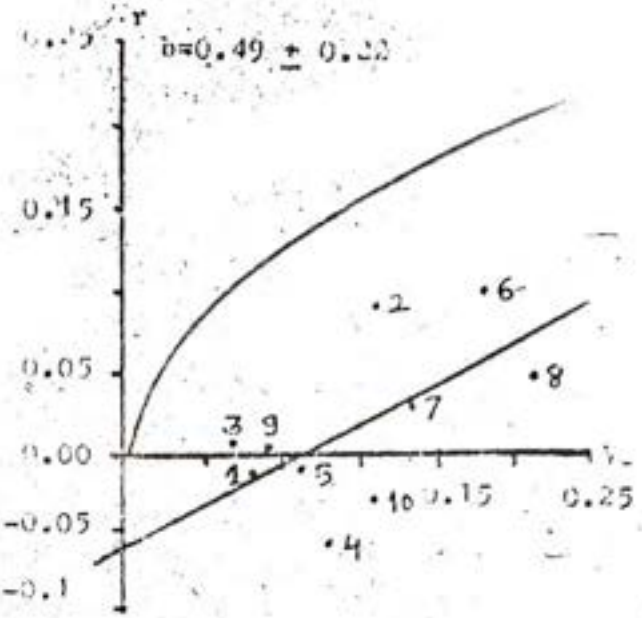

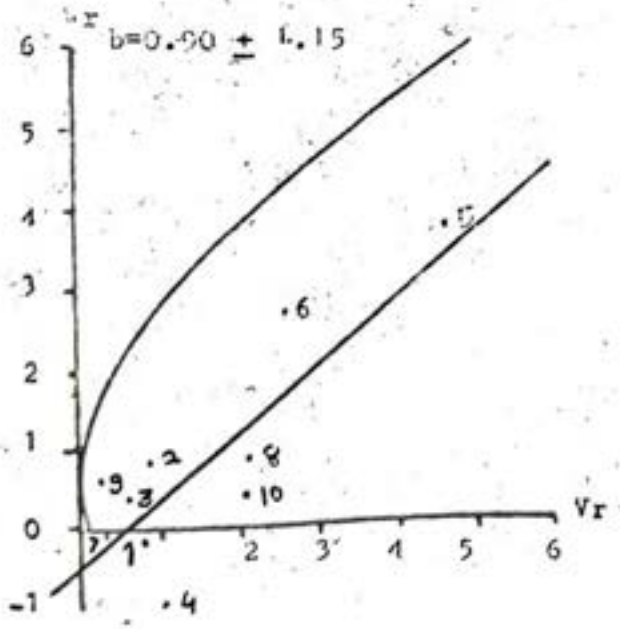

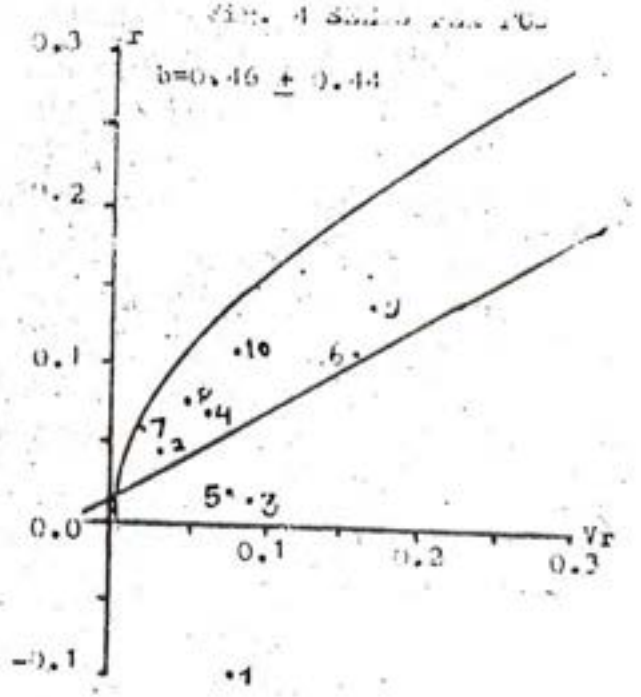

P1 = ICPL 269, F2 = Pusa Sweta 2, P3 = ICPL 87, P4 = GAUT 82-99, P5 = H 76-208, P6 = ICPL 312, P7 = ICPL 151, P8 = ICPL 8306, P9 = BDN 31, P10 = BWR 245

In the variance-covariance graph for pod length (Fig.1), the regression line (b = -0.11 ± 0.33) differ significantly from the unit slope, suggesting the presence of non-allelic interactions for pod length. Similar findings are also reported by Patel (1985) in their diallel analysis for combining ability. The regression line intercepted the Wr-axis above the origin, indicating partial dominance for pod length. ICPL 8306 and ICPL 151 possessed more number of dominant genes, while BDN 31 contained more recessive genes. The rest of the parents lying in the middle along the regression line had intermediate frequencies of dominant and recessive alleles. Parental point of ICPL 269 fell relatively far below the regression line indicating complementary type of gene interaction. Correlation between parental measurement (Yr) and parental order of dominance was negative (r = -0.14) for pod length suggesting that higher expression of this character was controlled by dominant alleles. The wide gap between regression line and parabola curve suggested greater influence of environment on the expression of this characters. For branches per plant, the regression line (b - 0.49 ± 0.22) deviated significantly from unity in the variance-covariance graph (Fig.2) indicating role of non-allelic interactions in the inheritance of this characters which was similar to the findings of Malik *et al.* (1985). The regression line which cut the Wr-axis below the point of origin revealed overdominance for branches per plant. ICPL 87, ICPL 269 and BDN 31 and H 76-208 whose array points were situated near to the point of origin possessed most of the dominant alleles. The array points of ICPL 312 and ICPL 8306 were away from the origin indicating that they possessed most of the recessive alleles. Parents BWR 245, GAUT 82-99, Pusa Sweta 2 and ICPL 151 had equal proportion of dominant and recessive alleles. The correlation (r = -0.67) of parent means (Yr) on Wr + Yr was negative and significant suggesting that higher expression of this character was controlled by dominant alleles.

In respect of number of pods per plant, the regression coefficient (b=0.90 ± 1.15) did not differ significantly from the unit slope, suggesting the absence of non-allelic interactions and independent distribution of genes. The intercept of regression line indicated overdominance (Fig. 3). The dispression of parental array points of ICPL 151, BDN 31, ICPL 87, Pusa Sweta 2 and ICPL 269 indicated that large number of dominant genes were responsible for the control of this trait and there is less diversity among these parents. Whereas the parent H 76-208 had the maximum recessive genes. Parent ICPL 312 possessed equal proportion of dominant and recessive genes. The estimate of correlation coefficient (r=0.50) between parental measurement (Yr) and the parental order of dominance (Wr+Vr) was nonsignificant indicating an ambidirectional trend of dominance. Earlier, Dahiya and Brar (1977) reported that high pod number was under the influence of dominant genes. The slope of regression line (b=0.46 ± 0.44) in the variance-covariance graph (Fig.4) depart significantly from unity suggesting predominance of nonallelic interactions in the expression of number of seeds per pod. This results confirm with Malik *et al.* (1985). The regression line intercepted the Wr-axis above the point of origin, indicated partial dominance for this trait. ICPL 151, Pusa Sweta-2, ICPL 8306, GAUT 82-99, H 76-208 and ICPL 87 whose array points occupied positions nearer to the point of origin, had most of the dominant alleles. Whereas the ICPL 312 and HDN 31 had most of the recessive alleles. The array point of ICPL 269 fell relatively far below the regression line indicating complimentary type of gene interaction. Correlation (r=-0.13) of parental means (Yr) on Wr + Vr was not significantly

differ from zero for seeds per pod indicating an ambidirectional trend of dominance.

The graphical analysis indicated that none of the parents had complete set of neither dominance nor recessive alleles for any of the characters. Hence concentration of favourable allele in a populations through recurrent selection could be achieved for combining high mean performance with high level of dominance. Intermating of the desirable segregants is suggested which would favour positive dominant and recessive alleles along with the genes having additive effects. In present study ICPL 269 could be used in further breeding programme to combine attributes like pods per plant and number of branches per plant.

REFERENCES

Hayman, B. I. (1954). The theory and analysis of diallel crosses. *Genetics* **39** : 789-809.

Malik, B. P. S., R. S. Paroda, S. Singh and V. P. Singh (1985). Genetics of some quantitative characters in pigeonpea. *Crop Improv.* **12** (1) : 80-81.

Patel, D. B. (1985). Heterosis and combining ability in pigeonpea (*Cajanus cajan* (L.) Millsp. Unpublished M.Sc. (Agri.) Thesis submitted to Gujarat Agricultural University, Sardar Krushinagar.

Zaveri, P. P., A. R. Pathak, G. V. Patel, L. K. Dhaduk, H. R. Kher, R. M. Shah and P. S. Bharodia (1989). Genetic studies in relation to pigeonpea hybrids based on male sterile lines. Paper presented at the National Symposium on "New frontiers in Pulse Research and Development" held at Directorate of Pulses Research Kanpur, 10-12 Nov., 1989.

Dahiya, B. S. and Brar, J. S. (1977). Diallel analysis of genetic variation in pigeonpea (*Cajanus cajan*) *Expt. Agric.* **13** : 193-200.

Sidhu, P. S., M. M. Verma and T. S. Sandhu (1981). Genetic analysis of seed and other traits in pigeonpea crop. *Improve.* **8** (2) : 106-210.

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Heterosis in F_2 Populations of Pigeonpea (*Cajanus cajan* (L.) Millsp.)

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ABSTRACT

Pigeonpea F_2 populations could provide a clue to combine beneficial traits of high-yielding adapted elite germplasm with those of short crop span. In the study, F_2 populations were studied for seed yield and primary yield component. These F_2 populations were produced through half diallel mating scheme involving ten cultivars. Heterosis of the F_2 over the high-parent was observed in nine (20 % of F_2 populations) F_2 populations. The heterosis for yield of F_2 resulted mainly from increased pod number rather than number of branches per plant. High heterosis for early maturity was recorded in 36 (80% of F_2s) F_2 populations. These results suggested that high yielding F_2 can be developed that may contain acceptable levels of earliness.

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INTRODUCTION

The primary limitation of commercial use of F_1 population of pigeonpea is expensive on account of high cost of F_1 seed. Usage of F_2 seeds is increasing among public programmes and in private seed companies. Information about heterosis among hybrid combinations is essential to optimize F_2 seed development. At present, limited information is available.

Research on varietal hybrids of pigeonpea based on genetic male sterility (Reddy *et al.* 1977) has demonstrated considerable heterosis for seed yield (Green *et al.*, 1979). The research reported was conducted to provide information on the potential value of F_2 population for yield and certain yield components among selected group of 10 cultivars.

MATERIALS AND METHODS

Ten short duration pigeonpea cultivars, viz. ICPL-269, Pusa Sweta 2, ICPL 87, GAUT 82-99, H 76-208, ICPL 312, ICPL 151, ICPL 8306, BDN 31 and BWR 245 and their half diallel F_2s, were grown in randomized block design with four replications at the Research Farm, Gujarat Agricultural University, Sardar Krushinagar during 1990. Each entry was grown in a 4 rows plot of 4.0 m length, spaced at 60 x 20 cm. Standard cultural practices were followed throughout the growing season. Ten plants were randomly selected to record observations. Heterosis of F_2 population for seed yield components were measured comparing each specific F_2 population with the respective high parent using the method of meaningful paired observations.

RESULTS AND DISCUSSION

The analysis of variance indicated the presence of significant variation among genotypes. Differences between hybrids and their parents were significant for seed yield and yield components, indicating the presence of heterosis in all traits in the F_2 generation.

Twenty-seven of 45 F_2 populations had negative and significant heterobeltiosis for days to 50% flowering, whereas thirty-six F_2 populations exhibited negative and significant heterobeltiosis for days to maturity. Heterosis for plant height ranged from - 36.36 to 35.96. Six hybrid combinations exhibited positive heterosis over their respective better parent and nine had significantly negative for plant height. Out of 45 only 4 F_2 populations showed significantly positive and one negative heterobeltiosis (HP heterosis) for number of branches per plant. For number of pods per plant, thirteen F_2 populations had more pod number than their respective high parents. Heterosis for pod number was the major determinant of the seed yield in best performing F_2 populations.

Positive F_2 HP heterosis for seed yield was observed in 9 out of 45 F_2 populations. The parent BWR 245 was involved in six of these nine populations. GAUT 82-99 in four and ICPL 312 and ICPL 8306 of were involved in three populations, as one of the parents. The highest yielding F_2 population derived from GAUT 82-99 x ICPL 312 out yielded the high parent by 124.56% and highest yielding parental cultivar H 76-208 by 15.6%. The eight F_2 populations showing positive HP heterosis, yielded 64 to 100% increased seed yield as H 76-208.

The F_2 population resulting from a cross of two cultivars that differed by any number of unlinked loci is expected to lose 50% of the F_1 dominance effects, whereas the additive effects should be constant from one generation to the next (Hayman, 1958). Therefore, it seems reasonable to infer that SCA effects in F_1 should be less important than in the F_2. In the present study F_2 HP was obsereved for seed yield, number of pods per plant and earliness for several hybrid combinations. These results probably indicate that epistasis and/or dominance effects for F_2 heterosis in pigeonpea could be important to a certain extent. F_2 populations exhibiting significant F_2 HP heterosis for seed yield also had significantly higher number of pods per plant than HP. The highest yielding F_2 population GAUG 82-99 x ICPL 312 exhibited increase of 124.56% in yield, 80.52% in number of pods per plant and 19.92% in plant height, compared to its high parent. Considering F_2 HP heterosis, 20% of the F_2 populations showed a significant increased in seed yield, 29% for number of pods per plant, 9% for number of branches per plant and 13% for plant height; whereas decrease in 60% for days to flowering and 80% for days to maturity over their high-parents which has great importance for per day productivity. High heterosis was for number of pods per plant and branches per plant and seed yield per plant were also reported by Singh *et al.* (1983) and (1989).

It is observed that performance of a number of F_2 populations deviated from expected values, based on an additive model suggesting that the parents of F_2 can not always be chosen on the basis of their own performances.

TABLE 1

Mean yield components and heterosis expressed as a percentage of the better parent (BP) in F_2 hybrids and parents grown in four environments.

F_2 Crosses	Days to 50% flowering		Days to maturity		Plant height		Number of branches per plant		Number of pods per plant		Seed yield per plant	
	F_2	BP	F_2	BP	F_2	BP	F_2	BP	F_2	BP	F_2	BP
1	2	3	4	5	6	7	8	9	10	11	12	13
ICPL 269	101.00	–	152.75	–	141.18	–	7.13	–	203.23	–	50.87	–
Pusa Sweta 2	85.25	–	139.25	–	89.08	–	3.93	–	86.85	–	25.77	–
ICPL 87	93.00	–	142.00	–	89.35	–	6.15	–	185.35	–	50.34	–
GAUT 82-99	94.75	–	146.50	–	101.30	–	6.80	–	125.00	–	27.78	–
H 76-208	85.75	–	133.50	–	100.53	–	7.23	–	355.83	–	53.96	–
ICPL 312	84.50	–	143.25	–	79.98	–	3.63	–	69.33	–	21.02	–
ICPL 151	85.50	–	158.00	–	88.45	–	5.53	–	100.68	–	27.59	–
ICPL 8306	74.50	–	156.75	–	81.28	–	6.43	–	97.80	–	20.16	–
BDN 31	86.50	–	142.50	–	83.75	–	5.53	–	137.50	–	32.43	–
BWR 245	127.00	–	193.75	–	138.93	–	6.48	–	65.05	–	19.58	–
ICPL 269 x Pusa Sweta 2	93.00	-7.92**	131.75	-13.75**	100.80	-28.60**	5.55	-22.16	153.25	24.59**	38.70	-23.92*
ICPL 269 x ICPL 87	84.75	-16.09**	133.75	-12.44**	89.85	-36.36**	7.18	0.70	166.50	-18.07**	39.05	-23.23**
ICPL 269 x GAUT 82-99	85.75	-15.10**	142.25	-6.87**	110.60	-21.66**	4.63	-35.09	130.65	-35.71**	31.36	-38.34**
ICPL 269 x H 76-208	84.75	-16.09**	134.25	-12.11*	95.50	-32.35**	5.80	-19.78	107.23	-69.87**	25.51	-52.72**
ICPL 269 x ICPL 312	89.75	-11.14**	144.00	-5.73**	122.90	-12.95**	7.03	-1.40	161.03	-20.77**	37.43	-26.41**
ICPL 269 x ICPL 151	85.25	-15.59**	135.00	-14.56**	90.50	-35.90**	6.80	-11.58	128.50	-36.77**	34.35	-32.48**
ICPL 269 x ICPL 8306	85.25	-15.59**	130.75	-16.59**	95.68	-32.23**	6.90	-3.16	119.85	-41.03**	38.26	-24.78**
ICPL 269 x BDN 31	97.00	-3.96**	145.25	-4.91**	125.48	-11.12*	7.40	3.86	152.90	-24.76**	45.40	-10.75
ICPL 269 x BWR 245	96.25	-24.24**	144.50	-25.42**	119.75	-15.17**	6.03	-15.43	124.58	-38.70**	32.54	-36.03**
Pusa Sweta 2 x ICPL 87	85.75	-7.80**	144.00	1.41	90.85	1.64	6.33	2.85	137.33	-25.91**	41.43	-17.71
Pusa Sweta 2 x GAUT 82-99	96.50	1.85*	148.75	1.54	117.70	16.19*	5.98	-12.13	143.65	14.92*	36.19	30.28
Pusa Sweta 2 x H 76-208	97.25	13.41**	149.25	7.18**	136.68	35.96*	8.19	11.07	150.33	-57.75**	39.90	-26.05**
Pusa Sweta 2 x ICPL 312	84.75	-0.59	133.75	-6.63**	87.90	-1.32	5.65	43.77*	111.98	28.93**	35.63	38.28
Pusa Sweta 2 x ICPL 151	86.25	0.88	142.75	-9.65**	85.35	-4.18	6.73	21.72	137.73	36.80	38.11	38.12
Pusa Sweta 2 x ICPL 8306	85.75	0.59	132.50	-13.56**	97.28	9.21	7.40	15.10	101.73	4.01	32.80	27.30
Pusa Sweta 2 x BDN 31	95.25	10.12**	143.50	0.70	96.18	7.97	7.70	39.24	154.65	12.47	42.97	32.09
Pusa Sweta 2 x BWR 245	99.00	-22.05**	143.00	-26.19**	136.63	-1.66	7.60	17.28	187.93	116.38**	49.44	91.86**
ICPL 87 X GAUT 82-99	85.75	-9.50**	134.75	-8.53	91.10	-10.07	6.75	-0.74	141.40	-23.71**	40.47	-19.60
ICPL 87 X H 76-208	89.25	-4.03**	134.75	-5.11**	112.10	11.52	6.60	-8.65	178.25	-49.82**	40.79	-24.41*

1	2	3	4	5	6	7	8	9	10	11	12	13
ICPL 87 X ICPL 312	93.25	0.27	132.00	-7.85*	117.75	31.79**	7.35	19.51	204.60	-10.39*	35.87	-28.75**
ICPL 87 X ICPL 151	85.25	-8.33**	134.00	-15.19**	83.55	-6.49	5.03	-18.29	123.63	-33.30**	36.50	-27.49**
ICPL 87 X ICPL 8306	85.50	-8.07**	140.00	-10.69**	108.25	21.15*	5.60	-12.84	162.85	-12.14*	35.37	-29.73**
ICPL 87 X BDN 31	85.50	-8.07**	136.75	-4.04**	83.53	-6.52	6.45	4.88	152.48	-17.74**	37.46	-25.59*
ICPL 87 X BWR 245	96.25	-24.21**	151.50	-21.81**	130.85	-5.81	7.75	19.59	175.05	-5.56	44.21	-12.17
GAUT 82-99 X H 76-208	93.50	-1.32	143.75	-1.88	120.88	19.32**	5.45	-24.57	152.98	-57.00**	37.08	-31.36**
GAUT 82-99 X ICPL 312	94.00	-0.79	144.25	-1.54	118.48	16.92*	8.40	23.53	225.65	80.52**	62.38	124.56**
GAUT 82-99 X ICPL 151	93.00	-1.85*	142.25	-9.97**	91.60	-9.58	7.25	6.62	133.00	6.40	43.55	56.76**
GAUT 82-99 X ICPL 8306	86.50	-8.71**	140.25	-10.53**	92.70	-8.98	7.38	8.46	200.35	60.28**	42.78	54.02**
GAUT 82-99 X BDN 31	93.50	-1.32	144.75	-1.20	92.70	-8.43	6.03	-11.40	152.95	11.24	38.52	18.77
GAUT 82-99 X BWR 245	115.25	-9.25**	160.75	-17.03**	144.38	3.82	7.88	15.81	171.23	36.98**	47.49	52.95**
H 76-208 X ICPL 312	94.75	10.50**	148.25	3.49*	110.55	9.92	5.08	-29.74*	212.13	-40.39**	45.49	-15.44
H 76-208 X ICPL 151	93.75	9.33**	143.00	-9.49**	110.95	10.37	7.78	7.61	142.08	-60.07**	37.49	-30.52**
H 76-208 X ICPL 8306	84.50	-1.46	128.50	-18.02**	75.35	-4.15	6.38	-11.76	192.38	-45.94**	40.45	-25.03*
H 76-208 X BDN 31	86.00	-0.58	132.50	-7.02**	115.43	14.82	7.93	6.69	147.50	-58.55**	35.42	-34.36**
H 76-208 X BWR 245	95.50	-24.80**	148.25	-23.48**	127.10	-8.51	7.33	1.38	179.30	-49.61**	39.84	-26.16**
ICPL 312 X ICPL 151	84.00	-1.75	134.50	-14.87**	85.50	-3.28	6.38	15.39	124.60	23.76**	34.46	24.91
ICPL 312 X ICPL 8306	85.00	0.59	131.25	-16.27**	81.38	0.13	5.05	-21.46	119.13	21.87*	34.60	64.61*
ICPL X BDN 31	83.75	-3.18**	137.00	-4.36**	74.28	-11.31	7.45	34.72*	116.78	-15.07*	28.07	-13.46
ICPL X BWR 245	98.50	-22.49**	147.00	-24.13**	131.68	-5.22	8.00	23.46	161.28	132.64**	42.08	100.18**
ICPL 151 X ICPL 8306	85.25	0.09	130.00	-17.72**	94.53	6.87	4.80	-25.29	131.63	30.74**	37.19	34.80
ICPL X BDN 31	85.50	-1.16	133.50	-15.51**	81.13	-8.28	5.43	-1.81	101.30	-26.33**	26.12	-19.47*
ICPL X BWR 245	98.50	-22.44**	157.75	-18.58**	147.05	5.85	9.20	41.97**	184.60	83.36**	46.27	67.72**
ICPL 8306 X BDN 31	84.50	-2.31*	136.75	-12.76**	92.00	10.25	7.68	19.40	148.83	8.24**	33.72	3.97
ICPL 8306 X BWR 245	99.75	-21.45**	156.00	-19.48**	123.23	-11.30	10.43	60.96**	236.43	141.74	54.08	188.30**
BDN 31 X BWR 245	100.50	-20.82**	158.25	-18.32**	128.63	-7.41	7.48	15.44	130.38	-5.18	41.41	27.70
S. Em. ±		0.89		1.98		7.62		0.88		9.06		5.40
C.D. 1 %		1.74		3.88		14.93		1.72		17.76		10.58
C. D. 5%		2.28		5.07		19.51		2.25		23.19		13.82

* and ** Significant at 5% and 1% level of significance, respectively.

REFERENCES

Green, J. M. Sharma. D. Saxena. K. B. Reddy, L. J. and Gupta. S. C. 1979. Pigeonpea breeding at ICRISAT presented at the Regional Workshop on Tropical Grain Legumes, University of the West Indies. 18-22, June 1979, St. Angustine, Trinidad.

Hayman, B. I. 1958. The separation of epistatic from additive and dominance variation in generation means. *Heredity* 12 : 371-390.

Reddy, B. C. S., Reddy, L. J. and Murthi. A. N. 1977. Reproductive variants in *Cajanus cajan* (L.) Millsp. *Tropical Grain Legume Bulletin* **6** : 11.

Singh, G. P., R. M. Singh and U. P. Singh 1989. Heterosis in pigeonpea Hybrids. *IPN* **10** : 6-8.

Singh, S. P., Govil, J. N. and Ram H. 1983. Combining ability and heterosis in early pigeonpea hybrids. *Indian Journal of Genetics and Plant Breeding* **43** : 481-486.

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Combining Ability Analysis for Yield Components in Pearl Millet

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ABSTRACT

A line x tester analysis using 6 females and 16 pollinator parents was employed to study the combining ability for days to ear emergence, plant height and 500 grain weight under three environments. Both non-additive and additive genetic variances played an important role. However, former was more important for days to ear emergence and plant height, whereas latter for grain weight. For all the characters both the components interacted with the environments. However, non-additive genetic variance was found more responsive to environmental changes. Complementary type epistasis was responsible for crosses having high desirable *sca* effects. *Per se* performance and *gca* effects of parents were related for days to flowering and plant height. The *sca* effects and mean performance of hybrids were not related for these characters.

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INTRODUCTION

The combining ability for grain yield of parents depend upon various complex genic interactions of yield components which cannot be fully judged by phenotypic performance and adaptation qualities. The combining ability gives an indication of the genic behaviour of the parental material. It is, therefore, desirable to select the parents for hybrids on the basis of their combining ability and its interaction for downy mildew disease and grain yield for this material in pearl millet *Pennisetum typhoides* (Brum. f. Stapf and C. E. Hubb) has already been reported (Pethani *et al.* 1980 and Pethani and Kapoor 1984). Therefore, present paper involved information on general and specific combining ability variances and effects for three yield components viz., days to ear emergence, plant height and 500 grain weight over three environments.

MATERIALS AND METHODS

Male sterile lines '5071 A', '5054 A', '5094 A', '23 D_2A' and '126 D_2A' and an open pollinated line 'HC 73-1' were crossed with 16 pollinated parents derived from diverse multiple parentage, selected from progenies of hybrids after intermating and selfing.

Each entry was sown in 11 x 11 simple lattice design including 22 parents, 96 F_1 hybrids and 3 checks. Three experiments were laid out, two at Hissar (E_1 and E_2 with 4 and 2 replications respectively) in Haryana and one at Kodinar (E_3

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with 4 replications, normal sowing and medium fertility) in Gujarat. E_1 was normal environment with high fertility, whereas E_2 was with delayed sowing and medium fertility. Each entry was sown in a single row plot of 3 m length, 60 cm apart maintaining plant to plant distance at 20 cm. Five plants were selected randomly to study the days to ear emergence, plant height (cm) and 500 grain weight (g). The genetic parameters were estimated by line x tester analysis (Kempthorne, 1957). For estimating the general and specific combining ability effects and their interaction with environment, the linear model similar to the one used by Pethani *et al.* (1980) was used.

RESULTS AND DISCUSSION

The ANOVA for the experimental design revealed significant differences for days to ear emergence, plant height and 500 grain weight among hybrids, males and females in all the three environments. The relatively higher magnitude of variance due to parents *vs* hybrids indicated heterosis for these characters.

The analysis for combining ability indicated significant mean squares due to females, males and females x males interaction in all the environments as well as on pooled basis for all the three characters (Table 1 & 2). The magnitude of variance component of general combining ability (gca) of females (Gi., $\sigma^2 f$) was of higher order than that of males (G_j, $\sigma^2 m$) in most of the cases (Table 1). The preponderance of $\sigma^2 f$ as compared to $\sigma^2 m$ to *gca* variance for these characters may be attributed either to the effect of sterile cytoplasm or to the presence of maternal effect or both with greater genetic diverse.

The variance components due to specific combining ability (*sca*) and general combining ability (*gca*) were important with preponderance of non-additive genetic variance for ear emergence and plant height in all the environments and on pooled basis (Table 1 & 2). These results are in full agreement with the previous reports (Ramanujam and Verma, 1976; Basavaraji *et al.*, 1980) for days to ear emergence and plant height. Contrary to this, Pokhriyal *et al.* (1976) and Kapoor *et al.* (1979) reported higher magnitude of σ^2 gca for days to flowering and plant height. For seed size both the genetic components were important but with preponderance of additive genetic variance. For this character, a majority of the previous studies supported the result of present study (Singh and Murty, 1974). Higher magnitude of non-additive gene effects for seed size was reported by Pokhriyal *et al.* (1974).

Further, significant interaction with environment for the combining ability variance on pooled basis for females (G_i. x E), males (Gj x E) and hybrids (Sij x E) for ear emergence revealed importance of both the genetic variances with greater importance of non-additive genetic variance to environmental changes (Table 2). In case of plant height and 500 grain weight, environmental interaction of females *gca* variance component (Gi x E) was significant against its interaction of hybrids with environment (Sij X E), whereas environmental interaction of males *gca* variance component was nonsignificant. This indicated stability of males additive genetic variance, whereas females additive and non-additive genetic variances of hybrids were highly sensitive to changing environments. Pethani and Kapoor (1984; 1985) reported preponderance of non-additive genetic variance for grain and fodder yield in this material. The low value of σ^2sca / σ^2gca (<1) for grain weight together with high heritability values in all the environments further substantiate the greater role of additive gene effect for grain weight. Evidently response to selection for high grain weight would be effective, which increases the frequency of desirable additive

TABLE 1

Analysis of variance for combining ability under different environments.

Variation due to	df	Days to ear emergence			Plant height			500 grain weight		
		E_1	E_2	E_3	E_1	E_2	E_3	E_1	E_2	E_3
Combining ability analysis										
Females (G_i)	5	163.2 **	107.9 **	278.6 **	15092 **	3381 **	11276 **	25.02 **	7.24 **	11.14 **
Males (G_j)	15	186.1 **	42.0 *	78.2 **	2585 **	1891 **	1139 **	1.36 **	0.65 **	0.39 **
Females x males (Sij)	75	20.0 **	12.0 **	33.4 **	804 **	351 **	814 **	0.60 **	0.38 **	0.41 **
Error	285	0.85	3.35	2.15	45.1	88.9	20.4	0.117	0.208	0.128
Variance components										
Females (G_i)		2.24	3.00	3.03	223.2	94.9	163.5	0.381	0.214	0.168
Males (G_j)		6.92	2.50	1.66	77.2	128.4	13.5	0.031	0.022	0.001
Females x males (Sij)		4.79	4.33	7.81	189.6	131.1	198.5	0.122	0.086	0.072
σ^2sca		4.789	4.335	7.811	189.6	131.1	198.5	0.121	0.086	0.072
σ^2gca		3.515	2.961	3.297	182.6	103.9	122.6	0.286	0.162	0.122
σ^2e		0.212	1.674	0.539	11.3	44.5	5.1	0.029	0.104	0.030
σ^2sca/σ^2gca		1.362	1.515	2.396	1.04	1.26	1.62	0.425	0.531	0.588
Heritability		41.27	32.25	20.31	47.61	37.17	37.58	65.45	45.99	53.99

** p = 0.01. The error df for E_2 is 95.

gene. For days to earing and plant height, with greater magnitude on non-additive gene effects in presence of additive genetic variance and their sensitivity to environments alongwith high heritability indicated that desirable change may be attainable with a system that can exploit both the genetic effects simultaneously. Breeding for restorers and/or male-sterile maintainer lines by recurrent selection of selfing and *inter se* mating method could mean exploitation and accumulation of fixable type of gene effects and at the same time maintains desirable heterozygosity for exploiting the dominance gene effect may prove to be beneficial in improving the parental lines and combining these characters at desirable level alongwith high grain yield and tolerance to downy mildew by adopting appropriate breeding approaches (Pethani *et al.*, 1980).

The estimates of *gca* effects (Table 3) revealed that '5054 A', '5094 A', 'H 66' and 'H 112' were good general combiners for early ear emergence and dwarfness but were poor combiner for grain size. 'H 130-2' was good general combiner for earliness but was average combiner for plant height and grain size '23 D_2A' was good combiner for late ear emergence, dwarfness and bold/grain size. '126 D_2A' was good combiner for tallness and bold grain size alongwith lateness. This revealed that '126 D_2B', 'H 232' and '23 D_2B' possessed genes for boldness, whereas 'H 130-2', 'H 112', 'H 66', '5054 B' and '5094 B' possessed desirable genes for earliness. Pethani *et al.* (1980) and Pethani and Kapoor (1984) also reported good general combining ability for grain yield and resistance to downy mildew disease for parents '5054 A', '5094 A', and 'H 112'. For downy mildew resistance '126 D_2A' and 'H 66' were reported as good combiners but were poor combiners for grain yield. Hence, these parents can serve as an useful material for improvement through recombination breeding and for getting elite restorer (R) and maintainer (B) lines having earliness, bold grain, resistance to downy mildew with desirable height for high grain yielding hybrid combiners.

Out of total 96 crosses, eleven crosses exhibited desirable negative significant *sca* effects for days to ear emergence. Thirteen crosses had significant *sca* effect for tallness and 2 crosses had for dwarfness. Seven crosses showed high *sca* effect for grain size.

The cross '126 D_2A' x 'H 49' exhibited the desirable lowest significant *sca* effects for ear emergence followed by '5054 A' x 'H 482'. The high specific combiners for grain size were '5094 A' x 'H 232', '5094 A' x 'H 206', '5071 A' x 'H 130-2' and '5071 A' x 'H 132-2' in linear order.

Most of the crosses showing significant desirable *sca* effects for these three characters involved one good and one average or even negative general combiner and such crosses could produce transgressive segregants of the additive genetic system in the good combiners and complementary epistatic effects in the F_1s act in the same direction to maximise the desirable plant attributes. Pethani and Kapoor (1984) reported high *sca* effects in a cross for grain yield which was responsible due to complementary type of epistasis in this material. Cytoplasmic - generic male sterility, which is already established in this crop, could be successfully exploited for hybrid production and this may efficiently and effectively be used for the above types of genetic behaviour involved.

'5054 A' x 'H 192-2' and '23 D_2A' x 'H 112' had significant desirable negative *sca* effects for days to ear emergence. These hybrids were also highly responsive to environmental changes

TABLE 2

Pooled analysis of variance for combining ability.

Variation due to	*df*	*Days to ear emergence*	*Plant height*	*500 grain weight*
Combining ability analysis				
Females (Gi.)	5	103.1** ++	5586** ++	11.53** ++
Males (G_j)	15	55.9** ++	1638** ++	0.59** ++
Females x males (Sij)	75	13.3** ++	667** ++	0.25** ++
Environments (E)	2	708.5** ++	81638** ++	17.51** ++
Gi x E	10	15.6** ++	711** ++	0.645** ++
Gj x E	30	12.2** ++	175**	0.110**
Sij x E	150	4.9**	289**	0.101**
Error	665	0.91	20.3	0.055
Variance components				
Females (Gi)		1.65	113.9	0.223
Males (G_j)		1.96	28.8	0.018
Females x males (Sij)		2.81	136.0	0.051
Gi x E		0.67	28.3	0.036
Gj x E		1.22	-13.8	0.001
Sij x E		4.106	238.5	0.046
σ^2sca		2.806	136.0	0.051
σ^2gca		1.733	90.7	0.167
σ^2sca/σ^2gca		1.619	1.50	0.306

** p = 0.01 against pooled error, ++p = 0.01 against interaction.

TABLE 3

The gca effects of the parents for various characters.

Days to ear emergence				*Plant height*				*500 grain weight*			
Females		*Males*		*Females*		*Males*		*Females*		*Males*	
1 '5071 A'	0.86*	1 'H 46'	-0.91	1 '5071 A'	- 9.01**	1 'H 46'	- 7.34	1 '5071 A'	- 0.303**	1 'H 46'	-0.053
2 '5054 A'	- 1.62**	2 'H 92-2'	- 0.44	2 '5054 A'	- 3.51*	2 'H 92-2'	8.14	2 '5054 A'	-0.421**	2 'H 92-2	0.058
3. '5094 A'	-1.77**	3 'H 112'	-1.70**	3. '5094 A'	-10.57**	3 'H 112'	-10.26**	3. '5094 A'	- 0.359**	3 'H 112'	-0.104
4. 'HC 73-1'	- 0.34	4 'H 130-2'	- 3.13**	4. 'HC 73-1'	17.60**	4 'H 130-2'	- 2.34	4. 'HC 73-1'	0.044	4 'H 130-2'	0.191
5 '23 D_2 A'	1.54**	5 'H 47-1'	- 0.75	5 '23 D_2 A'	- 5.16**	5 'H 47-1'	1.96	5 '23 D_2 A'	0.157*	5 'H 47-1'	0.059
6 '126 D_2 A'	1.33**	6 'H 153'	-1.02*	6 '126 D_2 A'	10.65	6 'H 153'	- 1.81	6 '126 D_2 A'	0.881**	6 'H 153'	-0.251*
		7 'H 206'	1.78**			7 'H 206'	4.59			7 'H 206'	0.056
		8 'H 284'	-0.56			8 'H 284'	8.34**			8 'H 284'	0.020
		9 'H 49'	1.11*			9 'H 49'	11.69**			9 'H 49'	0.053
		10 'H 66'	- 1.45**			10 'H 66'	- 6.14*			10 'H 66'	-0.371**
		11 'H 138'	2.95**			11 'H 138	6.89			11 'H 138'	0.151
		12 'H 482'	3.73**			12 'H 482'	1.54			12 'H 482'	-0.093
		13 'M 64P_2'	- 0.20			13 'M 64 P_2'	- 4.23			13 'M 64 P_2'	0.173
		14 'H 192-2'	1.06*			14 'H 192-2'	-7.95**			14 'H 192-2'	- 0.128
		15 'C 6'	0.36			15 'C 6'	- 2.84			15 'C 6'	- 0.077
		16 'H 232'	0.81			16 'H 232'	8.56**			16 'H 232'	0.377**
SE ±	0.20	SE ±	0.35	SE ±	1.03	SE ±	1.78	SE ±	0.053	SE ±	0.093

The sca effects of the hybrids

Days to ear emergence				*Plant height*				*500 grain weight*				
1 '126D_2A'	X	'H 49'	- 3.86**	1 23 D_2A	X	H 66	22.13**	1	5094 A	X	H 232	0.584**
2 5054 A	X	H 482	- 3.36**	2 5094 A	X	H 206	19.68**	2	5094 A	X	H 206	0.512**
3 5071 A	X	H 46	- 2.99**	3 '23D_2A	X	H 232	17.38**	3	5071 A	X	H 130-2	0.498**
4 5054 A	X	H 66	- 2.71**	4 HC 73-1	X	H 482	16.18**	4	5071 A	X	H 192-2	0.492**
5 5054 A	X	H 192-2	- 2.61**	5 5071 A	X	H 192-2	14.70**	5	5054 A	X	H 49	0.470*
6 126 D_2A	X	H 47-1	- 2.38*	6 5071 A	X	H 130-2	13.60**	6	HC 73-1	X	C-6	0.428*
7 5094 A	X	H 49	- 2.37*	7 126 D_2A	X	[illegible]	13.57**	7	5054 A	X	H 47-1	0.403*
8 23 D_2A	X	H 92-2	- 2.36*	8 23 D_2A	X	C-6	[illegible]	[illegible]	126 D_2A	X	H 192-2	0.389
9 '23 D_2A'	X	H 112	- 2.32*	9 126 D_2A	X	H 66	11.54*	9	23 D_2A	X	H 66	0.363
10 5054 A	X	M64 P_2	- 2.28*	10 5094 A	X	H 482	11.50*	10	23 D_2A	X	H 46	0.347

* P = 0.05, ** P = 0.01

for grain and fodder yield (Pethani and Kapoor, 1984; 1985; 1986). Likewise '5094 A' x 'H 206' possessed high sca effects for tallness and bold grain size, whereas '23 D_2A' x 'H 66' was good combiner for tallness but was average combiner for grain size, however both these hybrids were observed with high *sca* effects and high mean performance for grain yield (Pethani and Kapoor, 1984). Hence, these hybrids can be directly exploited for these characters including grain yield.

Dwarfing is an important character in this crop for easy maintaining and developing 'R' and 'B' lines. High grain yielding hybrids (Pethani and Kapoor, 1984; 1986) had mostly high *sca* effects for tallness. Thus dwarf hybrids with higher grain yield could be made if the possible association between grain yield and plant height is broken.

A high positive correlation between *per se* performance of the parents and the estimates of *gca* effects was observed for days to ear emergence ($r = 0.659^{**}$) and plant height ($r = 0.636^{**}$). This suggested that high *per se* performance would yield good general combiner for these two characters. However, the absence of such association for 500 grain weight indicated that the choice of parents should be based not only on their mean performance but also its merit on combining ability in cross combination for grain size. Absence of association between *per se* performance and *sca* effects of the hybrids evidenced the utility of working out the *sca* effects for all the three characters.

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REFERENCES

Basavaraju, R., K. M. Safeeula and B. R. Murty, 1980. Combining ability in pearl millet. *Indian J. Genet.* **40** : 528-536.

Kapoor, R. L. Sain Dass and S. R. Batra, 1979. Combining ability of some new developed lines of pearl millet. *Indian J. agric. Sci.* **49** : 253-258.

Kempthorne, O., 1957. 'An introduction to Genetics Statistics' John Wiley and Sons, Inc. New York.

Pethani, K. V. and R. L. Kapoor, 1984. Combining ability and its interaction with environment for grain yield in pearl millet. *Indian J. agri. Sci.* **54** : 87-92.

Pethani, K. V. and R. L. Kapoor, 1985. Combining ability and genotype x environment interaction for dry fodder yield in pearl millet. *GAU Res. J.* **11** : 1-9.

Pethani, K. V. and R. L. Kapoor, 1986. Phenotypic stability study for grain yield in pearl millet. *Indian J. Genet.* **45** : 362-367.

Pethani, K. V., R. L. Kapoor and S. Chandra, 1980. Gene action and phenotypic stability for incidence of downy mildew disease in pearl millet. *Indian J. Agric. Res.* **14** : 217-223.

Pokhriyal, S. C., R. R. Patil, Ram Dass and Balzor Singh, 1974. Combining ability of new male sterile lines in pearl millet. *Indian J. Genet.* **34** : 208-215.

Pokhriyal, S. C., K. V. Unikrishnan, B. Singh, R. Dass and R. R. Patil, 1976. Combining ability for downy mildew resistance lines in pearl millet *Indian J. Genet.* **36** : 403-408.

Ramanujam, S. and V. S. Verma, 1976. Combining ability for some fodder attributes in pearl millet. *Indian J. Genet.* **36** : 371-378.

Singh, B. B. and B. R. Murthy, 1974. Variation for yield and development characters in pearl millet *Indian J. Genet.* **34** : 417-421.

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Model Size Group of Banana Prawn *Penaeus merguiensis* (de Man) at Okha*

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ABSTRACT

In order to get monthwise length frequency of Banana prawn *Penaeus merguiensis* de Man, prawn were measured from landings at Okha. Total length in mm and weight in gms were measured at every 15 days interval. It is observed that model size of male increases from January to May, decreases in June again increasing in July. Second decreasing is found in November and it increases from December. Similarly model size of female also shows two peak one in June and second in October.

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INTRODUCTION

To determine age and growth trend of fishery in commercial prawn catch of male and female *Penaeus merguiensis* (de-Man). Study of size group in different months is necessary. This will also help in finding out structure of population.

MATERIALS AND METHODS

Model size group

It is advisable to arrive at Model size group at given length frequency monthwise. In order to do so, random samples from landings at Okha were taken during 1991-92 and 1992-93. Samples were also collected on board or fishing vessel while on brooder collection trips. Total length in mm Carapace length in mm. and weight in gms were measured separately for both males and females. Observations were made every 15 days.

A total of 1527 females and 1225 males were measured. They were grouped into 5 mm size groups, from 110-115 mm onwards. A percentage of each size group compared to total sampled size of each month was calculated.

RESULTS AND DISCUSSION

Fig. 1 and 2 indicate monthwise model size group for male and female of *P. merguiensis*.

Monthwise details of size groups and model size groups as well as percentage of model size groups are discussed.

Model size group for females

In January females under 140 mm were

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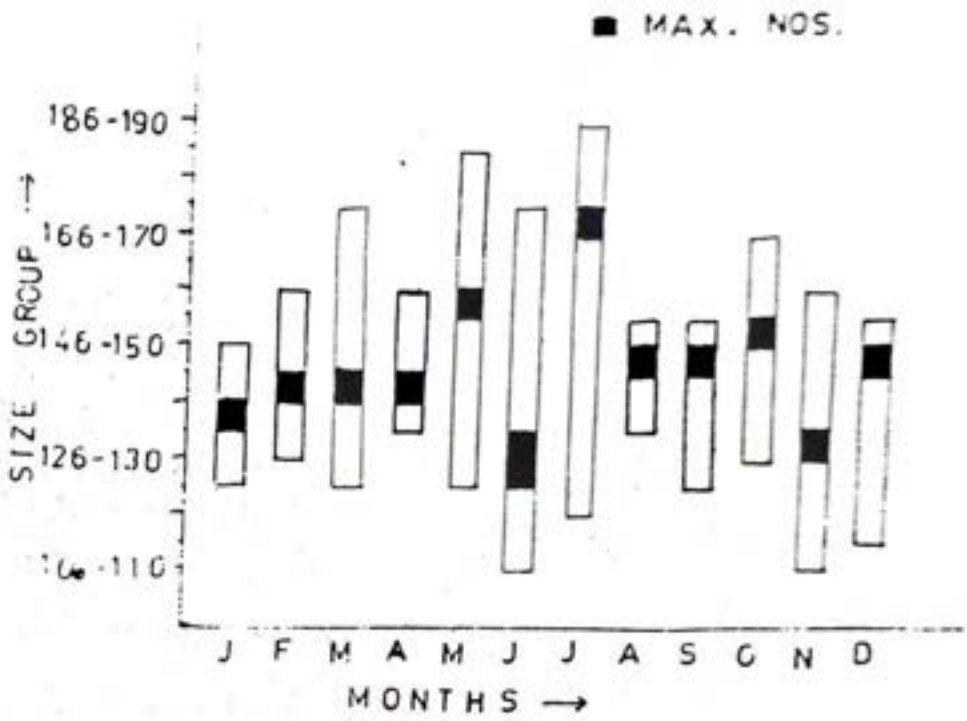
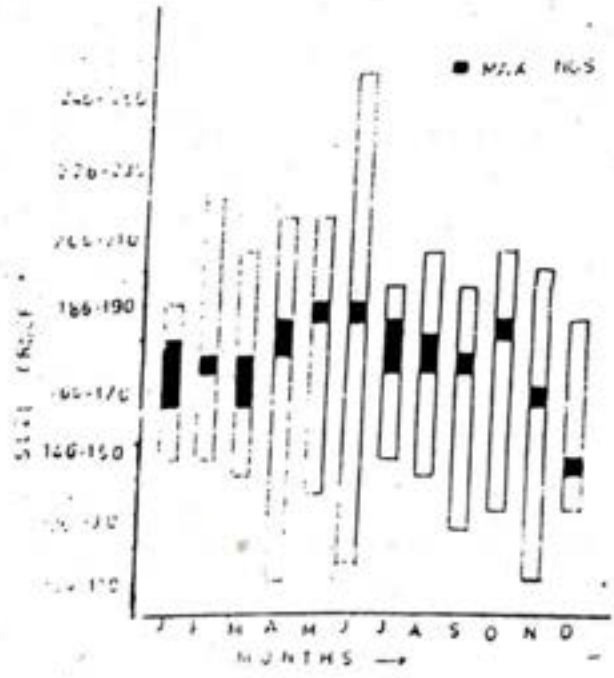


Size Group in Different Months
at Okha Landing Centre of *Penaeus merguiensis* male
Fig. - I



Size Group in Different Months at
Okha Landing Centre of *Penaeus merguiensis* female
Fig. - II

not seen. About 45% of total females were in between model size group of 161 to 180 mm.

In February 21.43% were found in 171-175 mm group. The remaining were in between 141-145 to 181-185 mm group.

In March 25.81% of females were from model size group 161-165 mm and 16.13% in 171-175 mm group.

In April 6.66% were found in 110-115 mm group which shows the entry of early adult females. However, 11.66% were found in 166-170 mm group and 191-195 mm group each. 16.66% in 171-185 model size group.

In May, in females, it was noted that 186-190 mm size group contributed 35.71% and 151-155 mm size group contributed about 21.5% followed by 136-140 mm size group 14.28%. Minimum and maximum group observed were 131-135 mm and 201-205 mm.

In June also maximum percentage 15.78% in size group found in 186-190 mm. However, 161-175 mm groups contributed about 33%. Minimum and maximum size group range found were 116-120 mm and 251-155 mm group respectively.

In July the maximum percentage of size group is seen in between 171-185 mm. Size increasing trend from 156-160 mm to 171-175 mm could be seen. Maximum size group recorded was 191-195 mm group.

In August trawlers were not in operation. Hence only gill net catch was landed which shows selective size group.

In September, size group varied from 126-130 mm to 191-195 mm group with a maximum size group 171-175 mm followed by 156-165 mm and 176-185 mm groups.

In October, the size group range was from 126-130 mm to 210-205 mm group shows the growth of females. The maximum number in size group of 181-190 mm was observed. Here second peak in size increases is found.

Once again in November minimum size group recorded was 110-115 mm and maximum of 196-200 mm. Maximum number in 161-165 mm group followed by 171-175 mm about 14%.

In Dcecember, size group was ranging in between 131-135 mm to 181-185 with a maximum in 141-145 mm (27.74%) followed by 151-155 mm group (about 17 to 20%).

Model size in males

Monthwise model size group observed in *P. merguiensis* males are as under :

In January size group was in between 126-130 mm (16.66%) to 146-150 mm (16.6%) group with a maximum 50% in 136-150 mm size group was observed.

In February size group recorded was between 131-135 mm to 146-150 mm with a maximum 44.4% in 141-145 mm group followed by 146-150 mm group (33.33%) which shows the growth of males.

In March size group ranged from 126-130 mm to 171-175 mm group with maximum number in 141-145 mm (25%) followed by 131-140 mm group 21.43%.

In April, size group recorded was from 136-140 mm to 156-160 mm with a maximum (50%) in 141-145 mm group.

In May, size group was ranging from 126-130 mm to 181-185 mm group with a maximum number in 151-160 mm group (36.11%) followed by 156-160 mm group 16.67%.

In June minimum size group 110-120 mm group was recorded which indicates new in adult size and about 57% in size range of 126-135 mm group. The maximum size recorded was in 171-175 mm group.

Males found in July was in between 121-125 to 181-185 mm group with about 43% in size range of 171-175 mm group. Only one male was in the size group of 186-190 mm.

In August as trawler was not in operation, only gill net catch was taken and hence only selective size group was cought.

In September, size group range in male found was in between 126-130 mm group to 146-150 mm with maximum number in 146-150 mm group (about 33%).

In October, size range was found between 130-135 mm to 166-170 mm group with maximum number (30.55%) in 150-155 group followed by 141-145 mm (25%) size group.

In November, once again the minimum size 110-115 mm was found, with a maximum number in about 25% in 131-135 mm group followed by 121-125 mm group about 16.4% indicates new entry in adult male *P. mergiuensis.* Maximum size group recorded was in 156-160 mm.

In December, size range was in between 116-120 mm group with maximum in 146-150 mm size (24.74%) followed by 126-130 mm group and 141-145 mm group about 17 to 20%.

On Saurashtra coast, spawners of *P. Merguiensis* were more during October to December and March-April. In February mature prawns were not seen. However, maturing prawns formed 50% of total adult prawns.

Lalita Devi (1985) has observed (at Uppada near Kakinada) that *P. merguiensis* fishery was good during January-February and July-September. Size ranged from 100-214 mm with majority in size range 170-190 mm during January-February and 120-140 mm during rest of the year.

Nandakumar (1988) have observed that near Karnataka most of the females of *P. merguiensis* were in 106-215 mm size group.

While on Saurashtra coast at Okha landing centre size range of females of *P. merguiensis* observed by author was from 110-255 mm with maximum of 185-190 mm group in May - June.

REFERENCES

Lalita Devi, S. 1985. Artisanal Fishery for prawns at Uppada near Kakinada in Andhra Pradesh coast. *Mar. Fish. Infor. Serv.*, T & E *Ser.*, **62** : 6-11.

Nandukumar G. 1988. Observation on the fishery of Banana prawn along the north Kanara coast with notes on its scholling behavicur and migration. *Mar. Fish. Infor. Serv.*, T & E *Ser.* **81** : 13-15.

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Screening of Brinjal Varieties Against Insect Pests

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ABSTRACT

Twenty eight varieties of brinjal were screened against insect pests out of which Pusa purple long, Pusa purple cluster, Junagadh long, Pusa kranti, S-71-5-39-9, S-71, 21-4-22 and Arka kusumkar were found to be comparatively resistant to brinjal fruit and shoot borer (*Leucinodus orbonalis* Guen.), variety Manjari gota to jassid (*Amrasca biguttula biguttula* Ishida) and whitefly (*Bemisia tabaci* Gennadius), and varieties Manjari gota, B-47, Local green, Pusa kranti, Arka kusumkar and S-71-21-4-22 to aphid (*Aphis gossypii* G.).

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INTRODUCTION

Among the solanaceous vegetables, brinjal (egg plant) is extensively grown in India, and is very popular among people of all social strata. In India, it is an important article of diet and consumed in variety of ways. Brinjal crop is attacked by a number of insect pests from the time of planting till its harvest. Brinjal fruit and shoot borer (*Leucinodus orbonalis*), aphid (*Aphis gossypii*), jassid (*Amrasca biguttula biguttula*) and whitefly (*Bemisia tabaci*) are the important pests of brinjal out of which fruit and shoot borer is the most destructive pest and causes damage to both shoots and fruits of brinjal (Mehto *et al.*, 1980). Gangwar and Sachan (1981) reported that damage due to this pest varied from 26.3 to 62.5 per cent on brinjal fruits. Sucking pests *Viz.* Jassid, whitefly and aphid occur regularly on brinjal crop and cause enormous damage by sucking cell sap from the leaves.

Various workers have screened varieties of brinjal against fruit and shoot borer, jassid, whitefly and aphid in India (Mote 1981; 1982; Mallik *et al.*, 1986; Pawar *et al.*, 1987 and Anonymous 1988; 1990). Efforts have been made to screen brinjal varieties against borer and sucking pests under Southern Gujarat conditions.

MATERIALS AND METHODS

The field trial with twenty eight varieties of brinjal was conducted during 1990 at College Farm, Gujarat Agricultural University, Navsari (Guj.) adopting randomized block design replicated twice. The varieties under test were kept unsprayed throughout the crop period and all other recommended agronomical practices were followed for raising the cultivars of brinjal. Observations on healthy and damaged shoots by brinjal shoot and fruit borer were recorded from three rahdomly selected plants at fortnight interval and per cent shoot

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damage was worked out. In case of fruit infestation, number and weight of healthy and damaged fruits were recorded at the time of picking. The percentage fruit damage was calculated on number and weight of healthy and damaged fruits.

The populations of jassid, whitefly and aphid were recorded from three leaves, one each from top, middle and bottom part of three randomly selected plants at fortnight interval starting from 15 days after transplanting in each variety.

RESULTS AND DISCUSSION

The data in table 1 indicated that the infestation in shoots varied from 3.83 to 14.96 per cent in different varieties. The per cent infestation in shoots was comparatively low in variety Pusa long (3.83) which was at par with the varieties Pusa purple cluster (4.32), Pusa Kranti (4.65), Junagadh long (4.78), S-71-5-39-9 (5.42), S-71-21-4-22 (5.51) and Arka kusumkar (5.91). The variety Gulabi was found to be the most susceptible with 14.96 per cent shoot damage and was at par with Junagadh ravaiya (12.23), G. B. 6 (11.33), B-33 (11.18), Arka navneet (11.71 and B-3(10.96).

Fruit infestation (6.50) was recorded to be lower in Pusa purple long and it was at par with Pusa purple cluster, Junagadh long, Pusa Kranti, S-71-5-39-9, Arka sheel, S-71-21-4-22, Chakalashi doli and Arka kusumkar. The variety Gulabi was found to be the most susceptible (22.70) and was at par with Junagadh ravaiya.

The results on percentage weight of damaged fruit showed that Pusa purple long was found to be the most resistant variety showing lower percentage of damaged fruits (6.45). The variety Gulabi was found to be the most susceptible as it showed 22.15 per cent weight of damaged fruits and was at par with Junagadh ravaiya. Varieties Pusa purple cluster and Pusa purple long have been reported to be fairly resistant to shoot and fruit borer, while varieties Arka kusumkar and Pusa kranti as the least susceptible (Gill and Chandha, 1979; Mote, 1981; Yein and Rathaiah, 1984 and Pawar *et al.*, 1987).

Jassid population was found to be the lowest (1.99 jassids/ 9 leaves) in variety Manjari gota followed by Pusa purple long (4.48), Pusa kranti (4.57) and Doli-5 (6.51) (Table 2). The varieties Arka sheel and Suphal were found to be the most susceptible in which jassid population was 27.52 and 26,98 per 9 leaves. Pawar *et al.*, (1987) reported that Pusa purple long and Manjari gota were the most promising varieties for jassid resistance which is in close agreement with per cent findings.

Whitefly population ranged between 11.97 to 79.46 per 9 leaves (Table - 2). The variety Manjari gota was the most resistant variety with the lowest number of whiteflies (11.57). Whitefly population was 18.89 in variety Doli-5 which was at par with that in Pusa purple long, Pusa Kranti, Junagadh long and Pusa purple cluster. The rest of the varieties showed comparatively higher population of whitefly (26.98 to 79.46). Population of whitefly was reported to be high on the varieties Doli-5 and Junagadh long (Anonymous, 1988).

Out of 28 varieties of brinjal, none of the variety was completely free from aphid infestation (Table 2). However, significantly lower number of aphid was recorded in Manjari gota (27.94 aphids/ 9 leaves) which was at par with that in B-47 (34.88), Local green (35.96), Pusa kranti (36.82), Arka kusumkar (37.93) and S-71-21-4-22 (39.45). Higher number of aphids (more than 120 aphids / 9 leaves) were recorded in Junagadh ravaiya, Surati ravaiya, S-71-5-39-9 and B-51.

TABLE 1

Incidence of *L. orbonalis* in different varieties of brinjal.

Variety	Average % infestation		
	Shoot	Fruit	
		Weight	Number
Arka Kusumkar	14.07 (5.91)	16.81 (8.36)	16.93 (8.48)
Arka Navneet	19.53 (11.17)	23.19 (15.50)	23.35 (15.71)
Arka Sheel	15.23 (6.90)	16.51 (8.07)	16.49 (8.05)
B-3	19.33 (10.96)	23.87 (16.37)	24.14 (16.72)
B-5	17.07 (8.62)	21.92 (13.94)	21.93 (13.95)
B-15	16.67 (8.23)	23.17 (15.48)	23.34 (15.69)
B-30	16.33 (7.90)	20.47 (12.23)	20.52 (12.28)
B-33	19.53 (11.18)	22.67 (14.85)	22.96 (15.21)
B-39	19.08 (10.67)	21.99 (14.02)	22.14 (14.20)
B-47	18.95 (10.55)	19.59 (11.24)	19.76 (11.43)
B-51	16.85 (8.40)	17.57 (9.11)	17.52 (9.06)
Chakalasi Doli	16.29 (7.86)	16.95 (8.49)	16.79 (8.34)
Doli-5	15.51 (7.15)	18.12 (9.67)	17.98 (9.52)
G.B. 6	19.67 (11.33)	24.44 (17.11)	24.62 (17.35)
Gulabi	12.76 (14.96)	28.08 (22.15)	28.46 (22.70)
Junagadh Long	12.63 (4.78)	15.54 (7.18)	15.90 (7.51)
Junagadh Ravaiya	20.47 (12.23)	26.68 (20.16)	26.96 (20.55)
Local (Green)	17.09 (8.64)	22.04 (14.08)	22.02 (14.06)
Manjari Gota	17.59 (9.13)	21.08 (12.93)	21.11 (12.97)
Pusa Kranti	12.45 (4.65)	15.95 (7.55)	15.93 (7.53)
Pusa purple Cluster	12.00 (4.32)	15.86 (7.47)	15.89 (7.49)
Pusa purple Long	11.29 (3.83)	14.71 (6.45)	14.78 (6.50)
S-16	16.59 (8.15)	20.38 (12.13)	20.45 (12.20)
S-71-5-39-9	13.46 (5.42)	16.35 (7.92)	16.22 (7.80)
S-71-21-4-22	13.58 (5.51)	16.61 (8.17)	16.79 (8.34)
S-71-31-24	16.17 (7.75)	25.64 (18.72)	25.68 (18.78)
Suphal	18.13 (9.68)	25.59 (18.65)	25.38 (18.37)
Surati Ravaiya	18.61 (10.18)	24.41 (17.07)	24.49 (17.18)
S. Em. ±	1.22	0.77	0.79
C.D. (P = 0.05)	3.54	2.25	2.30
C. V.	10.38	5.32	5.41

Figures in parentheses are retransformed values from angular scales. Figures outside parentheses are angular transformed values.

TABLE 2

Population of jassid, whitefly and aphid in different cultivars of brinjal.

Variety	*Average number/9 leaves*		
	Jassid	*Whitefly*	*Aphid*
Arka Kusumkar	4.00 (15.00)	4.88 (22.81)	6.24 (37.93)
Arka Navneet	4.42 (18.54)	5.43 (28.48)	6.75 (44.56)
Arka Sheel	5.34 (27.52)	5.62 (30.58)	7.68 (57.98)
B-3	4.18 (16.47)	7.23 (51.27)	9.11 (81.99)
B-5	4.24 (16.98)	5.91 (33.93)	7.78 (59.52)
B-15	2.98 (7.88)	5.29 (26.98)	7.97 (62.52)
B-30	4.30 (17.49)	7.03 (48.42)	8.69 (74.52)
B-33	3.74 (12.99)	8.97 (79.46)	9.07 (81.26)
B-39	3.31 (9.96)	8.24 (66.89)	7.54 (55.85)
B-47	4.06 (15.48)	6.32 (38.94)	5.99 (34.88)
B-51	3.86 (13.89)	5.52 (29.47)	12.40 (152.76)
Chakalasi Doli	4.58 (19.97)	5.43 (28.48)	6.86 (46.06)
Doli-5	2.74 (6.51)	4.46 (18.89)	7.30 (52.29)
G.B. 6	3.76 (13.14)	5.83 (32.99)	8.80 (76.44)
Gulabi	4.47 (18.98)	7.14 (49.98)	8.51 (71.42)
Junagadh Long	2.91 (7.47)	4.89 (22.91)	7.67 (57.83)
Junagadh Ravaiya	4.30 (17.49)	6.55 (41.90)	11.02 (120.44)
Local (Green)	4.06 (15.48)	7.58 (56.45)	6.08 (35.98)
Manjari Gota	1.73 (1.99)	3.46 (11.97)	5.38 (27.94)
Pusa Kranti	2.36 (4.57)	4.73 (21.37)	6.15 (36.82)
Pusa purple Cluster	2.74 (6.51)	4.99 (23.90)	7.96 (62.36)
Pusa purple Long	2.34 (4.48)	4.69 (20.99)	7.09 (49.27)
S-16	4.80 (22.04)	8.86 (77.49)	7.65 (57.52)
S-71-5-39-9	4.30 (17.49)	6.96 (47.44)	11.29 (126.46)
S-71-21-4-22	4.36 (18.01)	8.57 (72.44)	6.36 (39.45)
S-71-31-24	4.47 (18.98)	6.07 (35.84)	6.78 (44.97)
Suphal	5.29 (26.98)	6.04 (35.48)	9.14 (82.54)
Surati Ravaiya	4.35 (17.92)	6.71 (44.02)	11.68 (135.42)
S. Em. ±	0.19	0.22	0.35
C.D. (± P = 0.05)	0.55	0.63	1.02
C.V.	6.91	4.95	6.21

Figures in parentheses are retransformed values.
Figures outside parentheses are $\sqrt{X+1}$ transformed values.

REFERENCES

Anonymous (1988). Screening of different varieties of brinjal for their susceptibilities to major pests and diseases In : *Research Report 1988-89 of Department of Entomology, Gujarat Agril. University, Anand* presented in XXV Plant Protection Sub-Committee (PPSC) meeting of Agril. Research Council (Agresco) of Gujarat Agril. University, held on May 4-5, 1989 at Sardar Krushinagar pp.17 (unpublished).

Anonymous (1990). Screening of different varieties of brinjal for their susceptibilities to major pests and diseases. In: *Research Report 1990-91 of Department of Entomology, Gujarat Agril. University, Anand* presented in XXVI Plant Protection Sub-Committee (PPSC) meeting of Agril. Research Council (Agresco) of Gujarat Agril. University, held on April 15-16, 1991 at Navsari pp.5 (Unpublished).

Gangwar, S. K. and Sachan, J. N. (1981). Seasonal incidence and control of insect pests of brinjal with special reference to shoot and fruit borer. *Leucinodes orbonalis* Guen. in Meghalaya. *J. Res. Assam agric. Univ.*, **2** (2) : 187-192 (R. A. E. (A), **71** (4) : 333).

Gill, C. K. and Chandha, M. L. (1979). Resistance in brinjal to shoot and fruit borer, *Leucinodes orbonalis* Guen. (Pyralidae : Lepidoptera). *Indian J. Hort.* **36** (1) : 67-71.

Mallik, A. S.; Dhankhar, B. S. and Sharma N. K. (1986). Variability and correlations among certain characters in relation to shoot and fruit borer (*Leucinodes orbonalis* Guen.) infestation on brinjal. *Haryana agric. Univ. J. Res.* **16** (3) : 350-365 (R. A. E. (A), **76** (2) : 77).

Mehto, B. N.; Singh, K. M. and Singh, R. N. (1980). Dispersion of *Leucinodes orbonalis* Guen. during different seasons. *Indian J. Ent.*, **42** (3) : 539-540.

Mote, U. N. (1981). Varietal resistance in egg plant to *Leucinodes orbonalis* Guen. I. Screening under field conditions. *Indian J. Ent.*, **43** (1) : 112-115.

Mote, U. N. (1982). Varietal susceptibility of brinjal *Solanum melongena* L. to jassid, *Amrasca biguttula biguttula* Ishida. *J. Maharashtra agric. Univ.*, **7** (1) : 56-60 (R. A. E. (A), **71** (1) : 61).

Pawar, D. B.; Mote, V. N.; Kale, P. N. and Ajri, D. S. (1987). Promising resistant sources for jassid and fruit borer in brinjal. *Current Research Reporter*, **3** (1) : 81-84 (R. A. E. (A), **77** (3) : 217).

Yien, B. R. and Rathaiah, V. (1984). Field incidence of shoot and fruit borer and bacterial with in some promising cultivars of brinjal and their yield performance. *J. Res. Assam agric. Univ.*, **5** (1) : 104-107 (R. A. E. (A), **75** (10) : 641).

Biology and Population Dynamics of Sugarcane Whitefly, *Aleurolobus barodensis* Maskell under Junagadh Conditions of Gujarat*

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ABSTRACT

The biology of *Aleurolobus barodensis* Maskell was studied in detail. The incubation period of egg averaged 8.8 ± 0.56. The duration of first, second and third nymphal instars averaged 2.53 ± 0.64, 4.21 ± 0.70 and 4.53 ± 0.52 days respectively. Puparium period lasted for 10.80 ± 0.93 days. The pre-oviposition, oviposition and post-oviposition periods averaged 1.13 ± 0.09, 29 ± 0.21 and 2.10 ± 0.21 hours, respectively. A female laid on an average of 50.08 ± 10.33 eggs. The life cycle from egg to adult averaged 32.17 ± 3.35 days. The sex ratio was observed to be 3.08 females : 1 male in the field collected samples.

A study on occurrence and abundance of sugarcane whitefly revealed that it's infestation commenced from mid July (1.50 nymphs/cm²/leaf) and reached at a peak (3.93 nymphs/cm²/leaf) in the first week of October. The nymphal population was highest in the period between the mid September and mid November (3.13 to 3.95 nymphs/cm²/leaf). Out of two parasitoids, *Amitus aleurolobi* and *Encarsia isaaci; Amitus aleurolobi* was pre-dominant. The parasitism ranged from 1.5 to 49.0 per cent.

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INTRODUCTION

Among the sucking pests, whitefly is a serious pest almost in all the sugarcane growing states. There are three species of whitefly viz., *A. barodensis*, *Neomaskellia bergii* and *N. andropogonis* of which the later two species are sporadic in occurrence. Later it has assumed a serious proportion in parts of Bihar, Haryana, Punjab, Tamil Nadu and mid form in Andhra Pradesh (Agarwal and Siddiqui, 1964). The life history studies of this pest has been done by some workers (Hamid Mahmood, 1955 ; Sandhu and Singh, 1963). Very little work on the biology of this pest has been carried out so far in Saurashtra region of Gujarat State. An attempt was, therefore, made to study its biology and population dynamics.

MATERIALS AND METHODS

Sugarcane plants were raised in earthern pots for laboratory rearing of whitefly. Initial culture was raised by collecting whitefly adults from the

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infested cane fields with the help of aspiratory bottle and they were released in plastic jar (18 x 6 cm) containing sugarcane leaf for oviposition. After 24 hours whitefly adults were allowed to escape from the plant. The leaves containing eggs were placed again in plastic jar. The freshly laid eggs on the leaves were marked individually by drawing a circle around them and they were further observed for biology of whitefly at the room temperature.

Five plants were selected at random for counting the whitefly nymphs. The sugarcane crop (variety CO - 6304) was kept free from the application of insecticides. Observations on the whitefly nymphs were recorded at fortnight interval by observing three leaves (upper, middle and lower) of each selected plant. The nymphal population was recorded by counting the number of nymphs per cm^2 area of each leaf. Such observations were taken till the maturity of crop. The whitefly nymphs were collected from Departmental Farm at fortnight intervals through out the season. The nymphs of each collections were kept in glass tube (20 x 3.5 cm) in the laboratory to determine the nymphal parasitism. The percentage parasitism was worked out on the basis of total nymphs collected and number of nymph parasitized.

RESULTS AND DISCUSSION

A. Biology

Female whitefly laid eggs on the lower surface of leaf in a single strip or line. The freshly laid eggs were creamy yellow in colour which changed to light brownish grey after sometime and finally to shiny black with a round base. The incubation period ranged from 8 to 10 days with an average of 8.8 ± 0.56 days. Ninety two per cent of eggs were hatched. According to Husain (1929), the incubation period varied from 9 to 10 days whereas 10 days was reported by Hamid Mahmood (1955). The first, second and third nymphal instar periods lasted for 2-4, 3-5 and 4-5 days with an average of 2.35 ± 0.64, 4.21 ± 0.70 and 4.53 ± 0.52 days, respectively (Table 1). According to Hamid Mahmood (1955), the first, second and third nymphal instar periods were 2-4, 4-5 and 3-5 days, respectively. The total nymphal period varied from 10 to 12 days with an average of 11.53 ± 0.99 days. Sandhu and Singh (1963) reported that this period varied from 9.70 ± 1.27 to 15.60 ± 1.34 days. While it was 16-20 days and 19-32 days as reported by Banerjee and Butani (1975) and Garg and Chaudhary (1979), respectively. The freshly formed puparium was ash coloured and did not show any marked difference of character from nymphs except in respect of size. The puparium period varied from 10 to 13 days averaging 10.80 ± 0.93 days. The sex ratio showed that the females were more in number than the males. The sex ratio was 3.08 females : 1 male. The pre-oviposition oviposition and post-oviposition periods varied from 1 to 1.30, 27-31 and 2-2.50 hours with an average of 1.33 ± 0.09, 29 ± 0.21 and 2.10 ± 0.21 hours, respectively. The egg laying capacity of a single female varied from 27 to 63 with an average of 50.08 ± 10.03 eggs. Husain (1929) and Hamid Mahmood (1955) reported a maximum number of eggs laid by a single female was 51 and 52, respectively.

The longevity of female was 30 to 34.15 hours with an average of 32.32 ± 1.33 hours and 27.15 to 32.15 hours with an average of 29.46 ± 1.30 hours in case of males. The life cycle was completed within 32.17 ± 3.35 days.

B. Population dynamics

Data presented in Table 2 indicated that the whitefly infestation commenced from mid July

TABLE 1

Biology of *Aleurolobus barodensis* at 29.6 ± 3.0°C and 77.1 ± 1.0% RH.

Particulars	*Nos. observed*	*Duration in days*	
		Ave ± S. D.	*Range*
Egg	275	8.80 ± 0.56	8 - 10
Nymph	15	11.15 ± 0.99	10 - 12
First instar	15	2.53 ± 0.64	2 - 4
Second instar	15	4.21 ± 0.70	3 - 5
Third instar	15	4.53 ± 0.52	4 - 5
Puparium	15	10.80 ± 0.93	10 - 13
Pre-oviposition period (hrs)	12	1.13 ± 0.09	1.0 - 1.30
Oviposition period (hrs)	12	29.0 ± 0.21	27.0 - 31.00
Post - Oviposition period (hrs)	12	2.10 ± 0.21	2.0 - 2.50
Fecundity/female	12	50.08 ± 10.03	27 - 63
Adult longevity (hrs)			
Female	12	32.32 ± 1.33	30.0 - 34.15
Male	12	29.46 ± 1.30	27.15 - 32.15
Sex ratio (Female : Male)	102	3.08 : 1.0	

TABLE 2

Nymphal population and parasitism of *Aleurolobus barodensis* during 1991-92 by *Amitus aleurolobi* and *Encarsia isaaci*.

Standard Week	*Nymphs/ cm²/leaf*	*Parasitism (%)*
27	0.00	0.00
29	1.50	0.00
31	2.00	1.50
33	2.47	3.22
35	2.93	4.71
37	3.47	7.32
40	3.93	35.12
42	3.53	18.78
44	3.13	12.80
46	3.40	49.00
49	2.67	32.00
51	1.33	18.60
1	0.74	5.60
3	1.20	26.80
5	2.40	6.10
7	2.07	4.00
9	0.13	0.00
10	0.00	0.00

i.e., 1.5 nymphs/cm²/leaf and it gradually increased with the advancement of crop age, reached at peak (3.93 nymphs/cm²/leaf) in the first week of October (40th standard week). The nymphal population remained steady in the period between the mid September (37th standard week) and mid November i.e. 3.13 to 3.93 nymphs/cm²/ leaf.

The whitefly nymphs were found parasitized by two parasitoids, *Amitus aleurolobi* Mani and (Platygasteridae) and Encarsia isaaci Mani (Aphelinidae) during the year 1991-92. *A. aleurolobi* was found to be pre-dominant. The data on parasitism by both the parasitoids presented in Table-2 revealed that the activity of parasitoids commenced from early August and presented alongwith the host existence. The percentage parasitism varied from 1.50 to 49.00 per cent during the crop season.

REFERENCES

Agarwal R. A. and Z. A. Siddiqui, 1964. The pest of sugarcane in "Entomology in India" Ent. Soc. India, New Delhi pp. 149-186.

Banerjee and D. K. Butani. 1975. Insect pest of sugarcane and their control. *Indian Sugar.* **25** (6) : 561-572.

Garg. D. O. and J. P. Chaudhary. 1979. Insect pests of sugarcane in Punjab and their control I. sucking pests. *Indian Sugar*, **28** (10) : 697-701.

Hamid Mahmood, S. 1955. Morphology and biology of sugarcane whitefly, *Aleurolobus barodensis* Mask. in India, *Mem. Ent. Soc. India,* **4** : 1-34.

Husain, M. A. 1929. Annual report of the Entomologist to the Government Punjab, Lyallpur for the year 1927-28. Rep. Dept. Agric. Punjab, 1927-28 Part - II : pp. 55-59 Lahore, 1929.

Sandhu, J. S. and Singh Sardar 1963. Studies on the biology of sugarcane whitefly. *Aleurolobus barodersis* Mask. *Indian J. Sug. Res. Dev.*, **7** (2) 83-88.

Effect of Growth Regulators on the Rooting and Survial of Airlayers of Jack Fruit (*Artocarpus heterophyllus* Lam.)

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ABSTRACT

Investigation was carried out on propagation of jack fruit by airlayers to study the effect of three growth regulators viz., IAA, IBA and NAA each at three concentrations of 5000, 10,000 and 15,000 ppm IBA was found significantly superior to NAA and IAA and it was proved more effective at higher concentrations. The maximum values for percentage rooting (92.5%), length of primary root (29.7 cm), number of primary roots (29.0) and survival percentage (87.5%) after detachment were noted with IBA at 15,000 ppm concentration.

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INTRODUCTION

Jack fruit is, perhaps, the most yielding among different fruit plants. It's raw fruits are used for making vegetable and pickles, whereas ripe fruits are eaten as such. Propagation of jack fruit is generally done by seed through out the country but it leads to immense variation in the orchard performance besides late bearing. Several vegetative methods of propagation like inarching and budding have been tried which performed better but these were expensive. Some workers (Dhua and Sen, 1984; Mukherjee and Chatterjee, 1978 and Sen and Bose, 1959) observed response of airlayers to rooting and its survival by the application of growth regulators. Keeping this in view an attempt was made to study the induction of rooting in airlayers of jack fruit by using different growth regulators at different concentrations.

MATERIALS AND METHODS

The present study was conducted during the rainy season 1986-87 at farmer's field of village Mehduli, Distt. Balaghat (M. P.). Three growth regulators viz., Indole acetic acid (IAA), Indole butyric acid (IBA) and Naphthalene acetic acid (NAA), each at three concentrations, 5000 ppm., 10,000 ppm. and 15,000 ppm. were tested in lanolin paste (W/W). Ten twigs were airlayered for each treatment and replicated four times to form R. B. D. Four full grown bearing jack fruit trees of about twenty years age and of the same size and vigour represented four replications. The matured shoots of one to two years age

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and uniform size were selected for airlayering. The airlayering was performed as per the method suggested by Hortman and Kester (1992).

The observations on rooting percentage, length and number of primary roots were recorded after 75 days of airlayering. The survival percentage of airlayers was noted three months after detachment from the mother plant.

RESULTS AND DISCUSSION

Effect on rooting percentage of airlayers

All the three growth regulators and concentrations were found significantly superior to the control and to each other (Table - 1). In case of control, the mean rooting percentage of airlayers was only 5% whereas the IBA treated airlayers resulted in the highest percentage of rooting (66.40%) followed by those treated with NAA (36.83%) and IAA (31.17%). The 15,000 ppm concentration gave the highest (59.44%) rooting of airlayers which was followed by 10,000 ppm (40.60%) and 5,000 ppm (31.94). The increase in the concentration of growth regulators increased the percentage of rooting in each case. The interaction effect of growth regulators and concentrations was also significant. The maximum percentage (92.50%) rooting of airlayers was registered in IBA 15,000 ppm concentration which was significant to all other treatments.

Effect of length of primary root

The length of primary root in control was only 1.27 cm. (Table 1) whereas the IBA treated airlayers caused maximum length (19.59 cm) of primary root. Among the different concentrations, 15,000 ppm gave 18.46 cm. length of primary root followed by 10,000 ppm (11.46 cm) and at 5,000 ppm (8.06 cm). The concentrations were significant to each other. The interaction effect of growth regulators and concentrations was also significant. The IBA at 15,000 ppm concentration gave the highest (29.66 cm) length of primary root followed by IBA at 10,000 ppm concentration which gave 16.55 cm length of primary root.

Effect on number of primary roots

The IBA resulted in the maximum mean number (18.16) of primary roots which was significantly superior to NAA and IAA. The NAA and IAA were found at par. Concentrations of the growth regulators were found significantly superior to each other. The maximum mean number of primary roots (14.16) was observed in 15,000 ppm concentration. The 10,000 ppm and 5,000 ppm concentrations gave 8.67 and 5.58 mean number of primary roots respectively. While referring to the interaction effect, the IBA at each concentration gave significantly superior number of primary roots, (28.99) at 15,000 ppm. Increase in the concentration increased the number of primary roots. In the case of control, the mean number of primary roots was the lowest (0.50) and significantly inferior to the treated airlayers.

Effect on survival percentage of airlayers

Although the effect of growth regulators and concentrations were significant but interactions were insignificant (Table 1). The IBA gave maximum survival percentage (76.38%) of airlayers which was highly significant to those treated with NAA (47.20%) and IAA (45.83%). The maximum survival percentage (72.20%) was obtained at 15,000 ppm concentration which was at par to 10,000 ppm concentration (59.70%). The concentration of 5,000 ppm resulted in the lowest survival percentage (37.49%) of airlayers which was significantly inferior to 10,000 ppm and 15,000 ppm concentrations. In case of control, the survival percentage of airlayers was observed nil.

Thus, the survival of the airlayers is directly dependent on length and number of primary roots

TABLE 1

Rooting and survival of airlayers of jack fruit as affected by different growth regulators and their concentrations.

Growth regulators	*Percentage of rooting concentration (ppm)*				*Length of primary root (cm) concentration (ppm)*				*No. of primary roots concentration (ppm)*				*Survival percentage concentration (ppm)*			
	5000	*10000*	*15000*	*Mean*	*5000*	*10000*	*15000*	*Mean*	*5000*	*10000*	*15000*	*Mean*	*5000*	*10000*	*15000*	*Mean*
I.A.A.	25.82	30.00	37.50	31.17	6.67	10.44	12.14	9.75	4.00	5.37	6.00	5.12	25.00	50.00	62.50	45.83
I.B.A.	47.50	59.20	92.50	66.40	12.55	16.55	29.66	19.59	10.50	14.83	28.99	18.16	62.45	79.20	87.50	76.38
N.A.A.	22.50	38.60	49.31	36.83	4.97	7.38	13.29	8.55	2.28	5.62	7.50	5.12	25.00	50.00	66.60	47.20
Mean	31.94	42.60	59.44	–	8.06	11.46	18.46	–	5.58	8.67	14.16	–	37.49	59.70	72.20	–
Control	5.00				1.27				0.50				0.00			
C.D. at 5% for Gr. regu. & Conc.				5.36				1.19				1.35				18.93
C.D. at 1% for Gr. regu. & Conc.				7.28				1.62				1.84				25.73
C.D. at 5% for interaction				9.70				2.06				2.82				N.S.
C.D. at 1% for interaction				12.60				2.79				3.84				N.S.

induced as a result of growth regulators. The IBA proved significantly superior in this regard. Even, the lowest concentration 5,000 ppm of IBA was found to be as effective as 15,000 ppm concentration of NAA and IAA. Better rooting with the application of IBA in airlayers of jack fruit has also been observed by Singh (1955), Sen and Bose (1959) and Mukherjee and Chatterjee (1978), in mango by Chatterjee (1982), in sapota by Chatterjee *et al.* (1989) and in bael by Mukherjee *et al.* (1986).

REFERENCES

Chatterjee, B. K. (1982). Effect of different concentrations of growth regulators on rooting and survival percentage of mango airlayers. *Punjab Hort. J.*, **22** (3 & 4) : 128-30.

Chatterjee, B. K., D. P. Rao, B. P. Chakladar and S. K. Mukherjee (1989). Effect of different concentrations of growth regulators, etiolation and invigoration on the rooting of airlayers of sapota (*Achras sapota* Linn.) *Ind. J. Hort.*, **46** (4) : 426-29.

Dhua, R. S. and S. K. Sen (1984). Role of etiolation, auxinic and non-auxinic chemicals on root initiation of airlayers of jack fruit (*Artocarpus heterophyllus* Lam.). *Ind. J. Hort.*, **41** (1 & 2) : 116-19.

Hortmann, H. T. and D. E. Kester (1992). Plant propagation. 4rth Edn. Prentice Hall of India Pvt. Ltd., New Delhi.

Jindal, K. K. (1968). Propagation studies on *Anona squamosa* and *Artocarpus heterophyllus* Lam. Unpublished Master's thesis submitted to P. G. School, IARI, New Delhi.

Mukherjee, S. K. and B. K. Chatterjee (1978). Effect of etiolation and growth regulators on airlayering of jack fruit (*Artocarpus heterophyllus* Lam.) *Ind. J. Hort.* **35** : 1-4.

Mukherjee, S. K., D. P. Rao, B. P. Chakladar and B. K. Chatterjee (1986). Effect of growth regulators, invigoration and etiolation on rooting of airlayers of bael (*Aegle marmelos* corre). *Ind. J. Hort.*, **43** (1 & 2) : 9-12.

Sen, P. K. and T. Bose (1959). Effect of growth substances on rooting of jack fruit (*Artocarphus integrifolia* Linn.). layerings. *Ind. Agric* : **3** : 43 - 7.

Singh, S. N. (1955). Studies on rootage of fruit plants in relation to hormones. IV (*Artocarpus heterophyllus* Lam.). *Sci. and Cult.*, **20** : 393-5.

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Effect of Nitrogen, Phosphorus and Potash Fertilization on Chlorophyll Content and Yield of *Rosa hybrida* cv. 'Super Star'*

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ABSTRACT

In a field trial, on *Rosa hybrida* cv. 'Super Star' conducted at Indian Agricultural Research Institute, New Delhi during 1989-90; 125 g N, 175 g P_2O_5 and 100 g K_2O per 1.44 sq.m. produced more chlorophyll in leaves than rest of the treatments. Chlorophyll content increased with the leaf age and was found highest during the second flush of flowering. The maximum flower yield was recorded in the treatment combination of 75 g N, 125 g P_2O_5 and 100 g K_2O per 1.44 sq.m.

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INTRODUCTION

Chlorophylls, the green pigments of plants are the most important pigments active in photosynthetic process which are often associated with the production of carbohydrates. Among the several types, chlorophyll *a* and *b* are the best known and are most abundant in plants. The fundamental significance of photosynthetic process is that the photosynthetic apparatus equipped with an intricate array of membranes of pigments, traps light energy and effects its conversion to chemical energy. Nitrogen, phosphorus and potash fertilization had beneficial effects on chlorophyll accumulation in the leaves of rose (Maharana & Pradhan, 1976) and grape vine (Golinka, 1978). In view of the above, a field experiment was conducted on rose cv. 'Super star' at the Indian Agricultural Research Institute, New Delhi to find out the effects of N, P & K fertilization on chlorophyll content of leaves in the first two flushes of flowering and on flower yield.

MATERIALS AND METHODS

Two years old field grown bushes of uniform size and vigour of *Rosa hybrida* cv.' Super star' were treated with four levels of N (25, 75, 125 and 175 g/1.44 sq.m), three levels of P_2O_5 (75, 125 and 175 g./1.44 sq.m.) and two levels of K_2O (0 and 100 g/1.44 sq.m.) after pruning in October 1989. The experiment was laid out in split plot randomised block design, keeping N levels in the sub-plot. The plot size was 1.20 x 1.20 m accomodating sixteen plants spaced at 30 x 30 cm. There were three replications, each having twentyfour treatments.

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For estimation of chlorophyll the green leaves were collected treatmentwise in two major flushes of flowering in December, 1989 and February, 1990. The first five-foliate leaves were selected from the top portion of flowering stem. Chlorophyll *a*, *b* and total chlorophyll were extracted from leaves treatmentwise by non-maceration of tissue using dimethyl sulphoxide (DMSO) by the method of Hiscox and Israelstam (1979). Depending on greenness of the leaves .01-0.5 g of leaf material was weighed and put in a test tube containing 10 ml DMSO. The test tubes were kept in oven at 65° C for two hours. The tubes were taken out and optical density was read at 645 and 663 hm using Spectronic-20. The chlorophyll content was calculated by using following formulae :

$$\text{Chl } a = (12.7 \times \text{OD } 663) - (2.69 \times \text{OD } 645) \times \frac{V}{1000 \times W}$$

$$\text{Chl } b = (22.9 \times \text{OD } 645) - (4.68 \times \text{OD } 663) \times \frac{V}{1000 \times W}$$

Total Chl = Chl *a* + chl *b*

Where, V = Volume of the extract

W = Weight of the tissue taken

$$\text{Chl ratio} = \frac{\text{Chl } a}{\text{Chl } b}$$

Chlorophyll content = mg/g fresh weight of the leaf tissue

The observation on flower yield was taken up to September 90. Since several interactions of N, P and K under first flush of flowering were found significant, interaction tables on chlorophyll content are not included in this article.

All data are statistically analysed and presented in Table 1 & 2.

RESULTS AND DISCUSSION

In the present investigation marked increase in the chlorophyll *a*, total chlorophyll and chlorophyll *a:b* ratio in the second major flush of flowering of 'Super Star' was noticed over the first flush of flowering under different fertilizer treatments. In the second flush of flowering chlorophyll *b* content in leaves was reduced over the first flush (Table 1). In general, there was successive rise in chlorophyll *a*, *b* and total chlorophyll content with each increment of N, P_2O_2 and K_2O_5 doses (Fig. I and II). Chlorophyll a:b ratio was also significantly increased in the first flush of flowering with the higher doses of nitrogen, phosphorus and potash except with the treatment of N 175 g. It is apparent that the increased chlorophyll content was associated with the advancement of plant age. The rise in chlorophyll content was resulted in increased yield of flowers in 'Super Star'. Maximum yield was, however, recorded with the treatment combination of 75 g N, 125 g P_2O_5 and 100 g K_2O.

During the first flush of flowering in December, all the interactions on chlorophyll *a*, chlorophyll *b*, total chlorophyll content and chlorophyll *a : b* ratio were found significant, whereas during the second flush these were found non-significant.

The maximum number of flowers were recorded in the treatment combinations of $N_2 \times P_2$, $N_2 \times K_2$ and $N_2 \times P_2 \times K_2$ in N x P, N x K and N x P x K interactions respectively (Table 2).

Variation in chlorophyll content due to application of fertilizers was reported by various workers in different crops. Salukvadze (1983) observed in tea that chlorophyll content was low at the start i.e. in the month of May and increased gradually until October and was much higher throughout in the P treated variants. Patarava

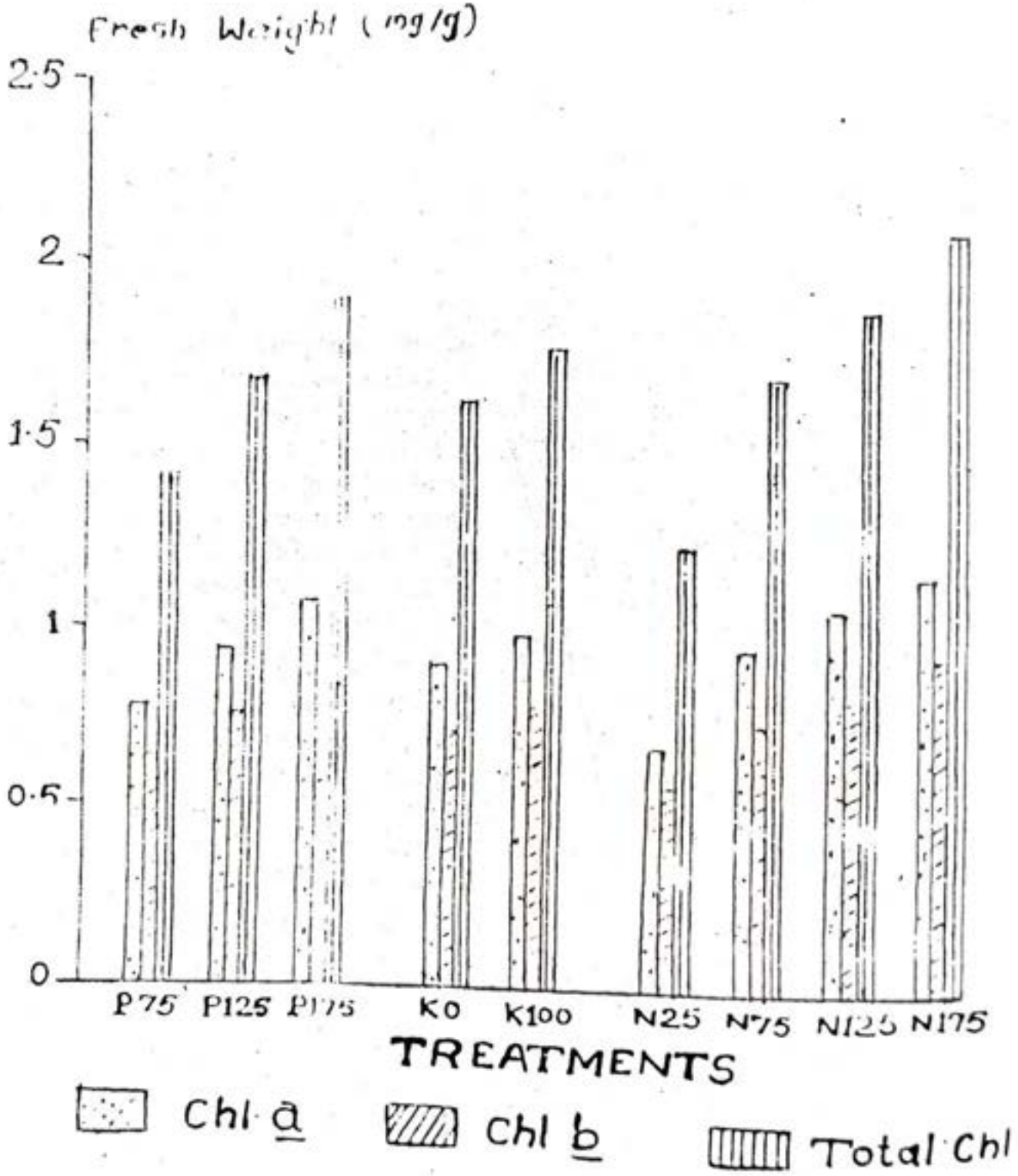

Fig.1 : Effect of NPK fertilization on chlorophyll content of *Rosa hybrida* cv. 'Supar Star' in the first flush of flowering.

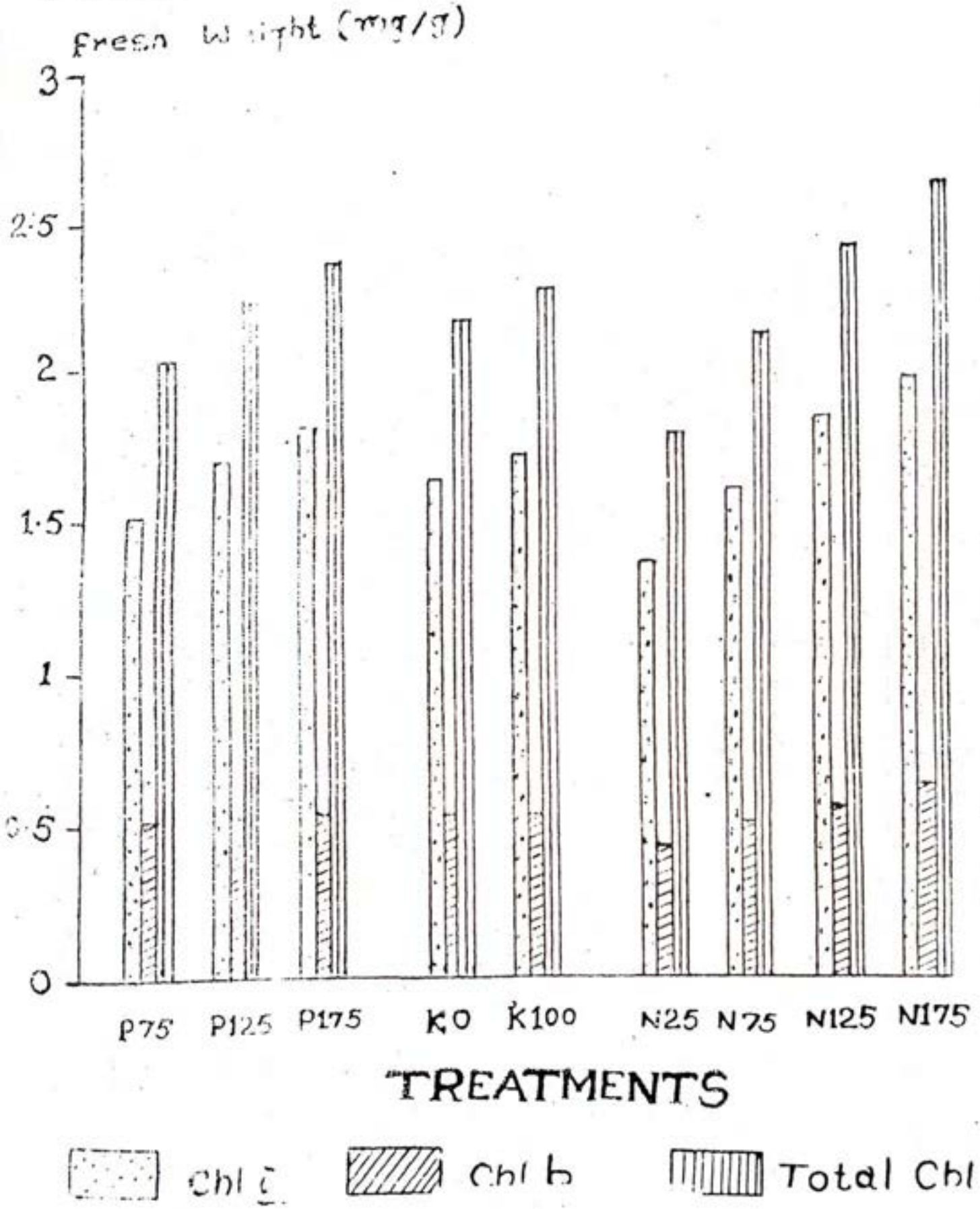

Fig.2 : Effect of NPK fertilization on chlorophyll content of *Rosa hybrida* cv. 'Supar Star' in the second flush of flowering.

TABLE 1

Effect of NPK fertilization on chlorophyll content (mg/g fresh weight) and yield of *Rosa hybrida* cv 'Super Star'.

Treatments		Chlorophyll-a		Chlorophyll-b		Total Chlorophyll		Chlorophyll a : b ratio		Total number of flower/plant/year
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Phosphorus										
P_2O_5	75 (P_1)	0.790	1.513	0.638	0.514	1.428	2.027	1.242	2.998	26.65
P_2O_5	125 (P_2)	0.930	1.701	0.743	0.523	1.673	2.224	1.249	3.250	41.08
P_2O_5	175 (P_3)	1.071	1.805	0.824	0.538	1.398	2.343	1.293	3.376	38.21
'F' test		**	**	**	N.S	**	**	**	N.S	**
S.Em.		0.004	0.0345	0.0012	–	0.0014	0.0313	0.0032	–	0.154
C.D. at 5%		0.0013	1.1087	0.0039	–	0.0043	0.0986	0.0100	–	0.486
Potash										
K_2O	0(K_1)	0.895	1.630	0.704	0.520	1.599	2.150	1.267	3.182	32.68
K_2O	100 (K_2)	0.966	1.715	0.766	0.530	1.732	2.245	1.256	3.234	37.94
'F' test		**	**	**	N.S	**	*	**	N.S	**
S.Em.		0.0003	0.0281	0.0010	–	0.0011	0.0255	0.0026	–	0.126
C.D. at 5%		0.0011	0.0887	0.0031	–	0.0035	0.0805	0.0082	–	0.397
Nitrogen										
N	25 (N_1)	0.659	1.351	0.551	0.422	1.210	1.773	1.198	3.250	26.25
N	75 (N_2)	0.919	1.585	0.713	0.509	1.632	0.094	1.288	3.126	43.38
N	125 (N_3)	1.023	1.822	0.783	0.551	1.806	2.373	1.304	3.332	38.31
N	175 (N_4)	1.121	1.933	0.893	0.619	2.014	2.552	1.256	3.124	33.30
'F' test		**	**	**	**	**	**	**	N.S	**
S.Em.		0.0010	0.0517	0.0011	0.0123	0.0016	0.0514	0.0033	–	0.244
C.D. at 5%		0.0029	0.1484	0.0032	0.0354	0.0047	0.1475	0.0095	–	0.702

** Highly significant *Significant at 5 per cent level. N. S. = Non-significant

1st = Leaves of 1st flush of flowering. 2nd = Leaves of 2nd flush of flowering

TABLE 2

Interactions of N x P, N x K and N x P x K on total number of flowers per plant per year of *Rosa hybrida* cv. 'Super Star'.

Particular	N_1	N_2	N_3	N_4
Interaction of N x P				
P_1	18.54	33.00	29.45	25.61
P_2	30.44	49.79	44.12	39.99
P_3	29.81	47.35	41.37	34.31
	'F' test	**		
	S.Em.	0.423		
	C.D. at 5%	1.216		
Interaction of N x K				
K_1	23.54	40.36	35.16	31.67
K_2	28.97	46.40	41.47	34.94
	'F' test	**		
	S.Em.	0.346		
	C.D.at 5%	0.993		
Interaction of N x P x K				
P_1K_1	17.75	31.92	28.92	24.92
P_1K_2	19.33	34.08	30.00	26.30
P_2K_1	25.50	45.83	39.17	37.78
P_2K_2	35.33	53.75	49.08	42.22
P_3K_1	27.37	43.33	37.42	32.33
P_3K_2	32.25	51.38	45.33	36.30
	'F' test	**		
	S.Em.	0.599		
	C. D. at 5%	1.719		

** Highly significant

(1969) recorded increased chlorophyll content with leaf age in tea shoots. Pirtskhalalshvili (1972) had, however, observed in oranges, mandarin and lemon that chlorophyll *a* and *b* were more with the application of $(NH_4)\ 2SO_4$, NPK and NPK + Ca + FYM respectively. Increased flower yield in rose cultivars was also reported by various researchers with the application of nitrogen (Borrelli, 1981), phosphorus (Johansson, 1978) and potash (Woodson and Boodley. 1982).

REFERENCES

Borrelli, A. 1981. The influence of the water regime and of nitrogen fertilizing on the production of roses under glass. *Rivista della Ortoflorofrutti coltura, Italiana,* **65** (2) : 109-117.

Golinka, P. E. 1978. The effect of different combinations of mineral nutrition on chlorophyll accumulation in grape vines. *Hort. Abstr.,* **49** : 9314.

Hiscox, J. D. and G. F. Israelstam. 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. *Canadian J. Bot.* **57** : 1332-1334.

Johansson, J. 1978. Effect of nutrient levels on growth, flowering and leaf nutrient content of greenhouse roses. *Acta Agriculturae Scandinavica.* **24** (4) : 363-386.

Maharana, T. and R. C. Pradhan, 1976. Effect of N, P and K and their combinations on growth, flowering and anthocyanin development of hybrid rose cv. "Celebration". *Punjab Horticulture Journal,* **16** (1/2) : 77-79.

Patarava, B. D. 1969. The effect of nitrogen on shoot formation and leaf pigmentation in tea plants. *Subtropicheskie Kul'tury,* **4** : 53-58.

Pirtskhalalshvili, E. S. 1972. The effect of fertilizers on the rate of photosynthesis and chlorophyll *a* and *b* content in citrus leaves. *Subtropicheskie Kul'tury,* **5** : 89-91.

Salukvadze, M. M. 1983. Shoot formation by tea and plastic pigment content of leaves in relation to different phosphorus application rates. *Subtropicheskie Kul'tury.* **6** : 40-47.

Woodson, W. R. and J. W. Boodley, 1982. Influence of potassium on the growth, flowering and chemical composition of greenhouse roses grown in recirculating nutrient solutions. *Hort. Science.* **17** (1) : 46-47.

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Attitude of SMSs (Participants) Towards Monthly Workshop in T & V System

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ABSTRACT

The Gujarat Agricultural University have a special obligation towards the monthly workshop (MWs) organised under the T & V System. Training of extension personnel in improved agricultural technology is an important Extension Education activity under T & V System. The SMSs of the Deptt. of Agriculture are trained for various training in pre-seasonal and monthly workshop at four campuses of the Gujarat Agricultural University. The attitude of SMSs towards monthly workshop required to be identified before imparting training to this Subject Matter Specialists. The attitude of SMSs is measured by administrating the scale developed by Patel (1991). The results of this study helps to improve the attitude of SMSs towards the monthly workshop.

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INTRODUCTION

Training of extension personnel and the practicing farmers in improved technology of agriculture constitute an important extension education activity under T & V System. Thus, in fact the entire strategy of transfer of technology under T & V system is based on the quality/ effectiveness of monthly workshops.

Attitude of an individual play an important role in determinating behaviour with respect to a particular psychological object, As corollary of this fact, the Subject Matter Specialists' (SMSs) attitude towards the monthly workshops of T & V system will largely determine the nature and extent of their involvement, participation in the monthly workshops and motivation to learn, which, in turn, reflect on the effectiveness of the workshops. If, SMS's have negative attitude towards monthly workshop, then they may not have strong motivation to learn in workshop and which results in failure to train them or failure to transfer the latest agricultural technologies to them, and ultimately to farmers. It is therefore crucial to identify the attitude of the SMSs towards monthly workshops. Keeping this in view, it was thought to measure the attitude of SMSs working in Gujarat through newly developed scale.

Objectives

(a) To measure the attitude of SMSs (participants) towards monthly workshop in T & V system.

(b) To compare the attitude between the SMSs

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participated at Anand and Sardar Krushinagar.

(c) To study the attitude of the SMSs for the different component of the monthly workshop.

(d) To study the association between the experience of SMSs and their attitude towards monthly workshop.

(e) To study the effect of job work on attitude of SMSs towards monthly workshop.

MATERIALS AND METHODS

There are six monthly workshop centres in the State to privide training to the SMSs working in Gujarat. The two monthly workshop centres i.e. Anand and Sardar Krushinagar were purposively selected for the study to make comparative study. All the SMSs and other participants who have attended the monthly workshop during the month of April 1991 at Anand and Sardar Krushinagar were selected as respondents. The attitude scale developed by Patel (1991) was administered on SMSs (participants) in person and data were collected. The data, thus collected from 62 respondents (30 from Sardar Krushinagar and 32 from Anand) were processed, tabulated, analysed and given statistical treatments.

The percentage, mean score, co-efficient of correlation 't' test and X^2 test were applied for the analysis.

RESULTS AND DISCUSSION

(A) Attitude towards Monthly Workshop

It was observed that the majority (80.65 per cent) of the respondents were having natural attitude towards monthly workshop, followed by 11.29 per cent of the respondents were having favourable attitude, while 8.06 per cent of the respondents belonged unfavourable attitude category. This finding is supported by Prajapati (1980). He found that the extension workers had neither favourable nor unfavourable attitude towards training component under T & V system.

(B) Comparison of attitude between the SMSs participated at Anand and Sardar Krushinagar

Both the monthly workshop centres studied i. e. Anand and Sardar Krushinagar are different in a sense that Anand centre is located at town place while Sardar Krushinagar is at remote place. However, it was revealed that there was no significant difference (t-2.38) in the attitude of the SMSs participated at Anand and Sardar Krushinagar. However, if the 't' value compared at 0.05 level, it was found that the attitude of SMSs participated at Sardar Krushinagar was significantly more favourable then the SMSs participated at Anand.

(C) Component-wise attitude of SMSs towards monthly workshop

To draw the inference SMSs were classified into three categories, i.e. agreed undecided and disagreed. The component wise number of SMSs for each category is given in Table 1.

(D) Association between the experience of SMSs and their attitude towards monthly workshop

It was thought that, if the person have more experience in T & V programme as SMS and if he has attended many monthly workshop, then there is a chance that he might be tired of repeatition of same type of technologies in different workshop and due to this his attitude may be different then newly joined or less experienced person. However, the value of correlation, coefficient (r) was found - 0.024, which was not significant and very low. Hence, there was no association between the

TABLE 1

Component-wise number of SMSs (participants) for each category.

Sr. No.	*Component*	*Number of SMS*		
		Agree (%)	*Undecided (%)*	*Disagree (%)*
1	*2*	*3*	*4*	*5*
1.	MTs (Master Trainers) provides important technologies in the monthly workshop (MW)	5 (8.06)	1 (1.61)	56 (90.33)
2.	If the additional information asked by the participants and not known to MT, then he provides in the next MW	10 (16.12)	1 (1.61)	51 (82.27)
3.	To refresh the knowledge MN is required	4 (6.45)	2 (3.22)	56 (90.33)
4.	The information given in the MW is timely	5 (8.06)	1 (1.61)	56 (90.33)
5.	Physical facilities and other infrastructural facilities are insufficient to organise MW effectively	29 (46.79)	6 (9.67)	27 (43.54)
6.	Required field visits are not organised during MW	27 (43.54)	5 (8.06)	30 (48.40)
7.	There is a fruitful discussion between MTs and participants during MW	10 (16.12)	1 (1.61)	51 (82.27)
8.	The duration of MW is not optimum to cover all the topics	22 (35.49)	4 (6.45)	36 (58.06)
9.	The MW helps in developing confidence in my work	5 (8.06)	1 (1.61)	56 (90.33)
10.	The literature provided in MW is of generalised nature and does not answer location-specific problems.	34 (54.85)	3 (4.83)	25 (40.32)
11.	More weightage is given on the theoretical aspects rather than practical	44 (70.98)	1 (1.61)	17 (27.41)
12.	The farmers' problems brought from the field are solved by the MTs during MW	10 (16.12)	7 (11.29)	45 (72.59)
13.	It is not necessary to conduct MW in every month, as there is a lot of repeatation in the subject matter	37 (59.67)	4 (6.45)	21 (33.88)
14.	Subjects/topics chosen for MW are proper and need based	4 (6.45)	4 (6.45)	54 (87.10)
15.	Top level scientists are not coming as MT in MW	48 (77.43)	3 (4.83)	11 (17.74)
16.	MTs are using insufficient teaching aids	42 (67.75)	6 (9.67)	14 (22.58)
17.	MTs conducting MW effectively and with maintaining interest of learners	13 (20.96)	4 (6.45)	45 (72.59)

experience of SMSs in T & V system and their attitude. In other words we can say that there is no effect of experience of SMSs in T & V system as SMS on their attitude towards monthly workshop.

(E) Effect of job work on attitude of SMSs towards monthly workshop

The SMSs/other participants of monthly workshop are engaged with different type of work. Some of them have to give training to farmers and some of them have to give training to the VLWs in fortnightly training meeting, while some are involved in both the training whereas some are not at all involved with training work. It was also thought that they may be more comfortable in giving training if they themselves get trained in monthly workshop. It means, the training of monthly workshop may be directly useful to them. Whereas other persons who are not involved in training work, they may not be directly benefitted by the monthly workshop. Thus, there may be a effect of job on the attitude of SMSs. To see this effect the X^2 test was applied. The results is given in Table 2.

In the Table 2, it can be seen that the X^2 value is 0.239 which is non-significant. Thus it can be concluded that there is no effect of job work on SMSs of their attitude towards monthly workshop. In other words it can be said that there is no effect on attitude towards monthly workshop even if SMSs are involved with farmers' training or the fortnightly training or both the training or none of the training.

TABLE 2

Effect of job work on attitude of SMSs towards monthly training.

		Fortnightly training work		*Total*
		Yes	*No*	
Farmers training work	Yes	28 (28.80)	19 (18.19)	47
	No	10 (9.19)	5 (5.80)	15
	Total :	38	24	61

X^2 value = 0.239 N. S.

Conclusion

1. It is found that the majority (80.65) per cent of the SMSs (participants) have shown neutral attitude towards monthly workshop, whereas, 11.29 per cent of the SMSs (participants) have favourable attitude and 8.06 per cent have unfavourable attitude.
2. There is no significant difference between the attitude of the SMSs participated at Anand and Sardar Krushinagar towards monthly workshop.
3. There is no association between the experience of SMSs (participants) in T & V system and their attitude towards monthly workshop.

4. There is no effect of job work (i.e. imparting farmers' training or fortnightly training or both farmers' and fortnightly training or none of the training) of SMSs (participants) on their attitude towards monthly workshop.

REFERENCES

Patel, A. A. (1991), The scale to measure attitude of SMSs towards monthly workshop in T '& V System. Special problem submitted to BACA, GAU, Anand.

Prajapati M. R. (1980). Attitude of extension workers towards new agril. ext.programme in district Jaipur (Raj.) Unpub. M.Sc. Thesis, University of Udaipur, Jobner (Rajasthan).

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Participation of Rural Women in Decision-Making

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ABSTRACT

The present study was conducted in Daskroi taluka of Ahmedabad district of Gujarat State in 1989 to find out the extent of participation of rural women in decision-making related to farm business, animal husbandry, expenditure pattern and children's education and marriage. The results indicated that majority (70.73) of the rural women alone made the decision on storage of grains for home consumption and other purposes. Whereas majority of the families made the decision on animal husbandry activities, expenditure pattern and decision on education and marriage of children jointly by rural women and their husbands. Moreover, it was also observed that decision on cropping pattern and marketing of produces made by husband alone in majority of families.

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INTRODUCTION

Agriculture is the largest industry in the country contributing to the source of livelihood for over 70 per cent of population. Decision-making is important because much of the success of farming depends upon how well the family makes decision. Since, farm business is a family enterprise in India in which husband and wife share work and pleasure both. It is therefore, excepted that all decisions related to farm operations are also taken jointly. In addition to participation in farm activities and physical work, rural women as wives and mothers have a considerable part in decision-making on household, agriculture and animal husbandry activities. In joint family not only the wives but also the mothers have a large part in decision-making. Truely called the better hold of the man, the woman plays a major role inside the home as a housewife managing the domestic family affairs out side as a co-partner in his profession. When so significant in her contribution on farm and animal husbandry - it is necessary to know whether she has any say in decision-making on matter related to farming and animal husbandry.

Keeping in view the above said facts an attempt was made to find out the extent of participation of rural women in decision making related to farm business, animal husbandry, expenditure pattern and children's education and marriage.

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MATERIALS AND METHODS

This investigation was carried out in Daskroi Taluka of Ahmedabad district of Gujarat. Two stage random sampling design was used to select a sample for the study. Thus, 100 respondents were randomly selected from 10 randomly selected villages of the said taluka. The respondents were asked about their participation in decision-making related to farm operations, animal husbandry tasks, expenditure pattern and children's education and marriage. Decision-making was grouped in to five groups viz., husband and wife jointly, wife alone, husband alone, friends and neighbours and relatives taking decisions etc.

RESULTS AND DISCUSSION

In order to plan and carry out farm and home programmes successfully in rural area, there is need to know whether decision taken by rural women was at individual level or joint decision. The data in this regard are presented in Table-1.

Table-1 shows the decision-making pattern on four selected areas as under :

I. Farm business related tasks

(A) Cropping pattern

Majority (68.29 per cent) of the husbands alone made the decision on deciding cropping pattern followed by 18.29 per cent rural women alone, whereas 10.98 per cent made joint decision by husbands and respondents. While in 2.44 per cent of the families made the decisions with help of neighbours and friends on cropping pattern which comprises the selection of crops, selection of area for crops, crop rotation, sowing time, use of manures and fertilizers, plant protection measures, use of modern recommended agricultural information and seed storage, etc.

(B) Marketing of produces

More than fifty (62.19 per cent) of the respondents stated that decision was made by their husbands on marketing of the produces which involves the quantity of grains to be marketed, rates and place of marketing etc. In 26.83 per cent of the families, the decision was made jointly by husband and respondent, whereas, 9.76 per cent of respondents indicated that decision was made by them on this aspects. While only 1.22 per cent of the respondents stated that neighbours and friends helped them in taking decisions on marketing of produces.

(C) Storage of grains

Majority (70.73 per cent) of the respondents made the decision on storage of food grains for home consumption and other purposes, followed by 20.73 per cent of the respondents stated that the decision was made by their husbands. While only 8.54 per cent of the families made the decision jointly by husband and respondent.

II. Animal husbandry activities

Nearly half (46.32 per cent) of the families made the decision on animal husbandry which involves selling price of milk and to sell or to purchase the animals jointly by husband and respondent followed by 33.68 per cent of the respondents made the decision themselves about these aspects. While 20.00 per cent of the respondents stated that the decision was made by their husbands only.

III. Expenditure patterns

About half (45.45 per cent) of the families, the decision was made jointly by husbands and respondents with respect to expenditure on food and clothes, selling and purchasing of land and amount to be spent on labour work etc. Whereas, 40.91 per cent of the respondents stated that decision was made by their husbands on expenditure pattern. While 13.64 per cent of the respondents made the decision themselves on these aspects.

TABLE I

Distribution of the respondents according to decision - making pattern in their families.

Sr. No.	*Particulars*	*Decision - Makers*				
		Husband	*Respondent*	*Husband and respondent*	*Neighbours and friends*	*Relatives*
I.	Farm business related task					
	A : About cropping pattern	56	15	9	2	0
		(68.29)	(18.29)	(10.98)	(2.44)	(0.00)
	B : Marketing of produces	51	8	22	1	0
		(62.19)	(9.76)	(26.83)	(1.22)	(0.00)
	C : Storage of grains	17	58	7	0	0
		(20.73)	(70.73)	(8.54)	(0.00)	(0.00)
II.	About animal husbandry	19	32	44	0	0
		(20.00)	(33.68)	(46.32)	(0.00)	(0.00)
III.	Expenditure pattern	36	12	40	0	0
		(40.91)	(13.64)	(45.45)	(0.00)	(0.00)
IV.	Children's Education and marriage					
	A : About education	32	23	7	0	0
		(34.78)	(25.00)	(40.22)	(0.00)	(0.00)
	B : About marriage	10	16	66	0	0
		(10.87)	(17.39)	(71.74)	(0.00)	(0.00)

Figures given in parentheses indicate percentages.

IV. Children's education and marriage

A : Education

In more than one third (40.22 per cent) of the families, decision on education of the children was jointly made by husband and respondent. While 34.78 per cent of the respondents stated that decision on education which comprises sending children school, educational level of children, selection of subject / branch and place of education etc. was made by their husbands. Whereas 25.00 per cent of the respondents made the decision themselves on education of children.

B : Marriage

More than one half (71.74 per cent) of the families made the decision on marriage of children jointly by husbands and respondents, followed by 17.39 per cent of the respondents made the decision themselves on marriage of children which involves desired marriage age for boys and girls, selection of match, expenditure on marriage and bout dowry etc. whereas 10.87 of the respondents stated that their husbands made decisions on these aspects.

It is seen that decision made by the majority of the respondents (70.73 per cent) on storage of grains (33.68 per cent) animal husbandry, (13.64 per cent) expenditure pattern, (18.29 per cent). Cropping pattern and (25.00 per cent) children's education and (17.39 per cent) children's marriage indicates their individual level of decision making pattern in rural families. Also the joint decisions taken up with their husbands on animal husbandry, expenditure pattern, marketing of produces, children's education and marriage and cropping pattern show their active involvement in rural families decision-making pattern.

These findings are supported by Puri (1971 and 1972), Devadas (1975), Malik (1979), Badigar and Rao (1980), Sisodia (1985) and Nikhade *et al.* (1988).

Rural women mostly participate in making decision on storage of grains, about cropping pattern, marketing of produces, animal husbandry, expenditure pattern, children's education and marriage. More intensive training programmes should organise for them so that the latest know-how can reach to the actual user of the technology. The training programme of one day/two days in the area of farm activities, animal husbandry, and health and sanitation in the village itself to enable rural women to derive benefit from them.

REFERENCES

Badiger, C. and Rao, M.K.S. (1980). Participation of Farm Women in Decision-Making on Farm and Home Aspects. *Current Research.* **9** (12) : 199-200.

Devadas, R. P. (1975). Role of Women in Modern Agriculture. *Indian Farming* **25** (8) : 15-17.

Malik R. (1979). The Decision-making by farm women regarding Improved Agricultural Practices. *Ind. J. Ext. Edu.* **15** (3 & 4) 64-69.

Nikhade, D. M., Shinde, P. S. and Kotecha, P. F. (1988). Role of Farm Family members in Decision-making in Adoption of Farm Innovations. *Maha. J. Ext. Edu.* **7** : 37-41.

Puri, S. (1971). Delineating of areas of Decision-making by Farm Women. *Ind. J. Ext. Edu.* **7** (3 & 4) : 144.

Puri, S. (1972). Decision-making pattern with respect to farm related and Family Planning Decisions. *Indian J. Ext. Edu.* **8** (3 & 4) : 120-124.

Sisodia, J. S. (1985). Role of Farm Women in Agriculture : A study of chambal command area of Madhya Pradesh. *Indian J. Ag. Econ.* **40** (3) : 224.

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Uniformity Trial on Lucern

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ABSTRACT

Uniformity trial on lucern (Cv. Anand 2) was conducted for two crop seasons for generating information +on plot *technique. The experimental crop was grown on loamy sand soil in about 0.2 ha in first season and 0.06 ha in second season. Cutwise green fodder yields of 1200 and 400 units (each of 1m x 1m area) were recorded and analysed. The results revealed that coefficient of variation per unit area (C. V. %) decreased with the increase in size of plot. The rate of reduction in C. V. % was more with the increase in width of the plot (i.e. no of rows) then that with the increase in length of the plot. 10 units plot (1 m x 10 m) was found optimum for field experiment. The estimates of soil heterogeneity index, b', based on average yield of six cuts were 0.263 and 0.369. Lattice design was found efficient than Randomized Block design.

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INTRODUCTION

Agricultural research workers are mainly concerned with field experimentation. The choice of suitable size and shape of plot is an important factor in efficient planning of field experiment. The optimum plot size depends on nature of experimental material, soil variability, kind of crop, number of treatments per block and cost of various operations. Knowledge of soil variability which could be evaluated through uniformity trial, helps in determining the optimum size and shape of plot. Several workers have utilized uniformity trials in various crops to estimate optimum size and shape of plot as well as to study the effect of size and shape of plots, number of replications and choice of experimental designs on the precision of estimates. Such information, however, is not available for Lucern (alfalfa) crop grown on loamy sand soil of Middle Gujarat. This paper presents the results on plot technique study in Lucern crop grown on loamy sand soil of Middle Gujarat.

MATERIALS AND METHODS

Uniformity trial in lucern (*Medicago sativa*, L.) crop (Cv. Anand 2) was conducted at the Forage Research Farm, Gujarat Agricultural University, Anand Campus, Anand, during the crop seasons of the years 1988-89 and 1989-90.

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The crop was drilled at 25 cm distance with a seed rate of 10 kg/ha. At the time of preparation of land 20 tonnes FYM, 20 kg nitrogen and 80 kg phosphorus per hectare were given as a basal dose. The field actually used had a dimension of 30 m x 40 m in the first year and 40 m x 10 m in the second year of the study.

The crop was harvested in small units; the size of the basic units being 1 m x 1 m (i.e. 4 rows each of 1 m length). There were 1200 and 400 basic units under study during first and second year respectively. The cut-wise green fodder yield was recorded for each unit. The first cut was taken after 60 days from sowing and thereafter every 30 days during winter season and 20 to 25 days during summer season. In all six cuts were obtained in each year. The optimum plot size was computed according to the Maximum Curvature method (Federer 1955), and Soil heterogeneity index described by Smith, (1938). The Relative efficiency of lattice design with randomized block design was estimated according to the procedure outlined by Zuhlke and Gritton, (1970).

RESULTS AND DISCUSSION

The C.V.% in general, decreased with the advancement of the crop age upto fourth cut thereafter it showed increasing trend (Table 1). The sixth cut showed maximum variability while fourth cut had minimum variability. The C. V. % decreased with the increase in the plot size upto 80 units plot (Table 1). These results are akin to those reported by Torrie *et al.* (1963), Handa *et al.* (1982) and Patel *et al.* (1985). The greater decrease in C.V.% was observed when the area per plot increased from one unit to 10 units plot in first year and from one unit to eight units plot in second year. Therefore 10 units size plot was considered as optimum plot size.

The trend was expressed in an equation form. The equations derived to show the relation between C.V.% and plot size (X) using original data as well as long transformed data.

1. Original data

$\hat{C.V.\%} = 23.12 - 0.27X + 0.002X^2$ ... First year ($R^2 = 0.80$)

$\hat{C.V.\%} = 20.43 - 0.36X + 0.002X^2$ ... Second year ($R^2 = 0.84$)

2. Log transformed data

$\hat{C.V.\%} = 26.12 - 6.50 \log X$ ... First year ($R^2 = 0.93$)

$\hat{C.V.\%} = 23.51 - 7.83 \log X$ ... Second year ($R^2 = 0.96$)

The regression analysis showed that the efficiency of prediction of C. V. % was high when the variable X was transformed to log scale.

The rate of reduction in C.V.% was more with the increase in width of the plot (i.e. number of rows) than that with the increase in length of the plot (Figure 1). The results thus revealed that long and narrow plot covering more number of rows (rather than length of rows) should be preferred for field experiments on lucern.

The estimates of soil heterogeneity index, b' are presented in Table 2.

The results revealed that b' varied from 0.18 (fifth cut) to 0.50 (third cut) during first year (1988-89) and from 0.13 (second cut) to 0.76 (fifth cut) during second year (1989-90). This indicated that the fertility variation among adjacent plots as judged by b' values calculated from field data was not consistent. The definite reasoning for such large deviations could not be resolved. However, information on plant density before each cut, growth parameters, nutrient movement and weather parameters might help in explaining such large deviations in b' values.

The estimates of relative efficiency of simple and balanced lattice designs over Randomized

TABLE 1

Coefficient of variation per unit size in per cent for green fodder yield of lucern.

Basic unit	Cut number						Av. for plot size
	1	2	3	4	5	6	
				1988-89			
1	30.70	29.46	21.08	16.91	29.39	38.43	27.66
2	27.31	24.77	17.16	14.74	26.67	35.38	24.34
3	20.80	21.63	14.14	13.10	24.56	33.75	22.00
4	25.47	21.94	14.86	13.58	25.13	32.70	22.28
5	23.53	20.47	13.72	13.16	24.50	32.04	21.14
6	21.81	18.60	11.74	11.88	23.33	31.80	19.86
8	23.45	18.97	13.16	12.77	23.94	30.41	20.45
10	21.01	17.25	11.55	11.89	23.08	29.65	19.07
12	20.71	16.88	10.09	11.18	22.49	30.06	18.57
15	18.04	15.60	8.90	11.09	22.34	29.07	17.51
16	21.08	16.42	11.26	11.68	22.59	28.84	18.65
20	19.34	15.30	10.20	11.01	21.90	27.60	17.56
24	19.36	14.91	9.17	10.68	21.70	28.44	17.37
25	19.23	15.45	9.79	11.01	22.00	28.48	17.66
30	15.20	13.07	7.25	10.17	21.03	27.32	15.67
40	16.41	12.85	9.07	9.32	18.01	22.24	14.65
48	17.06	12.97	8.10	10.28	20.95	27.31	16.11
50	16.83	12.80	8.33	10.21	20.95	26.32	16.71
60	13.93	11.68	6.23	9.47	20.10	25.83	14.90
75	12.89	11.71	5.10	10.21	21.16	26.77	14.64
80	13.14	10.30	7.73	7.51	13.76	16.37	11.47
100	14.85	10.94	7.24	9.33	19.66	24.20	14.37
				1989-90			
1	26.41	25.26	20.63	19.51	26.37	26.31	24.08
2	23.66	21.90	18.73	17.08	23.28	24.43	21.52
4	21.36	19.27	17.18	14.11	19.59	22.28	18.97
5	20.28	18.10	16.39	12.99	19.08	20.53	17.90
8	18.94	17.05	15.20	10.38	12.74	16.62	15.15
10	18.42	15.85	15.17	11.26	16.01	18.02	15.79
16	17.34	15.49	13.57	7.99	7.27	11.87	12.26
20	16.56	14.62	13.95	9.35	11.98	14.95	13.57
25	16.06	13.75	14.40	8.46	14.08	16.12	13.76
40	13.82	12.69	11.17	6.45	7.16	11.25	10.43
50	14.20	11.73	13.03	6.96	9.83	11.72	11.25
80	11.31	10.17	8.78	4.86	3.39	7.41	7.65
100	12.50	11.10	11.91	6.15	4.80	6.68	8.86

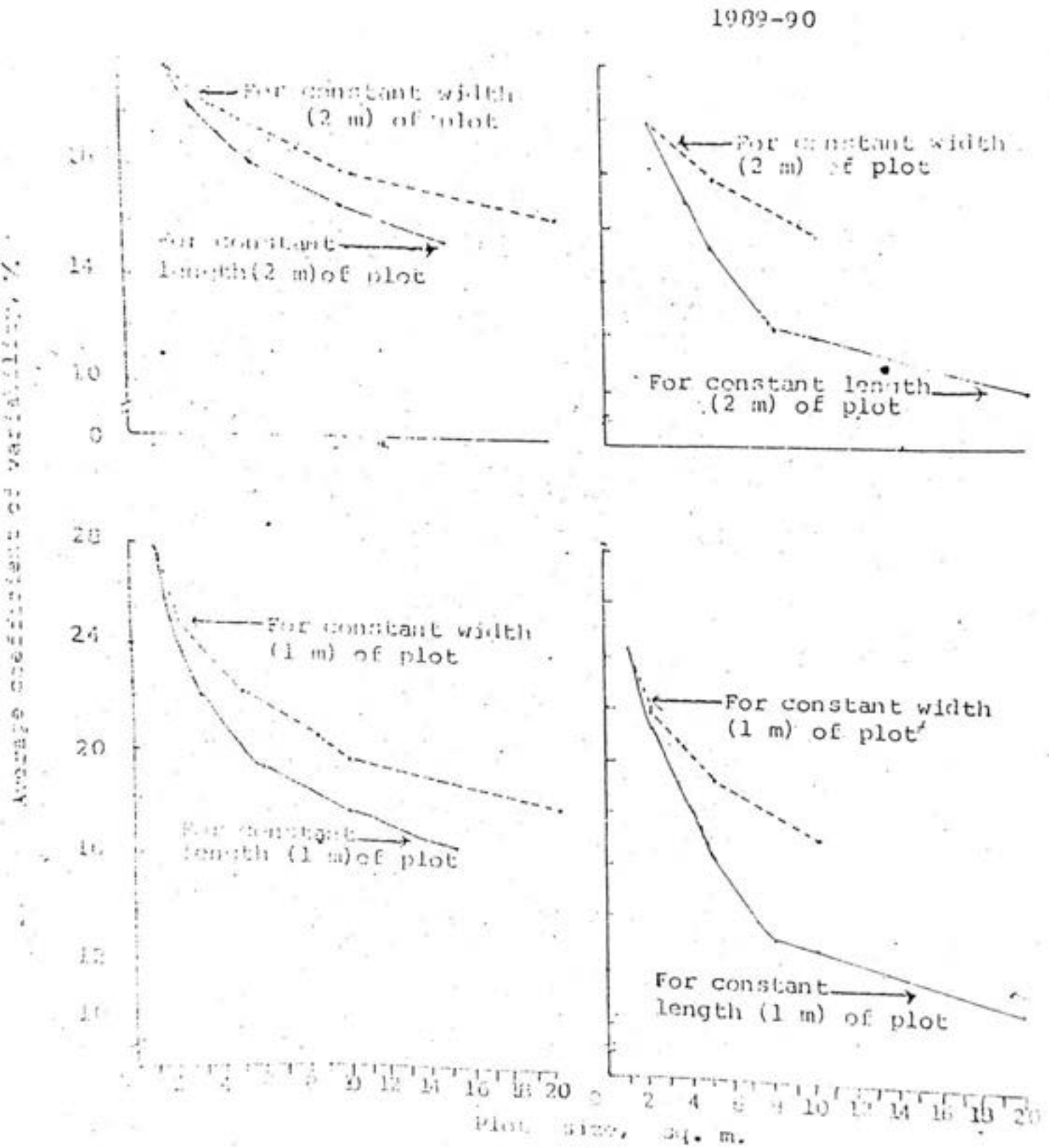

Fig. 1 : Effect of constant length or width of plot on coefficient of variability (averaged over 6 cuts) of different sized plot.

TABLE 2

Estimates of soil heterogeneity index, b'.

Cut	1988-89	1989-90
1	0.35	0.34
2	0.43	0.13
3	0.50	0.29
4	0.25	0.23
5	0.18	0.76
6	0.21	0.56

Block design based on yield data generated for 10 units sized plots and 16 and 25 treatments are presented in Table 3.

The results (Table 3) indicated that both the designs were comparatively more efficient than Randomized Block design for field experiments on lucern. These results are akin to those reported by Torrie *et al.* (1963) and Zuhlke and Gritton (1970). Though results are inconsistent (Table 3), it appears that use of confounding concept in field experiments on lucern crop could help in improving efficiency of the estimates.

TABLE 3

The estimates of relative efficiency of the Simple and Balanced lattice designs over Randomized Blok design.

No. of treats.	Cut	Simple lattice		Balanced lattice	
		1988-89	1989-90	1988-89	1989-90
16	1	168	115	180	118
	2	111	134	113	141
	3	112	133	115	139
	4	214	101	232	101
	5	108	107	138	132
	6	105	239	123	260
	Av.	136	138	150	149
25	1	100	102	100	102
	2	100	105	100	107
	3	100	100	101	100
	4	159	120	170	126
	5	176	111	189	115
	6	200	117	217	121
	Av.	139	109	146	112

REFERENCES

Federer, W. T. 1955. Experimental designs. The MacMillan Co., New York. pp 62-63.

Handa D. P.; P. R. Sreenath; J. A. Sastry; S. K. Raipal and N. P. Shukla 1982. Size and shape of plots and block for experiments with oat grown for fodder. *Ind. J. Agric. Sci.* **52** : 466-71.

Patel, N. M.; R. B. Patel and A. S. Patel 1985. Plot size studies in forage oat under two methods of irrigation. *Guj. Agril. Uni. Res. J.*, **10** : 5-9.

Smith, H. F. 1938. An empirical law describing heterogeneity in the yields of agricultural crops. *J. Agric. Sci.*, **28** : 1-23.

Torrie, J. H.; D. R. Schmidt and G. H: Tenpas. 1963. Estimation of optimum plot size and shape and replicate number of forage yield of alfalfa-brome grass mixture. *Agron. J.*, **55** : 258-60.

Zuhlke, T. A. and E. T. Gritton. 1970. Relative precision of different experimental designs and number of replications in pea yield trials. *Agron. J.* **62** : 61-67.

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Variation in Leaf Attributes of Cotton

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ABSTRACT

A study was undertaken to predict quantity of insecticide solution to be sprayed at various growth stages of Cotton Hybrid 4. Leaf area, leaf area index (LAI), leaf number and leafweight increased up to 120 days of crop age and thereafter these variables showed declining trend. Quadratic trend due to age of crop was observed for all attributes. Leaf weight accounted for maximum variability of LAI. Prediction equations were worked out.

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INTRODUCTION

Cotton Hybrid 4 is highly susceptible to pests and diseases needing continuous watch on the crop for taking timely plant protection measures. Due to lack of knowledge, farmers are generally using excess quantity of insecticide(s) and water (in mixture). This leads to increased cost of cultivation, toxicity to plants, residual problems affecting the health of animals as well as human beings and environmental pollution.

The quantity of pesticide(s) and water for preparing mixture to be used at a given stage of crop primarily depends on the vegetative growth of the plant. Vegetation is the expression of leaf number and leaf area which are important leaf parameters influencing yield. They could be utilized to determine total vegetation at a particular stage (age) of the crop. This in a way helps in estimating precisely the actual quantity of pesticide(s) mixture required for spraying. Such information for susceptible crop like Cotton Hybrid 4 may help in reducing cost of cultivation besides other associated problems. The present study is a part of the investigation undertaken to predict quantity of insecticide solution required for spray at different growth stages of cotton hybrid 4.

MATERIALS AND METHODS

Cotton Hybrid 4 was planted at a spacing of 120 cm x 60 cm, covering an area about 0.15 hectare at the Plant Breeding Research Farm, GAU, Anand. The crop cultivation practices including plant protection measures in vogue on the farm were followed. The cropped field was divided into four blocks. Each block was divided into nine

plots for collecting observations at nine growth stages of crop (30, 45, 60, 75, 90, 120, 150, 180 and 210 days after sowing). At each stage, four plots (one from each block) were selected at random for the purpose. The competitive plants from these plots were cut from ground level and brought to the laboratory. The number of plants measured in nine growth stages were 38, 32, 31, 30, 20, 16, 16, 16 and 16 (in sequence) making total 215 plants. The different measures like number of leaves per plant, leaf area per plant and leaf weight per plant were recorded. The leaf area was determined using automatic Leaf Area Meter (Model LI 3000; accuracy ± 2%).

The LAI was worked out by taking ratio of total leaf area per plant to the total area of the ground surface per plant (Watson, 1958). The green leaf weight (leaf weight) of all the leaves of each plant was recorded in gramme (g) after completing leaf area measurement.

RESULTS AND DISCUSSION

Variation in leaf attributes : The range and mean values for different characters studied in the present investigation at different growth stages (Days after sowing, DAS) are summarized in Table 1 and are depicted in Figures 1 to 4.

Number of leaves : The mean number of leaves per plant (Table 1) showed increasing trend upto 120 days of crop, thereafter declining trend was observed. The number of leaves per plant ranged from 8 to 10 with an average of 8.74 + 0.08 in first stage of counting (30 DAS) and it increased to 477.75 ± 25.46 leaves per plant with a range of 305 to 636 leaves per plant in the sixth stage (120 DAS). After attaining maturity, leaves get detached naturally from the plant affecting leaf count. The average number of leaves per plant decreased to 219.81 ± 9.40 in the last count (210 DAS) with a range of 165 to 290 leaves. These results are akin to those reported by Shanmughum *et al.* (1980). Present study is based on total 35677 leaves counted in nine stages of crop growth. Maximum variation in number of leaves was observed at 120 DAS followed by 150, 210 and 180 DAS.

Leaf area : The results (Table 1) indicated that average leaf area per plant in the first stage (30 DAS) was 321.36 ± 5.77 sq.cm. and it increased to 25644.38 ± 1027.88 sq.cm. when crop attained age of 120 days. The declining trend after 120 days brought down the leaf area per plant to an average of 4547.24 ± 245.81 sq.cm. in the last measurement (210 DAS). The maximum variation in leaf area was observed at 210 DAS followed by 150, 180 and 120 DAS. These results are similar to those reported by Anonymous (1983 to 1986).

Leaf area index (LAI) : The mean leaf area index (Table 1) showed similar trend as observed in leaf area per plant.

Leaf weight : The data summarized in Table 1 indicated increasing trend in leaf weight per plant with the increase in the age of plant upto 120 days. The average leaf weight per plant in first stage (30 DAS) was 7.97 ± 0.18 g with a range of 6.46 to 10.19 g which increased to 681.04 ± 32.56 g when crop attained the age of 120 days. The decreasing trend after 120 days resulted in lowering leaf weight per plant which was reduced to 140.69 + 6.86 g per plant (210 DAS).

Trend and prediction : The attributes studied showed in general increasing trend up to 120 DAS and thereafter decreasing trend (Table 1 and Fig. 1 to 4). The analysis of variance (Table 2) indicated significant quadratic trend in all the variables barring number of

Fig. 1 : Number of leaves

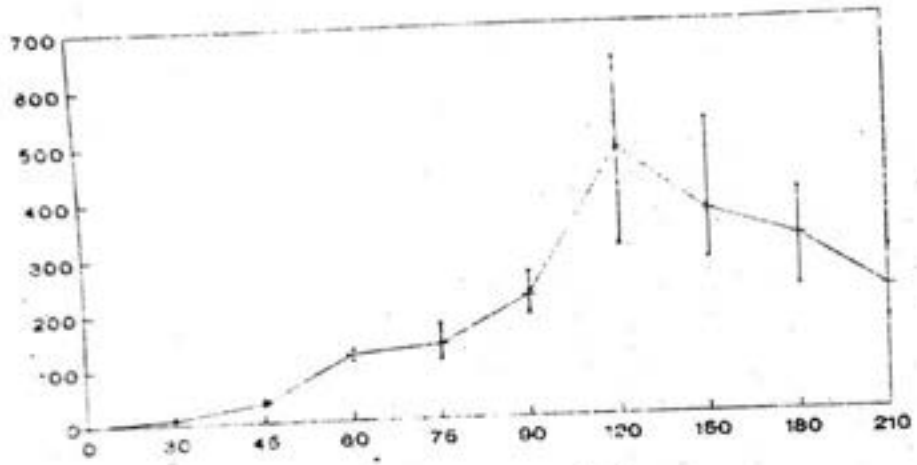

Fig. 2 : Leaf area

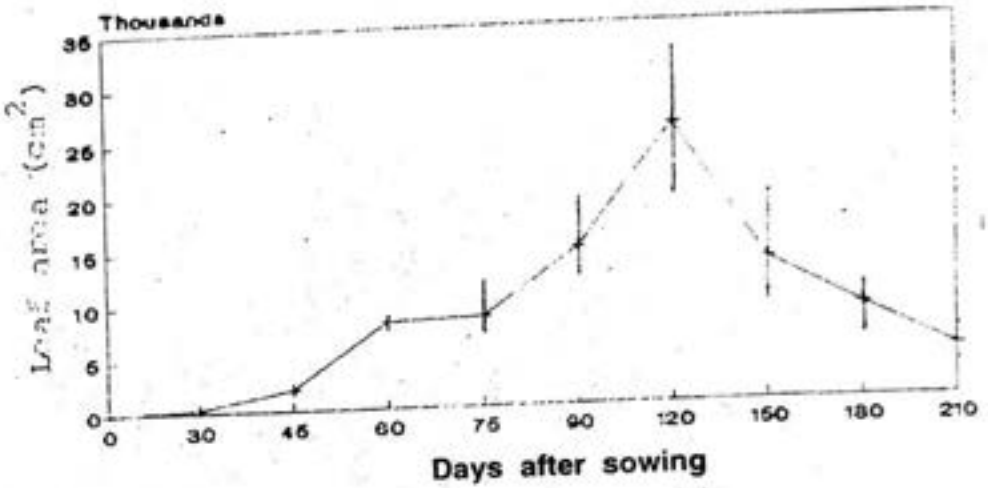

Fig. 3 :Leaf area index

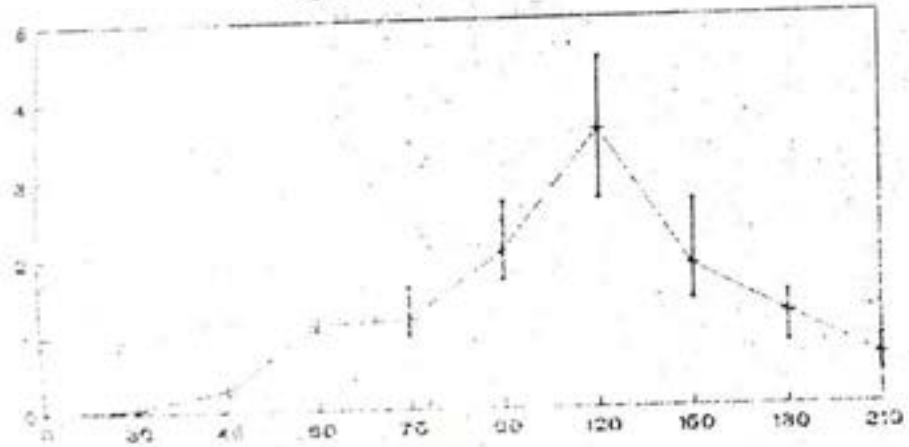

Fig. 4 : Leaf weight

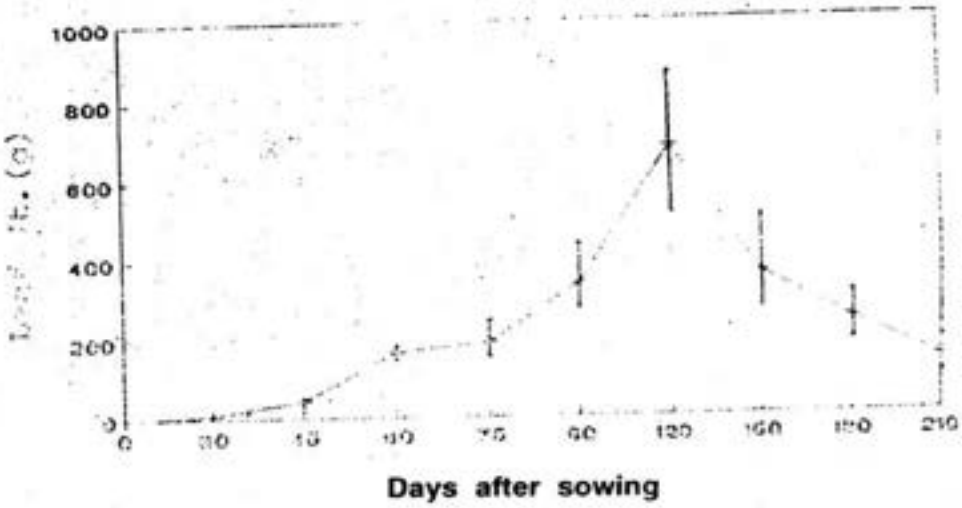

TABLE 1

Mean values of various characters of Cotton Hybrid 4.

DAS	E	No. of leaves	Leaf area	Leaf area index	Leaf weight
30	R	8.00 - 10.00	270.09 - 391.99	0.038 - 0.0.54	6.46 - 10.19
	M	8.74 ± 0.0.8	321.36 ± 5.77	0.045 ± 0.001	7.97 ± 0.18
	C	5.76	11.07	11.06	13.85
45	R	32.00 - 38.00	1702.32 - 2199.99	0.236 - 0.306	34.56 - 50.54
	M	34.78 ± 0.27	2015.39 ± 23.02	0.280 ± 0.003	43.47 ± 0.71
	C	4.37	6.46	6.46	9.21
60	R	108.00 - 129.00	7456.36 - 8510.72	1.036 - 1.182	149.80 - 182.90
	M	121.03 ± 1.11	8045.16 ± 47.11	1.117 ± 0.007	166.65 ± 1.90
	C	5.13	3.26	3.26	6.34
75	R	107.00 - 172.00	6955.94 - 11484.86	0.966 - 1.595	152.20 - 245.70
	M	135.23 ± 3.36	8411.81 ± 225.31	1.168 ± 0.031	190.06 ± 4.55
	C	13.61	14.67	14.67	13.11
90	R	185.00 - 260.00	11945.72 - 19055.90	1.659 - 2.647	275.50 - 435.20
	M	218.45 ± 5.30	14553.27 ± 413.07	2.021 ± 0.057	336.46 ± 9.42
	C	10.86	12.69	12.69	12.53
120	R	305.00 - 636.00	19241.53 - 32260.58	2.672 - 4.481	510.30 - 865.30
	M	477.75 ± 25.46	25644.38 ± 1027.88	3.562 ± 0.143	681.04 ± 32.56
	C	21.32	16.03	16.03	19.12
150	R	277.00 - 525.00	9870.28 - 18997.66	1.371 - 2.639	272.00 - 501.20
	M	364.88 ± 17.42	13046.02 ± 633.52	1.812 ± 0.088	359.48 ± 15.99
	C	19.10	19.42	19.42	17.79
180	R	225.00 - 397.00	5890.05 - 10401.86	0.818 - 1.445	186.00 - 309.00
	M	315.94 ± 13.04	8604.33 ± 380.41	1.195 ± 0.053	244.00 ± 10.07
	C	16.51	17.68	17.68	16.51
210	R	165.00 - 290.00	3068.74 - 6279.81	0.426 - 0.872	98.00 - 189.00
	M	219.81 ± 9.40	4547.24 ± 245.81	0.632 ± 0.034	140.69 ± 6.86
	C	17.10	21.62	21.62	19.52

Legend : DAS = Days after sowing; E = Estimates; R = Range;
M = Mean ± SE; C = C.V. %

leaves which showed significant linear component also. The quadratic trend accounted for 84.2, 76.4, 76.4 and 78.3 per cent of the total variation in number of leaves, leaf area, leaf area index and leaf weight respectively.

Above equations are based on age of crop (DAS) hence the prediction of each variable is possible through nondestructive method which is always desirable from production as well as economy view point. Number of leaves can be predicted more precisely using age of crop than any other leaf variables.

The variables studied are associated with each other (Table 3).

The results indicated that each variable could be predicted with very high degree of precision by using the information of other variables. For collecting information on these four variables one has to cut the leaves (or plant) which may prove detrimental from production view point, hence any nondestructive method may prove more useful. Secondly the present study was undertaken to predict the quantity of insecticide solution required at different growth stages. Under the circumstances

TABLE 2

Partitioning of mean squares due to stages.

Source	d.f.	NOL	LA	LAI	LW
		M.S.	M.S.	M.S.	M.S.
Linear	1	85459.98*	30409330.54	0.587	37854.13
Residual	7	15188.26	62461473.34	1.205	41492.09
Quadratic	1	76100.95**	327083312.14**	6.309**	204287.13**
Residual	6	5036.14	18357833.55	0.354	14359.58
Cubic	1	7243.76	15378.54	0.000	1498.00
Residual	5	4594.62	22026324.55	0.425	16931.90
Total	8				

Legend : * and ** Significant at 5 and 1 per cent level of significance.
NOL = Number of leaves; LA = Leaf area;
LAI = Leaf area index; LW = Leaf weight

Regression analysis revealed the following prediction equations

Number of leaves :	$\hat{NOL} = -301.24 + 9.25\ D - 0.03\ D^2$	($R^2 = 84.2\ \%$)
Leaf area :	$\hat{LA} = -15862.3 + 529.3\ D - 2.1\ D^2$	($R^2 = 76.4\ \%$)
Leaf area index =	$\hat{LAI} = -2.203 + 0.074\ D - 0.0003\ D^2$	($R^2 = 76.4\ \%$)
Leaf weight	$\hat{LW} -426.13 + 13.55\ D - 0.005\ D^2$	($R^2 = 73.8\ \%$)

Where D = Number of days after sowing (DAS)

TABLE 3

Estimates of corrleation coefficient between pairs of attributes.

Attributes	LA	LAI	LW
NOL	0.8596**	0.8596**	0.9096**
LA		1.0000**	0.9912**
LAI			0.9912**

**Significant at 1 per cent level of significance.

nondestructive method will be easier for farmers to follow. Among four variables, farmers can count number of days crop has completed (i.e. age) and leaves very easily at a given crop stage. Therefore number of leaves and the age of crop were considered for predicting the quantity of insecticide solution. This part is not included here.

REFERENCES

Anonymous (1983-86). Annual Report. Cotton Research Station, Gujarat Agricultural University, Surat.

Shanmugham, K.; Rao, H. K. H. and Seshadri, V. (1980). The influence of leaf shape on growth and yield attributes on upland cotton. *Indian J. Agric. Sci.* **50** (10) : 736-744.

Watson D. J. (1958). The dependence net assimilation rate on leaf area index. *Ann. Bot., London. NS* **22** : 37-54.

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Auto Irrigation by Suction Force; Concept and Prospects

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ABSTRACT

An auto irrigation technique was developed by using soil moisture stress as suction force to lift water from very shallow sources. The burried porous ceremic pots were used to discharge water making equilibrium with soil moisture stress and thus a partial vacuum was created inside the pots, which is utilized as a suction force to lift water for continous flow without using any external energy. The maximum discharge at 0.5 m suction lift was found 2-3 l per day. This technique will be useful to irrigate at low suction lift, with zero energy consumption.

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INTRODUCTION

The efficient management and application of water for irrigation solely depends on the irrigation techniques and methods used, this calls for rehabilitation of the existing irrigation/methods and adoption of modern irrigation strategies in increasing the crop production. The conventional methods particularly surface methods are consuming large amount of water per unit area. The pressure irrigation methods viz., Drip and Sprinkler though gives high irrigation efficiency but the energy requirement is more. Work has been done by Kornev (1924), he has placed a porous clay pipe in soil and found suction force of the soil reaches its critical value at one half saturation and is dependent on colloids present. Richards (1934), Murotsev (1979) and Rathod and Solanki (1989) have also worked on similar aspects. There is very little information available on the utility of this technique, keeping in view, efforts have been made to harness the soil moisture stress to lift water for irrigation and to validate the practical feasibility of an auto irrigation technique by utilising suction force through pitchers, which reduces on-farm water losses, soil erosion, energy and labour consumption.

Theoretical considerations

When a porous ceremic cup connected through a tube filled with water placed in soil, the water inside the porous cup comes in hydraulic contact and tends to equilibrate with surrounding soil water tension, through the pores in the ceremic walls. The soil water being at subatmospheric pressure exercise a suction which draw out water from the cup, causes continuous flow in the piping and lift water from certain head without applying any external energy. The flow of water and suction lift created depends upon the soil as well as properties of the porous material.

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The cup conductance is the rate of flow of water through the porous cup under unit hydraulic head difference. Mathematically it can be determined by the following equation (Kenworthy 1945).

$$K = \frac{A}{t} \; 1_n \frac{h_1}{h_2} \qquad ..(1)$$

Where, K is conductivity of porous cup, ml $h^{-1}m^{-1}$, A is cross sectional area of the tube, cm^2, h_1 is initial pressure head of water, m, h_2 is final pressure head of water, m, and t is time required for pressure head to drop from h_1 to h_2, h.

The air entry value is the property of cup and defined as the air pressure difference between the inside and the outside of the cup wall which causes an air leak or just force the air through the wetted porous cup wall. It is the upper limit of the suction in tube beyond which continuity of water column will break.

MATERIALS AND METHODS

The experimental set-up consists of wooden box 1.8 m x 0.5 m x 0.5 m filled with air dried soil having particle size less than 2 mm and particle density 1.35 g cm^{-3}. China clay pitcher of diameter 12.5 cm. and air entry value of 2.15 atm having pot conductance of 4 mlh^{-1} atm^{-1} were used in experiment. The rubber cock with two holes of 5 mm diameter was fixed on the mouth of the pitcher. The priming tube with cut-off valve was connected with one hole of rubber cock and another hole was connected with a graduated sink filled with water through a suction tube of 5 mm diameter. The whole system was made air tight. Three pitchers having suction lifts of 0.5 m, 1.0 m and 1.5 m were burried in the experimental box at equal distance of 0.6 m below the top surface of the soil as shown in Fig. 1.

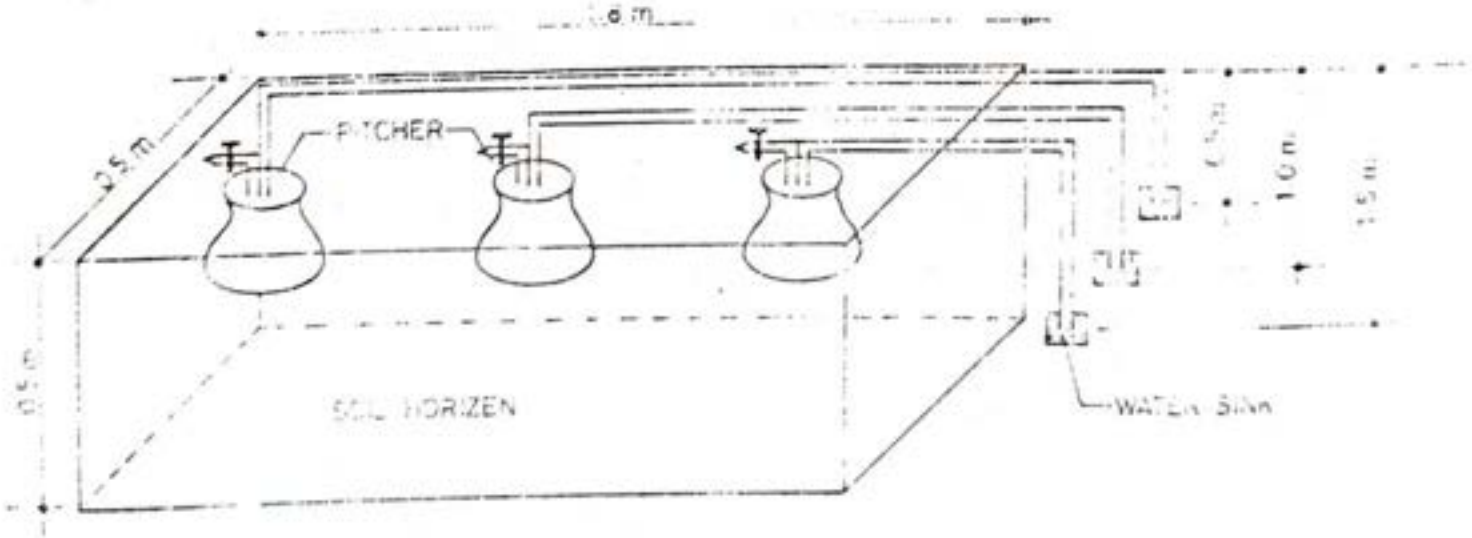

Fig. 1 : Experimental setup

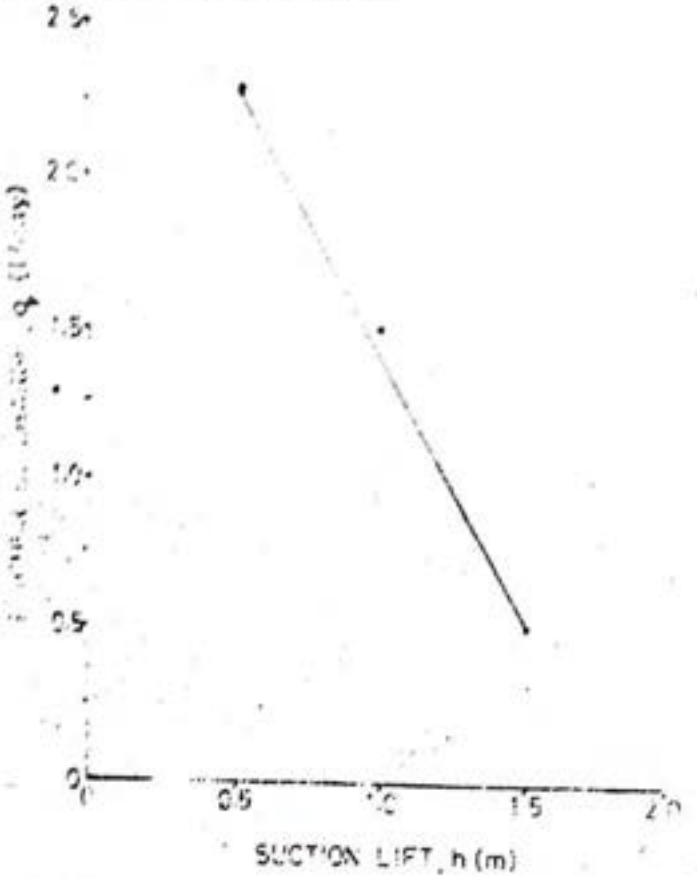

Fig. 2 : Variation of pitcher discharge (q) with suction lift (h)

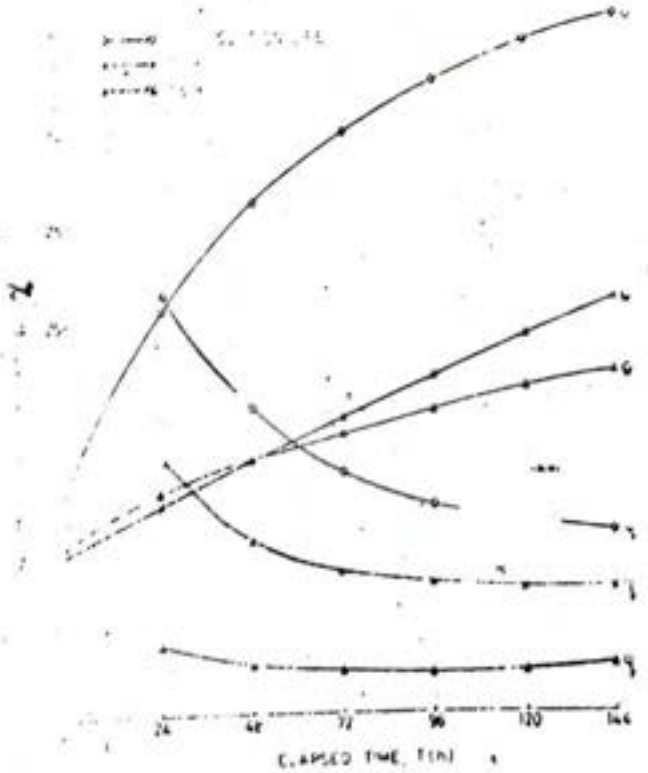

Fig. 3 : Variation of pitcher discharge (q) and moisture content (θ) with elapsed time (h)

RESULTS AND DISCUSSION

The discharge from the pot is mainly a function of the suction lift, the maximum discharge at 0.5 m suction lift was found 2,3 1 per day, whereas the minimum was 0.48 1 per day at 1.5 m suction lift, as shown in Fig. 2. The relationship between elapsed time and discharge for various suction lifts shows (Fig. 3) that discharge reduces with elapsed time at all suction lifts. With elapsed time the soil get saturated, which reduces the suction force thus discharge from pitchers also reduces. The moisture content and time relationship (Fig. 3) shows that the moisture content around the pots was increased with time and is more for less suction lift and vice-versa.

It may be concluded that in Auto Irrigation Technique, discharge has a reciprocal relationship with the suction lift, and it will be useful for irrigation at low suction lift, particularly ornamental plants with zero energy consumption.

REFERENCES

Kenworthy A. L. (1945). Cup conductance, field and laboratory calibration of tensiometers employing inexpensive porous cup. *Soil Science*, 59 : 397 - 403.

Kornev, V. G. (1924). The absorbing power of soils and the principle of automatic self-irrigation of soils. *Soil Science*-17 : 428.

Murontsev N. A. (1979). An automatic system for irrigating crops with ground water, *soviet Agril. Sci.* 8 : 71-73.

Rathod, R. L. and Solanki B. J., (1989). Development of an auto irrigation device. Unpublished B. Tech. thesis, College of Agril. Engg. & Tech., Junagadh.

Richards, L. A. (1934). Some improvements in auto irrigator apparatus, J. of Agril. Research 49; 115-121.

Short Communications

Response of Cotton G. Cot. Hy. 8 to Irrigation Based on IW/CPE Ratio

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A field experiment to work out irrigation requirements of cotton variety G. Cot. Hy.8 was conducted at Main Cotton Research Station, GAU, Surat during *kharif* 1992-93. The soil of the field was clayey with water content on weight basis at field capacity (0.3 Atm was 32.5 and permanent wilting point at 15 Atm) was 16.0 per cent. The soil was neutral with pH 7.5, available nitrogen 226 kg/ha, available phosphorus 23.3 kg/ha and available potash 720 kg/ha.

Four treatments viz., control (traditional system of irrigation), IW/CPE ratio 0.4, 0.6 and 0.8 were replicated six times in a Randomized Block Design. Ridges 120 cm apart were prepared in the last week of May, 1992 in dry conditions. The seeds were dibbled manually on the ridges at 45 cm spacing after commencement of effective rainfall on 27th June, 1992. Recommended fertilizer dose of 320 kg N/ha in the form of urea was applied to all the treatments in four equal splits i.e. 25% at 15 DAS (days after sowing), 25% at square initiation stage, 25% at flowering stage and remaining 25% at first boll bursting stage. In the traditional system, irrigation was given at 25 days interval whereas in other treatments irrigation was given at the IW/CPE ratio of 0.4, 0.6 and 0.8. Three picking operations were done on 26-12-92, 21-1-93 and 9-2-93. The meteorological data are presented in Table-1.

Perusal of the data in Table-2 indicates that different irrigation treatments had no significant effect on seed cotton yield and ancilliary characters like boll number, sympodial branches and plant height at maturity. This might be due to cotton being a deep rooted crop can tap available moisture from different soil depths. Secondly, the capillary contribution might have supplied enough moisture for the cotton crop at different stages of growth hence crop did not suffer for want of moisture at different stages of crop growth even if irrigation was given at 0.4 IW/CPE ratio.

These findings would show that the irrigation schedule based on IW/CPE ratio 0.4 can produce seed cotton yield as high as traditional system of irrigation with less than half the quantity (210 mm) of irrigation water used. The constancy in seed cotton yield with further increasing IW/CPE ratio from 0.4 to 0.6 or 0.8 indicates that IW/CPE ratio greater than 0.4 IW/CPE ratio may not be advantageous for harvesting potential yield of cotton G. Cot. Hy.8. The present study therefore, indicates that under the given set of condition

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TABLE I

Effect of different treatments on seed cotton yield and ancillary characters.

Treatments (IW/CPE) irrigations		*Seed cotton yield (kg/ha)*	*Bolls/ plant (no)*	*Sympodial branches/ plant (no)*	*Plant height (cms)*	*Irrigation water appl--ied (mm)*	*Total Irrigation (no)*	*Dates of irrigations*
1.	Control	2317	50	24	102	490	7	5/10/92, 31/10/92, 27/11/92, 22/12/92, 17/1/93, 12/2/93 and 28/2/93
2	0.4	2268	44	23	87	210	3	27/11/92, 5/1/93 and 5/2/93
3.	0.6	2279	44	22	89	350	5	17/11/92, 10/12/92, 9/1/93, 5/2/93 and 26/2/93
4.	0.8	2021	40	21	87	420	6	13/11/92, 27/11/92, 17/12/92, 9/1/93, 29/1/93 and 18/2/93
	S.Em.±	125.1	2.8	1.1	5.2	–	–	–
	C.D.at 5%	N.S.	N.S.	N.S.	N.S.	–	–	–
	C.V. %	11.3	15.2	11.9	14.1	–	–	–

the irrigation based on IW/CPE ratio 0.4 was the best for seed cotton yield and resulted in saving irrigation water by 57.1%, 50% and 40% as compared to the traditional system of irrigation, 0.8 and 0.6 IW/CPE ratio, respectively. Yadav (1972) suggested four irrigations for optimum yield of cotton for Hissar conditions. Verma *et al.* (1991) reported that water requirement of crop varies with crop variety, soil type and climatic conditions of the region.

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REFERENCES

Verma, B. L., R. K. Siag and Ram Deo (1991). Effect of mulching and irrigation levels on yield and water use of American cotton. *J. Cotton Res. & Dev.* **5** (2) : 129-134.

Yadav, J. S. P. (1972). Annual Progress report of I.C.A.R. All India Co-ordinated Scheme for Research on Water Management and Salinity C.S.S.R.I., Karnal, Haryana.

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Effect of Different Sources of Nitrogen and its Split Application on the Yield of Rustica Tobacco

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An experiment was conducted to study the effect of different sources and its split application on the yield of rastica tobacco variety R-9 at the Bidi Tobacco Research Station, Gujarat Agricultural University, Anand during rabi 1981-82 under irrigated condition. The soil was sandy loam in texture having low in total nitrogen (670 kg ha^{-1}) and phosphorus (26.88 kg ha^{-1}), high potash (452 kg ha^{-1}) with pH 7.4. The experiment was laid out in a randomized block design with four replications. Treatments consisted of three nitrogen sources i.e. ammonium sulphate (F_1), Urea (F_2) and half ammonium sulphate +half urea (F_3) on nitrogen basis all at the rate of 150 kg Nha^{-1} and three split applications i.e. 50 per cent N as a basal + 50 per cent N after 35 DAT (S_1), 50 per cent N as a basal dose + 10 per cent N after 10 DAT + 40 per cent N after 10 DAT (S_2) and 50 per cent N as a basal dose + 10 per cent N after 10 DAT 20 per cent N after 35 DAT + 20 per cent N after 60 DAT (S_3) compared with present recommended dose of 150 kg Nha^{-1} (90 per cent N as a basal + 10 per cent N after 10 DAT in the form of ammonium sulphate) as a control treatment (Anonymous, 1980). The crop was transplanted with 60 cm x 60 cm spacing, uniform plant population was maintained in the experiment. Yield attributing characters like plant height, leaf width, length were measured. Similarly the leaf area was measured with the help of square centimeter frame from five randomly selected plants in each treatments.

It is observed from Table 1 that the different sources of nitrogen and its split application failed to show any significant effects in increasing plant height, leaf length, width, area and nicotine content. However, there was a significant effect of nitrogen sources on green as well as cured leaf weight which ultimately increase yield of rustica tobacco under the application of nitrogen from ammonium sulphate (F_1) and ammonium sulphate + Urea as (F_3) compare to nitrogen applied from urea alone (F_2). This might be due to increase the thickness of leaves as ammonium sulphate contain 23 per cent sulphate which enhance the absorption of nitrogen and also involved in the formation of chlorophyll which helpful in the activation of photosynthesis process and manufacturing of carbohydrates in the leaves resulted into higher green as well as cured leaf weight of tobacco crop also reported similar results by Singh and Bairathi (1980) and Rathore and Manohar (1989).

From the above discussion, it can be concluded that rustica tobacco could be manured with recommanded nitrogen (150 kg Nha^{-1}) dose

TABLE 1

Yield and yield attributes of rustica tobacco as influenced by different sources of N and its split applications.

Sr. No.	*Treatments*	*Plant height (cm)*	*Leaf length (cm)*	*Leaf width (cm)*	*Leaf area (cm)2*	*Green leaf weight per plant (gm)*	*Cured leaf weight per plant (gm)*	*Cured leaf yield (kg ha^{-1})*	*Nicotine content (%)*
Source of N fertilizer									
1.	Ammonium sulphate	39.36	39.50	39.20	801.50	429	92	2369	4.54
2.	Urea	39.93	39.70	39.10	787.50	382	83	2144	4.55
3.	Ammonium sulphate + Urea	39.60	39.60	29.20	801.50	408	89	2280	4.54
4.	Split application of N 50% basal + 50%.35 DAT	39.63	39.30	38.80	788.10	399	87	2233	4.54
5.	50% basal + 10% + 40% at 10 and 35 DAT	39.37	39.70	39.30	794.90	408	89	2268	4.55
6.	50% basal + 10% + 20% 20% at 10, 35 and 60 DAT	39.52	39.90	39.40	807.40	412	89	2291	4.55
7.	Control (90% basal + 10% at DAT by Ammo. Sulphate)	39.67	39.00	38.60	792.50	417	88	2326	4.54
	C.D. (P=0.05) for source	NS	NS	NS	NS	19	4	116	NS
	Split application	NS	NS	NS	NS	NS	NS	NS	NS
	Source x Split	NS	NS	NS	NS	NS	NS	NS	NS
	Control Vs rest	NS	NS	NS	NS	NS	NS	NS	NS
	C.V.%	1.0	2.1	2.4	2.9	5.7	5.6	6.02	0.33

DAT = Days After Transplanting.

with half in the form of ammonium sulphate, half in the form of urea in one split i.e. 50 per cent N as a basal and 50 per cent N after 35 DAT (F_3S_1) under middle Gujarat condition these findings corroborate the results put forward by Sinha *et al.* (1978).

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REFERENCES

Anonymous, 1980. Annual Report, Bidi Tobacco Research Station, Gujarat Agricultural University, Anand.

Sinha, R., Pandey, R. G. and Dwivedi, S. S. 1978. Studies on crop performance and economics of chewing tobacco under different sources and timing of nitrogen application in North Bihar. *Indian J. Agron.*, **23** (3) : 261-266.

Singh, K. S. and Bairathi, R. C. 1980. A study in the sulphur fertilization of mustard in semi-arid tract of Rajasthan, *Annals of Arid Zone.* **19** (3) : 197-202.

Rathore, P. S. and Manohar, S. S. 1989. Response of mustard to nitrogen and sulphur. *Indian J. Agron.*, **34** : 333-336.

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Evaluation of Row Ratio Under Intercropping in Sesame with Greengram

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Sesame is an important oilseed crop. It is very sensitive to both heavy as well as scare rains resulting into instability in its production and economic returns. Recently intercropping has been recognised as a potentially beneficial system of crop production under dry land condition. Besides in a normal season, intercropping increases total production in addition to stabilization of production in rainfed areas (Rao and Willey, 1980). By adopting appropriate row ratio in intercropping system, the total productivity can be enhanced (Umrani *et al.* 1984). Pulses for its nitrogen fixing power are often used as intercrop with non-legumes, beneficial. Keeping these points in view a field experiment was planned to generate information on suitable row ratio under intercropping in sesame with greengram under rainfed condition.

An experiment was conducted at the Instructional Farm of Agronomy, Gujarat Agricultural University, Junagadh during *kharif* season of 1992-93. Nine treatments comprising of sole crop and intercrop with different row ratio were tried in randomized block design with four replications. The soil was medium in total nitrogen, available phosphorus and available potash with pH 7.6. The crop was fertilized with 25 kg N and 25 kg P_2O_5 ha^{-1} to sesame whereas 20 kg N and 40 kg P_2O_5 ha^{-1} to greengram at the time of sowing.

Intercropping system significantly influenced the growth as well as yield attributes of base crop of sesame and greengram as intercrop. Intercropping in sesame with greengram at 2 : 1 row ratio was distinctly superior over sole sesame in respect of giving the maximum sesame seed equivalent yield of 765 $kgha^{-1}$, net return of 8200 Rs ha^{-1}, high cost benefit ratio of 2.91 and land equivalent ratio (LER) of 1.33 under rainfed condition (Table 1). These results corroborate with the findings of Sharma and Kakati (1991).

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REFERENCES

Rao, M. R. and Willey, R. W. (1980). Stability of performance of pigeonpea/sorghum intercrop system. Int. Intercropping Workshop. ICRISAT, Hyderabad.

Sharma, N. N. and Kakati, N. N. (1991). Intercropping of sesame in pulse and maize. *Indian J. Agron.* **36** (4) : 556-558.

Umrani, N. K.; Shinde, S. H. and Dhonde, P. M. (1984). Studies on intercropping of pulses in kharif sorghum. *Indian J. Agron.* **29** (1) : 27-30.

TABLE I

Effect of different treatments on sesame seed equivalent yield, net return, cost benefit ratio and LER.

Treatments		*Sesame seed equivlent yield (kg ha^{-1})*	*Net Return (Rs ha^{-1})*	*Cost benefit ratio*	*Land equivalent ratio (LER)*
T_1	Sole sesame	630	4191	1.69	1.00
T_2	Sole greengram	460	3551	1.85	1.00
T_3	Sesame + greengram (1 : 1)	586	5880	2.55	1.08
T_4	Sesame + greengram (2 : 1)	765	8200	2.91	1.33
T_5	Sesame + greengram (3 : 1)	604	4837	1.96	1.03
T_6	Sesame + greengram (1 : 2)	525	4206	1.93	1.01
T_7	Sesame + greengram (1 : 3)	500	4442	2.13	0.99
T_8	Sesame + greengram (2 : 2)	592	5175	2.13	1.09
T_9	Sesame + greengram (2 : 3)	577	4986	2.10	1.07
	S. Em. ±	23	365	0.07	0.04
	C.D. at 5%	69	1074	0.20	0.13
	C.V. %	8.14	14.45	6.41	8.42

Gross income is calculated as under :

Sr.No.	Items	Rs/q
1.	Sesame seed	1600
2.	Sesame fodder	20
3.	Greengram grain	800
4.	Greengram fodder	30

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Effect of Spacing, N and P Levels on Nutrient Uptake by Indian Bean (*Dolichos lablab* L.)

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A replicated field trial was conducted at the college farm of Gujarat Agricultural University, Navsari during *rabi* season of 1985-86 in split plot design with three row spacings (30, 45 and 60 cm) as main plots and nine treatment combinations consisting of three levels of nitrogen (15, 25 and 35 kg N/ha) and three levels of phosphorus (30, 50 and 70 kg P_2O_5/ha) as sub plots treatment. Indian bean crop (Var. Wal 125-36) was sown on 1st Nov. 1985 and was harvested on 16th March, 1986. The soil of the experimental plot was clayey in texture, deficient in nitrogen (0.049%) medium in available phosphorus (28.0 kg P_2O_5/ ha) and sufficient in available potash (381.0 kg K_2O/ha) having PH 7.9.

Nitrogen content of grain and straw of Indian bean at harvesting stage were determined by the Kjeldahl's method, similarly phosphorus content was estimated by Olsen's method and recorded separately for each treatment. The uptake of N and P_2O_5 by Indian bean grain and straw were worked out by using the following formulae :

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient Content (\%)} \times \text{Yield (kg/ha)}}{100}$$

The data presented in Table-1 indicated that N, P content and uptake by grain and straw of Indian bean wore significantly affected by spacing. Significantly the highest N content in grain (3.57 per cent) and straw (1.77 per cent) were recorded under wider spacing (60 cm). However the highest N uptake of 65.06 and 77.80 kg/ha by grain and straw, respectively were observed with medium row spacing (45 cm.). Likewise, maximum P content (1.06 and 0.38) per cent) and P uptake (17.46 and 21.38 kg/ha) were recorded by grain and straw, respectively with 45 cm. inter row spacing. The higher uptake of N and P under 45 cm. spacing was attributed to the higher yield with this spacing.

The data also showed that N, P content and uptake by grain and straw of Indian bean were significantly influenced by nitrogen application. Significantly the highest N content (3.75 per cent) in grain was recorded with higher level of nitrogen (35 kg N/ha). Whereas maximum N content (1.58%) in straw was recorded with lower level of nitrogen (15 kg N/ha) but found statistically at par with 25 kg N/ha. The maximum P content (1.04 and 0.36 per cent) was recorded with application of 25 kg N/ha in grain and straw, respectively. So far as the uptake of N and P is concerned, significantly the highest uptake of both these nutrients was recorded with 25 kg N/ha by grain as well as straw of Indian bean. Kang (1975) also reported that 60 kg N/ha increased the N uptake and N content in soybean seeds.

Data further revealed that N, P content and uptake by grain and straw of Indian bean

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TABLE 1

Effect of row spacing and fertilizers on yield and nutrient uptake by indianbean.

Treatment	*Yield (Q/ha)*		*N-Content %*		*N-uptake (kg/ha)*		*P content (%)*		*P-uptake (kg/ha)*	
	Grain	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*	*Grain*	*Straw*
Spacing (cm)										
30	15.84	49.42	3.44	1.25	54.70	61.40	0.97	0.33	15.47	16.14
45	17.93	55.56	3.44	1.05	65.06	77.80	1.06	0.38	17.46	21.38
60	13.96	44.63	3.57	1.77	42.97	41.60	0.86	0.29	13.50	11.59
S Em ±	0.42	1.29	0.03	0.09	1.83	1.89	0.02	0.01	0.52	0.52
C. D. 5%	1.47	4.47	0.10	0.29	6.33	6.54	0.10	0.04	1.81	1.79
Nitrogen (kg N/ha)										
15	15.67	49.13	3.51	1.58	53.04	59.07	0.95	0.33	15.26	16.08
25	17.30	53.96	3.19	1.34	58.97	65.49	1.04	0.36	16.79	17.78
35	14.76	46.52	3.75	1.15	50.74	56.23	0.90	0.31	14.67	15.25
S Em ±	0.43	1.21	0.02	0.12	1.45	1.63	0.03	0.01	0.40	0.44
C. D. 5%	1.21	3.42	0.06	0.33	4.10	4.60	0.07	0.03	1.14	1.23
Phosphorus (kg P_2O_5/ha)										
30	14.78	46.13	3.48	1.24	50.19	55.66	0.89	0.31	14.49	15.14
50	17.34	54.06	3.55	1.61	58.19	65.66	1.04	0.36	16.89	17.81
70	15.60	49.43	3.43	1.22	53.64	59.48	0.95	0.33	15.34	16.16
S Em ±	0.43	1.21	0.02	0.12	1.45	1.63	0.03	0.01	0.40	0.44
C. D. 5 %	1.21	3.42	0.06	0.33	4.10	4.60	0.07	0.03	1.14	1.23

were significantly influenced by phosphorus application. Significantly the highest N content (3.55 and 1.61 per cent) and N uptake (58.19 and 65.66 kg/ha) were recorded in grain and straw, respectively, with the application of 50 kg P_2O_5/ha. Similarly the maximum P content and P uptake were recorded with 50 kg P_2O_5/ha to Indian bean. Palaniappan *et al.* (1984) also recorded 20.4 and 16.7 per cent higher uptake of N and P by pegion pea, respectively with the application of 25 kg P_2O_5/ha over no phosphorus.

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REFERENCES

Kang, B. T. 1975. Effect of inoculation and nitrogen fertilizer on soybean in western Nigeria. *EXP. Agric.* **11** (1) : 23-31.

Palaniappan, S. P.; Sundhaka Rao, R. and Soundra Rajan D. 1984. Studies on nutrientt uptake by pigeonpea as influenced by inter cropping and P fertilization. *Madras agric. J.* **71** (12) : 791-794.

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Effect of Seedrate and N P Fertilizers on the Quality and Economics of Summer Groundnut (*Arachis hypgaea* Linn.)

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Groundnut contributes about 68 per cent of the total oil seed production in India. The importance of groundnut in the world trade has been increased in recent years due to its kernels being rich in digestible protein and vitamins. A field experiment was laid out on groundnut during the summer-1983 at the campus farm, Gujarat Agricultural University, Navsari. The soil was clayey in texture, deficient in nitrogen, medium in available phosphorus and sufficient in available potash. Twenty seven treatment combinations consisting of three seed rates (80, 100 and 120 kg/ha), three levels of nitrogen (0, 25 and 50 kg/ha) and three levels of phosphorus (0, 50 and 100 kg/ha) were tried in a 33 factorial partial confounding in a randomized complete block design with three replications. The bunch type groundnut variety GAUG-1 was sown on February, 19 and was harvested on June 8, 1983.

The quality in form of shelling percentage and oil content of groundnut kernel was significantly affected by various seed rates. Increasing seed rate up to 100 kg/ha improved the shelling percentage but further increase in seed rate did not prove better. Consequently the higher oil yield was also obtained by 100 kg seed rate/ha. This is due to higher production of groundnut pods and higher oil content recorded with this treatment. The protein content and protein yield of the groundnut kernel was adversely affected by the increase in seed rate beyond 100 kg seeds/ha.

The quality of groundnut in terms of shelling percentage was improved with the application of nitrogen up to 25 kg N/ha and further increase in nitrogen was not found effective. Dalal and Saini (1968) also observed improvement in shelling percentage by nitrogen fertilization. There was a negative relation between oil content and nitrogen application. As a result, the oil content was decreased with application of nitrogen up to 50 kg N/ha. This findings are in agreement with those recorded by Bhuiya and Chowdhury (1974). However, the oil yield found to be significantly increased by application of nitrogen up to 25 kg N/ha and further increase in nitrogen up to 50 kg N/ha reduced it.

There was a positive response of nitrogen fertilization on protein content of groundnut kernel and as well as the protein yield. The protein percentage and protein yield were significantly increased with application of nitrogen up to 50 kg N/ha and 25 kg N/ha, respectively. The results are in conformity to those recorded by Bhuiya and Chowdhury (1974).

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TABLE 1

Effect of seedrate and fertilizer application on quality and economic of summer groundnut.

Treatment	Dry pod yield (kg/ha)	Dry vein yield kg/ha	Shelling precen-tage	Oil content of ground-nut kernel (%)	Oil yield (Q/ha)	Protein centent in ground-nut ker-nel (%)	Protein yield (Q/ha)	Net reali-zation	I.C.B.R. Gross	Net
Seedrate (kg/ha)										
80	2511	6616	69.3	48.0	8.4	29.6	5.2	5270	–	–
100	2820	7401	69.8	48.2	9.5	29.4	5.8	6322	1:10.0	1:9.0
120	2625	7710	69.1	47.9	8.7	29.1	5.3	5537	1:–5.3	1:-6.3
S. Em. ±	55.3	23.6	0.10	0.04	0.18	0.09	0.11			
C.D. at 5%	153.1	65.4	0.27	0.11	0.51	0.24	0.30			
Nitrogen levels (kg/ha)										
N_0	2501	6966	69.5	48.4	8.4	28.8	5.0	5302	–	–
N_{25}	2721	7234	69.9	48.1	9.2	29.2	5.6	5952	1:6.54	1:5.54
N_{50}	2733	7528	68.8	47.5	8.9	30.1	5.7	5876	1:0.71	1:-0.29
S. Em. ±	55.3	23.6	0.10	0.04	0.18	0.09	0.11			
C.D at 5%	153.1	65.4	0.27	0.11	0.51	0.24	0.30			
Phosphorus levels (kg/ha)										
P_0	2407	7174	69.0	47.4	7.9	28.7	4.8	5301	–	–
P_{50}	2748	7251	69.7	48.1	9.2	29.4	5.7	6047	1:3.59	1:2.59
P_{100}	2801	7301	69.5	48.4	9.4	29.9	5.8	5781	1:0.57	1:-0.43
S. Em. ±	55.3	23.6	0.10	0.04	0.18	0.09	0.11			
C. D. at 5%	153.1	65.4	0.27	0.11	0.51	0.24	0.30			
C. V. %	10.83	1.69	0.72	0.44	10.78	1.55	10.38			

Price of groundnut seed Rs. 6.00/kg
Income of groundnut pods @ Rs. 3.50/kg
Income of groundnut veins @ Rs. 0.15/kg

Cost of nitrogen in the form of urea Rs. 4.96/kg N
Cost of phosphorus in the form of S.S.P. Rs. 6.71/kg P_2O_5

The shelling percentage in groundnut was increased with application of phosphorus up to 50 kg P_2O_5/ha. Whereas the oil content and protein content were significantly improved by phosphorus application upto 100 kg P_2O_5/ha. These findings are in agreement with Ajaykumar and Venkatachari (1971). The oil yield and protein yield were significantly increased with application of phosphorus up to 50 kg P_2O_5/ha.

From the economics point of view, the maximum net returns of Rs. 6322, 5952 and 6047 per hectare were obtained from seed rates of 100 kg/ha with application of 25 kg N/ha and 50 kg P_2O_5/ha, respectively. So far as net ICBR is concerned, the maximum values 1 : 5.54 and 1 : 2.59 were recorded with the same application of 25 kg N and 50 kg P_2O_5 per hectare, respectively. Further increase in nitrogen upto 50 kg N and phosphorus upto 100 kg P_2O_5 per hectare was resulted in loss.

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REFERENCES

Ajaykumar, M. and Venkatachari, A. (1971). Studies on the effect of intra row spacings and fertility levels on the yield and quality of two varieties of groundnut (*Arachis hypogaea* L.) *Indian J. agric. Res.* **5** (2) : 67-73.

Bhuiya, Z. H. and Chowdhury, S. U. (1974). Effect of N, P, K and S on the protein and oil content of groundnut grown in Brahmaputra flood plain soil. *Indian J. agric. Sci.* **44** (11) : 751-754.

Dalal, J. L. and Saini, J. S. (1968). Differential response of varieties of *Arachis hypogaea* L. to graded doses of nitrogen. *J. Res. Punjab agric. Univ.* **5** (2) : 172-177.

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Path Analysis in Mustard (*Brassica juncea* L.)

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A path coefficient is a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the seperation of the correlation coefficient in to components of direct and indirect effects. This study was undertaken to findout the important plant traits in mustard for better production.

For studying the growth and yield parameters, a field experiment with twelve different irrigation treatments were conducted during *rabi* season of 1992-93 at Regional Sugarcane Research Station, Navsari. The experiment was laid out in randomized block design with three replications by keeping the net plot size of 3.9 m x 1.8 m.

Five plants were selected at random from each net plot for recording the plant characters. Data collected for correlation studies were used in the path coefficient analysis. Path values of ten plant character in relation to seed yield at harvest were calculated by setting simultaneous equations using corresponding correlations from the inverse of matrix (Dewey and Lu, 1959).

The results on path analysis presented in Table 1 revealed that the direct impact of number of primary branches/plant was remarkably positive and also the highest (0.8236) closely followed by number of secondary branches/plant (0.7594), seed yield/plant (0.6651) and plant height (0.3617). The present results corroborate the previous reports Pathak *et al.* (1984) as well as Ghosh and Chatterjee (1988). Whereas direct influence of test weight was negligible (0.1975) but positive indicating its poor direct contribution toward seed yield. Characters like dry matter accumulation/plant, 50 per cent flowering, number of siliquae/plant, number of seeds/siliqua and length of siliqua exhibited negative direct influence on seed yield.

Among the indirect effects, the influence of test weight through primary branches/plant was positive and strong (0.7626) closely followed by 50 per cent flowering (0.7568), plant height (0.7560) and dry matter/plant (0.7544).

Secondly indirect impact of number of seeds/siliqua as well as seed yield/plant through secondary branches/plant was also pronounce and positive (0.7534).

From the present studies, it could be inferred that the plant characters like primary and secondary branches/plant, plant height, seed yield/plant and test weight which were found to have more positive direct as well as indirect effects towards the seed yield and therefore, should be given more weightage while selecting the proper mustard genotypes for better seed yield.

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TABLE 1

Path coefficient of important growth and yield attributes.

Components	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1 = Plant height (cm)	**0.3617**	-0.2369	0.7560	0.7010	-0.3049	-0.0703	-0.9890	-0.2262	0.1888	0.6139
X_2 = Drymatter prod (g)	0.3403	**-0.2518**	0.7544	0.7162	-0.2994	0.0702	-1.0063	-0.1903	0.1882	0.6272
X_3 = Primary branches/plant	0.3320	-0.2306	**0.8236**	0.6683	-0.3360	-0.0664	-0.9533	-0.2310	0.1829	0.5820
X_4 = Secondary branches/ plant	0.3338	-0.2374	0.7247	**0.7594**	-0.2808	-0.0712	-1.0722	-0.1553	0.1825	0.6598
X_5 = 50 per cent flowering	0.3016	-0.2062	0.7568	0.5833	**-0.3656**	-0.0547	-0.8106	-0.2174	0.1615	0.4975
X_6 = No. of siliquae/plant	0.3411	-0.2372	0.7338	0.7253	-0.2683	**-0.0745**	-1.0409	-0.1935	0.1878	0.6458
X_7 = No. of seeds/siliqua	0.3309	-0.2344	0.7264	0.7534	-0.2742	-0.0718	**-1.0809**	-0.1566	0.1825	0.6605
X_8 = Length of siliqua (cm)	0.2597	-0.1521	0.6037	0.3744	-0.2522	-0.0458	-0.5372	**-0.3151**	0.1453	0.3299
X_9 = Test weight (g)	0.3458	-0.2399	0.7626	0.7017	-0.2990	-0.0709	-0.9987	-0.2319	**0.1975**	0.6179
X_{10} = Seed yield/plant (g)	0.3338	-0.2374	0.7206	0.7534	-0.2734	-0.0724	-1.0733	-0.1563	0.1835	**0.6651**
Correlation with 'Y'	0.863	0.889	0.831	0.927	0.698	0.902	0.919	0.433	0.861	0.930

Residual effect = 0.3125

Figures which are underlined denote direct effects.

REFERENCES

Dewey, D. R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.*, **51** : 515-518.

Ghosh, R. K. and Chatterjee, B. N. 1988. Path analysis of important growth functions of Indian mustard (*Brassica juncea* L.) *J. of Agron. and Crop Sc.*, **160** (2) : 116-121.

Pathak, H. C., Chaudhary, F. P. and Dixit, S. K. 1984. Selection criteria for seed yield in mustard. *Madras agric. J.*, **71** (1) : 758-762.

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Path Analysis in Pigeonpea

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Knowledge of the interrelationship among yield determining characters and their association with seed yield is of paramount importance in crop improvement programme. Correlation studies have been made in pigeonpea (Malik *et al.*, 1981 and Yadavendra *et al.*, 1981), but such attempts have remained meager in segregating populations. In present study, parental and F_2 generations of 10 x 10 diallel set of pigeonpea (*Cajanus cajan* (L.) Millsp.) were evaluated in a randomized block design with four replications at College Farm, S. K. Nagar. Ten competitive randomly selected plants were used to record observations on 9 characters (Table 1). For protein analysis the nitrogen content was determined with micro Kjeldahl's method (Jackson, 1967). The nitrogen content as determined above was multiplied by conversion factor 6.25 to obtain the protein content. Correlations were computed according to standard statistical method. The path-coefficient analysis was carried out using genotypic correlation co-efficient following Dewey and Lu (1959).

Genotypic correlation coefficients were, in general, higher than the corresponding phenotypic correlation coefficients (Table 1). Seed yield/plant exhibited highest positive and significant association with pods/plant followed by number of branches/plant and plant height. Association of 100-seed weight was significant and positive with pod length and seeds/pod, while its correlation with pods/plant was negative and significant. Seeds/pod was significantly and positively correlated with pod length and 100-seed weight, while its relationship with protein contents was significant and negative. Branches/plant exhibited significant and positive association with pods/plant, days to flowering and plant height. Pods/plant was negatively correlated with seeds/pod and 100-seed weight. Days to flowering and days to maturity were positively and significantly associated with each other and with plant height. Similar results in segregating generations were reported by Kumar and Hague (1973). Positive association of pods/plant with seed yield/plant was also observed by Malik *et al.* (1981).

The path coefficient analysis was carried out to estimate the direct and indirect effects of various components on seed yield to recommend reliable selection index. Pods/plant had the highest direct positive effect followed by seed/pod, days to flowering, branches/plant and 100-seed weight. The direct effect of pod length, days to maturity, plant height and protein content were observed to be negative. The trait pods/plant was the major yield component of seed yield/plant. These findings are akin to the finding of Malik *et al.* (1981). It was interesting to note that seeds/pod which had moderate direct effect was negatively correlated

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TABLE 1

Genotypic and phenotypic correlation coefficients between different characters in pigeonpea.

Characters		*Days to flowering*	*Days to maturity*	*Plant height*	*Branches/ plant*	*Pods/ plant*	*Pod length*	*Seeds/ pod*	*Seed yield/ plant*	*100-seed weight*	*Protein content*
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Days to flowering	G	-	0.760**	0.310**	0.428**	0.125	-0.176	-0.0351	0.272	0.184	0.156
	P	-	0.729**	0.697**	0.290	0.121	0.142	-0.250	0.191	0.131	0.152
Days to maturity	G	-	-	0.589**	0.297	-0.111	-0.245	-0.336	-0.071	0.199	0.062
	P	-	-	0.489**	0.175	-0.105	-0.175	-0.226	-0.042	0.165	0.060
Plant height	G	-	-	-	0.596**	0.354	-0.143	-0.235	0.484**	0.151	0.037
	P	-	-	-	0.398*	0.036	-0.105	-0.207	0.274	0.014	0.038
Branches/plant	G	-	-	-	-	0.549**	-0.222	-0.325	0.705**	-0.133	0.175
	P	-	-	-	-	0.364*	-0.152	-0.230	0.358*	-0.104	0.100
Pods/plant	G	-	-	-	-	-	-0.289	-0.447**	0.915**	-0.391*	0.174
	P	-	-	-	-	-	-0.215	-0.303	0.628**	-0.340	0.165
Pod length	G	-	-	-	-	-	-	1.011**	-0.039	0.538**	-0.417**
	P	-	-	-	-	-	-	0.632**	0.049	0.395*	-0.338
Seeds/pod	G	-	-	-	-	-	-	-	-0.280	0.448**	-0.514**
	P	-	-	-	-	-	-	-	-0.055	0.316	-0.329
Seed yield/plant	G	-	-	-	-	-	-	-	-	-0.122	0.124
	P	-	-	-	-	-	-	-	-	0.074	0.083
100-seed weight	G	-	-	-	-	-	-	-	-	-	0.027
	P	-	-	-	-	-	-	-	-	-	0.024
Protein content	G	-	-	-	-	-	-	-	-	-	-
	P	-	-	-	-	-	-	-	-	-	-

G = Genotypic Correlation coefficient

P = Phenotypic Correlation coefficient

* and ** significant at 5% and 1% levels of significance, respectively.

TABLE 2

Path coefficient analysis showing direct and indirect effect of yield components on seed yield in short duration pigeonpea.

	Effect Via									
	Days to flowering	*Days to maturity*	*Plant height*	*Branches/ plant*	*Pods/ plant*	*Pod/ length*	*Seeds/ pod*	*100-seed weight*	*Protein content*	*rg seed yield*
Days to flowering	**0.418**	-0.179	-0.144	0.128	0.118	0.056	-0.161	0.043	-0.007	0.272
Days to maturity	0.318	**-0.235**	-0.105	0.090	-0.105	0.078	-0.155	0.047	-0.003	-0.071
Plant height	0.339	-0.139	**-0.178**	0.178	0.336	0.046	-0.108	0.0012	-0.002	0.484
Branches/plant	0.179	-0.070	-0.106	**0.300**	0.520	0.071	-0.150	-0.031	-0.008	0.705
Pods/plant	0.052	0.026	-0.063	0.164	**0.949**	0.092	-0.206	-0.092	-0.008	0.915
Pod/length	-0.074	0.058	0.026	-0.067	-0.274	**-0.318**	0.465	0.126	0.019	-0.039
Sees/pod	-0.147	0.079	0.042	-0.097	-0.424	-0.320	**0.460**	0.105	0.023	-0.280
100-seed weight	0.077	-0.047	-0.008	-0.040	-0.371	-0.171	0.206	**0.234**	-0.002	-0.122
Protein content	0.065	-0.015	-0.007	0.053	0.165	0.133	-0.237	0.011	**-0.044**	0.124

Residual effect = 0.163.

The under lined figures denote the direct effects.

with seed yield. On the contrary plant height had negative direct effect but had positive correlation with seed yield/plant which can be described to high positive indirect effects through days to flowering and pods/plant. Number of branches/plant had moderate positive direct influence on seed yield. However, its indirect effect via pods/plant was high. Protein content had negligible direct contribution. The emphasis should be laid on the selection of yield contributing characters that directly or indirectly influence the final product of a crop. The results of the present investigation revealed that pods/plant, branches/plant and plant height can form a suitable selection index for genetic improvement of seed yield in pigeonpea.

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REFERENCES

Dewey, D. R. and K. H. Lu, 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* **50** : 633-7.

Jacksen, M. L. 'Soil chemical analysis' Prentic hall of India, Pvt. Ltd., New Delhi.

Kumar, A. and Hague, M. F. 1973. Variability and correlation studies in F_2 population of pigeonpea (*Cajanus cajan* (L.) Millsp.) *Mysore Journal of Agricultural Science*, **7** : 174-183.

Malik, B. P. S., V. P. Singh; R. S. Paroda and S. C. Gupta (1981). Correlation and path coefficient analysis in pigeonpea. *Crop Improvement* **8** (2) 100-105.

Yadvendra, J. P. Dixit, S. K. and Shah, R. M. 1981. Genetic variability, correlation and path coefficient analysis in pigeonpea, *G.A.U., Res. J.* **7** : 37-40.

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Agronomic Requirements of Deshi Cotton Hybrids in Respect of Plant Densities, Nitrogen and Phosphorus Levels

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A field trial was conducted at Main Cotton Research Station, Gujarat Agril. University, Surat, on clayey soil during *kharif* season of 1992-93 to study the agronomic requirements of herbaceum hybrids under irrigated condition. The treatments comprised all combination of two varieties viz., MDCH-201 and G. Cot. Dh-9; two spacings, 120 x 30 cms (27,777 plants/ha) and 120 x 45 cms (18,518 plants/ha), three levels of nitrogen 160, 240 and 320 kg n/ha and two levels of phosphorus 0 and 80 kg P_2O_5/ha. The trial was laid out in Factorial Randomized Block Design replicated three times. The ridges were prepared at 120 cm apart in dry conditions. The seeds were dibbled manually on the ridges at 30 cm and 45 cm intrarow spacing as per treatments. The sowing of both the varieties was done on 29th June, 1992. Entire dose of phosphorus and 1/4th dose of nitrogen as per treatments were applied in the form of diammonium phosphate and urea, respectively as basal application prior to sowing.

Remaining quantity of nitrogen was top dressed in three equal splits at an interval of 30 days from basal application in the form of urea as per treatments. The soil of the experimental field was clayey with pH 7.5, available nitrogen 220 kg/ha, available phosphorus 22.6 kg/ha and available potash 726 kg/ha. In all, three irrigations were given as and when required. Three pickings of seed cotton were done on 13.01.93, 09.02.93 and 06.03.1993. Plant protection measures were taken as per recommendation.

The data presented in Table-1 indicate that the production potential of both the cotton hybrids differed significantly with each other. The production potential of G. Cot. DH-9 was better (2230 kg/ha) than MDCH-201 (1650 kg/ha). Increase in seed cotton yield of G. Cot. DH-9 was to the tune of 26.0% (580 kg/ha) that MDCH-201. The per day production of G. Cot. DH-9 was much higher (9.02 kg/day/ha) than MDCH-201 (6.68 kg/day/ha). This was mainly due to significantly more number of bolls and sympodial branches/ plant and more plant height at maturity in G. Cot. DH-9 as compared to MDCH-201. Seed cotton yields were significantly higher in plots sown with higher plant density of 27,777 plants/ ha (120 x 30 cm) over normal plant density of 18,518 plants/ha (120 x 45 cm). Higher plant density exhibited a higher rise of seed cotton yield by 13.9% over normal plant density. This may because of higher number of bolls per unit area in higher plant density. Progressive rise in seed cotton yield with the increase in plant density was also reported by Singh *et al.* (1969).

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TABLE 1

Seed cotton yield (kg/ha), No. of bolls and sympodial branches/plant and plant height as influenced by different treatments.

Treatments	*Seed cotton yield (kg/ha)*	*No. of bolls plant*	*Sympodial branches plant*	*Plant height (cm) at maturity*
Varieties				
1. MDCH-201	1650	68	24	114
2. G. Cot. DH-9	2230	84	28	132
S. Em. ±	94.8	3.25	0.96	2.71
C.D. at 5%	277.4	9.51	2.82	7.9
Spacings				
1. 120 x 30 cm (27,777 plants/ha)	2085	68	26	121
2. 120 x 45 cms (18,518 plants/ha)	1795	84	26	124
S.Em. ±	94.8	3.25	0.96	2.71
C.D. at 5%	277.4	9.51	N.S.	N.S.
Nitrogen levels				
1. 160 kg N/ha	1660	67	21	110
2. 240 kg N/ha	2037	75	27	126
3. 320 kg N/ha	2123	85	30	132
S.Em. ±	116.1	3.98	1.18	3.32
C.D. at 5%	339.7	11.6	3.45	9.7
Phosphorus levels				
1. 0 kg P_2O_5/ha	1847	73	25	121
2. 80 -"-	2033	78	26	125
S.Em. ±	94.8	3.25	0.96	2.71
C.D. at 5%	N.S.	N.S.	N.S.	N.S.
C.V. %	23.9	21.0	18.3	10.8

TABLE 2

Plant density x variety interaction (seed cotton yield kg/ha).

	120 x 30 cm	*120 x 45 cm*		
MDCH-201	1602	1698	S.Em±	134.0
G.Cot. DH-9	2568	1892	C.D. at 5%	392.3

Bapna *et al.* (1976) and Jain and Katti (1980). Increase in seed cotton yield was recorded with the increasing levels of nitrogen application. Maximum seed cotton yield of 2123 kg/ha was obtained by application of 320 kg N/ha but it failed to show marked difference with that of 240 kg N/ ha. The increase in seed cotton yield by application of 240 and 320 kg N/ha was to the tune of 18.5% and 21.8% over lower level of 160 kg N/ha, respectively. The response per kg of applied nitrogen was 4.7 kg/kg of N with 240 kg N/ha as compared to 320 kg N/ha (2.89 kg/kg of N) over 160 kg N/ha. Similar trend in yield was reported by Nigam and Kotwani (1971). Application of 80 kg P_2O_5/ha had no significant influence in increasing seed cotton yield over control. Hence the application of phosphorus to cotton varieties is not advantageous. Patel *et al.* (1986) observed that application of phosphorus alone or in combination with nitrogen did not affect the seed cotton yield favourably under irrigated condition of Surat.

Interaction effect of plant density and variety in respect of seed cotton yield was found to be significant. The data presented in Table-2 indicate that cotton variety G. Cot. DH-9 showed distinct superiority to that of MDCH-201 taking a lead of 966 kg/ha seed cotton yield when sown with higher plant density of 27,777 plants/ ha (120 x 30 cm spacing).

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REFERENCES

Bapna, J. S., C. T. Patel and V. P. Chaudhari (1976). Studies on varietal response to nitrogen and plant density. *Cotton Dev.* **6** (1) : 8-10.

Jain, S. C. and G. V. Katti, (1980). Crop management in new strains of cotton under rainfed condition. *Indian J. Agron.* **25** (3) : 415-418.

Nigam, K. B. and H. G. Kotwani, (1971). Evauluation of *G. hirsutum* genetic stock at high levels of fertility. *Madras agric. J.* **58** (2) : 122-124.

Patel, P. G., N. P. Mehta, M. N. Patel and B. P. Patel. (1986). Production potential of irrigated cotton varieties/hybrids to graded levels of N, P and K in different soils of Gujarat. Paper presented at the National seminar on phosphorus application to cotton held at M.C.R.S., G.A.U., Surat on 21-22 May 1986.

Singh Chokhey, M. S. Khan and D. G. Sowani (1969). Effect of sowing time, spacing and nitrogen levels on irrigated cotton in Nimar tract of M. P. *Indian J. Agron.* **14** (2) : 142-146.

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Root Initiation Studies in Bougainvillea (*Bougainvillea peruviana* L.) Var. Marry Palmer

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Bougainvillea is accepted as an important ornamental plant in all the tropical and sub-tropical regions of the world due to its beauty, attractive appearance of colourful bracts and variegated leaves. It is a versatile ornamental shrub and is grown in the garden both as shrub and climber. It is also a drought resistant ornamental plant.

Bougainvillea is propagated by cutting, budding or layering. But it is usually propagated by cuttings. Among different varieties of *Bougainvillea*, Thimma and Marry Palmer are considered as difficult to root through cuttings (Mishra and Singh, 1984). Both the varieties are shyrooter and thus, rooted plants are costly for further planting. There is a great demand of these varieties, thus, there is a need to find out most effective growth regulator (s) with appropriate concentration for the best rooting and survival of these vareties of *Bougainvillea*.

The present investigation was carried out at Botanical Garden, Motibaug, Department of Agricultural Botany, Gujarat Agricultural University, Junagadh during rainy season of 1990 to know the effect of plant growth regulators on the rooting of Bougainvillea Var. Marry Palmer. The uniform and healthy cuttings with four nodes were selected for the study. The basal ends upto 5 cm length were dipped in fresh solution of IAA (1500 and 2000 ppm), NAA and IBA (3000 and 4000 ppm, each) for 15 seconds. Each cutting then was inserted upto two-third of its length into the pots filled with garden soil. The experiment was conducted in 30 cm earthen pots in a completely randomized block design with three replications. Ten cuttings in each treatment were planted and out of which five plants were selected randomly to record observations on length of longest shoot, number of sprouted buds/cutting, number of leaves/cutting, number of roots/cutting, length of longest root and per cent root initiation.

Analysis of variance revealed highly significant differences among the treatment for all the attributes studied. The results (Table 1) suggested that *Bougainvillea* can easily be propagated by cuttings soaked for 15 seconds in the solution of IBA (4000 ppm) as it produced significantly longest shoot, more number of leaves/ cutting, more number of roots/cutting, increased length of roots and higher percentage of root initiation. Similar findings were reported by Thumar (1991) in *Bougainvillea*. Therefore, after sufficient testing in the field it can be recommended on commercial scale.

TABLE 1

Rooting in bougainvillea Var. Marry Palmer through hormone treatments.

Treatments	*Length of longest shoot (cm)*	*No. of sprouted buds/cutting*	*No. of leaves/ cutting*	*No. of roots/ cutting*	*Length of longest root (cm)*	*Root initiation percentage*
IAA - 1500 ppm	22.42	3.92	47.87	21.28	32.63	54.22
IAA - 2000 ppm	24.96	2.82	41.06	60.13	26.80	72.55
NAA - 3000 ppm	18.21	3.01	31.72	53.93	41.23	40.66
NAA - 4000 ppm	21.80	2.93	30.56	12.56	16.52	21.66
IBA - 3000 ppm	33.82	2.20	38.40	89.00	37.77	74.22
IBA - 4000 ppm	36.78	2.08	41.98	96.80	51.47	88.55
Control	11.05	1.76	16.42	17.47	7.28	20.55
S.Em. ±	0.91	0.08	0.20	0.74	0.58	0.75
C.D. 5%	2.81	0.26	0.61	2.28	1.78	2.30

REFERENCES

Mishra, A. K. and O. S. Singh, 1984. Root induction in layers and stem cuttings of Morus alba L. and *Ziziphus mauritiana*. Lam. with special reference to plant growth regulators. *Indian J. Hort.*, **27** (1-2) : 141-145.

Thumar, B. V. 1991. Effect of plant growth regulators and number of nodes on the rooting of stem cuttings of bougainvillea (*Bougainvillea peruviana* L.) Var. Marry palmer and Thimma. Unpublished M.Sc. (Agri.) Thesis submitted to Gujarat Agricultural University, Sardar Krushinagar.

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Biology and Varietal Preference of Groundnut Seed Beetle, *Caryedon serratus* (Olivier)

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The beetle, *Caryedon serratus* (Olivier) (Bruchidae : Coleoptera) is the pest of the stored unshelled groundnuts and also tamarind pods (Mittal and Gupta, 1978; Connsay, 1983). It has been found damaging the stored groundnut in Saurashtra region of Gujarat State since last five years. Its habits and life - history were studied by Caldemon *et al.* (1967) and Connsay (1983). Some work on varietal resistance against *C. gonagra* was reported by Mittal (1969). Its biology and preference to the popular groundnut varieties have previously not been studied in Gujarat as a perusal of the published literature and therefore, such studies were undertaken under laboratory conditions.

The initial culture of *C. serratus* was raised by collecting the infested unshelled groundnuts stored in the surrounding areas of Main Dry Farming Research Station, Gujarat Agricultural University, Targhadia and they were reared in the laboratory. The newly emerged vergin beetles were paired and confined in a plasitc box (8 x 4 cm) for studying the fecundity and longevity. The groundnut seeds of variety GAUG - 10 were provided for egg laying and further development. The honey droplets on a plastic strips were provided as food for them. Groundnut seeds with eggs laid were replaced daily by the healthy seeds and number of eggs laid by an individual female was recorded. The larval and post larval development of this pest was studied on four different popular groundnut varieties (Table 2). The results on the biological studies and varietal preference are presented in Table 1 and 2.

Biology

The female beetle glued its eggs on seeds or kernels. The incubation period of eggs averaged 2.63 with a range of 2 to 5 days (Table 1). The newly hatched larva bore into the seed and developed inside the seed. The larval period ranged from 12 to 24 days with an average of 18.88 days. The development from the oviposition to larval stage lasted for 40 - 45 days (Caldemon *et al.*, 1967). The mature larva emerged out from the seed or pod and constructed papery cocoon externally to the seed or pod. The pupal period averaged 12.88 dyas with a range of 10 to 22 days. Caldemon *et al.* (1967) reported the pupal period to be 25 - 30 days.

The pre-oviposition, oviposition and post oviposition periods averaged 2.00, 23.10 and 17.10 days with a range of 1 to 3, 8 to 40 and 2 to 37 days, respectively. The number of eggs laid by a single female was 21 to 76 with an average of 52.30. The female laid an average of 13.6 eggs as reported by Caldemon *et al.*

TABLE 1

Biology of *Caryedon serratus* at 30.00 ± 2.52°C and 75.2 ± 17.2 % RH.

Stage	*Nos. studied*	*Duration in days*	
		Ave.	*Range*
Egg	51	2.63	2 - 5
Larva	58	18.88	12-24
Pupa	60	12.88	10 - 22
Adult			
Female	10	42.20	11 - 69
Male	10	27.70	12 - 45
Pre-oviposition period	10	2.00	1 - 3
Oviposition period	10	23.10	8 - 40
Post-oviposition period	10	17.10	2 - 37
Fecundity (Eggs/Female)	10	53.20	21 - 76
Sex ratio (Female : Male)	50	1 female : 1. 78 males	

TABLE 2

Larval period, pupal period and sex ratio of *Caryedon serratus* when reared on groundnut varieties (28.0 ± 3.1° C and 80.4 ± 10.3 % RH).

Variety	*Larval period (days)*	*Pupal period (days)*	*Sex ratio (F : M)*
J-11	30.94[a]	15.82[c]	0.83 : 1
(Bunch)	(23-39)*	(14.21)*	(11)**
	(17)**	(11)**	
JL-24	26.83[b]	17.56[a]	2.50 : 1
(Bunch)	(22-33)	(14-22)	(14)
	(18)	(16)	
GG-2	26.78[b]	16.85[a]	2.00 : 1
(Semi-spreading)	(22-32)	(13-20)	(12)
	(18)	(14)	
GAUG-10	24.71[c]	16.45[ba]	2.20 : 1
(Spreading)	(21-31)	(12-21)	(16)
	(21)	(20)	

* Range

** Numbers studied.

Means in the same column followed by the same letter are not significantly different by Duncan's Multiple Range Test.

(1967). The females survived longer (42.20 days) than males (27.70 days). The female and male lived for as many as 69 and 45 days, respectively. The females survived for 26-40 days with an average of 32.00 days without any food. The adults lived for 10 to 15 days (Caldemon *et al.* 1967). The sex ratio was observed to be 1 female : 1.78 males. The pest completed its life cycle (egg to adult) within 82.00 days. Caldemon *et .al.* (1967) reported the life cycle to be 65-75 days.

Varietal preference

The data presented in Table 2 revealed that the larval development was longer in the variety J-11 (30.94 days) and shorter in the variety GAUG-10 (24.71 days). While the pupal period was shorter in the variety J-11 (15.82 days) and longer in the variety JL-24 (17.56 days). The female population was produced more (2.50 females : 1 male) when the pest was reared on JL-24 and lesser females on J-11 (0.82 female : 1 male). The result indicated that the variety J-11 tolerated the development of this pest as compared to other three varieties studied.

The studies concluded that *C. serratus* completed its life cycle within 82.00 days. It preferred the groundnut variety J-11 less than other three varieties viz., JL-24, GG-2 and GAUG-10 for its development.

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REFERENCES

Caldemon, M., Denahaye, E. and S. Navarro. 1967. The life cycle of the groundnut seed beetle *Caryedon serratus* in Israel. *Israel J. agril. Res.*, **17** (3) : 145-148.

Connsay, J. A. 1983. Notes on the biology and ecology of the groundnut seed beetle Caryedon serratus (ol.) under field. *Trop. stored prod. inform.*, **45** : 11-13.

Mittal, V. P. 1969. Studies on relative resistance and susceptibility of some groundnut (*Arachis hypogaea* L.) varieties of groundnut bruchid (*Caryedon gonagra* Fab., Bruchidae : Coleoptera). *Bull. Grain Tech.*, **7** : 75-79.

Mittal, V. P. and H. C. L. Gupta. 1978. Efficacy of some fumigants against adults of Tamarind beetle (bruchid) *Caryedon serratus*. *Bull. Grain Tech.*, **16** (2) : 147-148.

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Sampling Technique for Assessing the Density of *Liriomyza trifolii* (Burgess) in Castor

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The Serpentine leaf miner, *Liriomyza trifolii* (Burgess) (Diptera : Agromyzidae) infests castor heavily with high density of larval mines during July to August (Kapadia, 1991). It is difficult, time consuming and laborious to count all the mines in all the leaves in a plant to estimate its incidence. Schuster and Beck (1992) developed the method for assessing densities of *L. trifolii* on tomato. They reported that the upper surface of the terminal three leaflets of the 7th leaf from the top of any stem may be used as a sample for evaluating densities of living or dead leafminer larvae. Information regarding the sampling technique of this pest on castor is, however, not available. The present study was, therefore, undertaken with view to devise a suitable sampling technique for estimating larval mines density in the field.

A castor field (GAUCH-1) of 50 x 50 m of one month old suffering heavy population of this pest was utilized for this study. It was divided into five plots. Ten plants selected at random from each plot were observed for counting the larval mines density. The fully developed leaf from the top of the plant was recognised as the first leaf of the plant and the number of mines on every numbered leaf up to bottom of the plant was counted during mid - August. The number of mines on 1st to 5th leaf and the mean number of all mines of the plant were statistically compared. The number of leaf representating the mines density of the whole plant was also tested in different plant samples to determine the representative plant sample.

The data revealed that the number of mines/ leaf was zero on the first leaf and it increased with advance of the leaf age i.e. 10.4 to 397.0 mines/2nd to 5th leaf, (Table 1). The average number of mines of all the leaves of the plant was 186.9 mines and its was significantly on par with the number of mines on the 3rd leaf (164.6 mines). It was apparent that the mines density on the third leaf of the infested castor plant projected as a representative of the mean mines density of the whole plant. The mines density of this pest can, thus be estimated by following the third leaf sample technique. The third leaf sample was tested in different plant samples. The data (Table 2) revealed that the difference in number of mines in different plant samples (3, 5, 8, 10, 15) was non-significant. It indicated that the small plant sample (3, 5)

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TABLE 1

Number of larval mines of *Liriomyza trifolii* on different numbered leaf of the castor plant.

Leaf sample	*Larval mines/leaf* (Nos.)*	
1st	0.00	(0.71)
2nd	10.40	(3.18)
3rd	164.60	(12.52)
4th	362.50	(18.87)
5th	397.00	(19.87)
All	186.90	(13.68)
S.Em. ±		(1.06)
C.D. (P = 0.05)		(3.27)

Figures in parentheses are $\sqrt{X+0.5}$ transformed values.
* Mean of 5 replications.

TABLE 2

Number of larval mines of *Liriomyza trilfolii* on the third leaf sample in different plant samples.

Plant sample	Larval mines/leaf* (Nos.)	
3	148.00	(12.18)
5	176.30	(13.28)
8	163.30	(12.78)
10	175.00	(13.23)
15	189.00	(13.75)
S.Em. ±		(00.34)
C.D. (P = 0.05)		(NS)

Figures in parantheses are $\sqrt{X+0.5}$ transformed values.
* Mean of 5 replications.

rather than large plant sample (8, 10, 15) could be helpful in estimating the mines density and the amount of time could be saved.

The study concluded that the mines density of *L. trifolii* on the third leaf can be utilized to evaluate the mines density of this pest.

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REFERENCES

Kapadia, M. N. 1991. Biology and host range of *Liriomyza trifolii* (Burgess) recorded as leaf miner of castor. *GAU. Res. J.* (Under publication).

Schuster, D. J. and H. W. Beck. 1992. Presence - absence sampling for assessing densities of larval leafminers in field-grown tomatoes. *Tropical Pest Management*, 38 (3) : 254-256.

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Influence of Abiotic Factors on the Infestation by the Yellow Stem Borer, *Scirpophaga, incertulas* Walker

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Among insect pests of major significance and regular occurrence in India, the stem borers are the most important infesting rice plants from seedling to maturity. The yellow stem borer, *Scirpophaga incertulas* (Walker) is an important pest and occurs in all the paddy growing tracts of Gujarat. It is, however, more acute in South Gujarat particularly in areas under double cropping system where damage from 15 to 20 per cent is not uncommon. The attack starts usually in late planted monsoon crop. The damage in the early stages of the crops results dead heart and at a later stage in white ears. Much work has been done on the chemical control of the pest, but a few reports are available on abundance of pest in relation to weather factors from different parts of the country (Roy *et al.*, 1979, Balasubramaniam *et al.*, 1982 and Ishhaque and Rahman, 1983).

The experiments were conducted at Agriculture Experimental Station, Gujarat Agricultural University, Paria during 'kharif' seasons of 1990 and 1991 with the rice variety GR-3. In each plot of 400 sq.m. (20 x 20 m), 5 quadrets of 1m² were randomly selected in 'W' design. From each quadrate 4 hills were selected at random for counting dead hearts or white ears at weekly intervals from a week following planting. To study the instantaneous effect of major abiotic factors viz., maximum temperature (X1), minimum temperature (X2), relative humidity (X3), rainfall (X4) and Sunshine (X5) on pest infestation, a correlation coefficient and multiple regression equation was worked out taking number of dead hearts or white ears per twenty hills as dependent variable (Y). Meteorological data were recorded from the observatory at Agricultural Experimental Station, Paria.

The impact of major abiotic factors on the incidence of dead hearts or white ears as affected by *S. incertulas* in different years is given vide table 1 and 2. It can be seen from the Table 1 that the quantum of dead hearts or white ears peaked on 37th standard week (37 dead hearts/ 20 hills) starting from 34th standard week (August) i.e. one week after transplanting (8 dead hearts / 20 hills) during 1990. Thereafter, it declined more or less gradually being minimum during 42nd standard week (2 white ears/20 hills). Although, none of the abiotic factors showed any significant impact on pest infestation, the number of dead hearts or white ears was comparatively less (10 white ears/ 20 hills) on 39th standard week when the rainfall was maximum (32.34 mm) obviously showing negative effect of rain. Similarly in the

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year 1991 (Table-1), the impact of rainfall was non-significant but showed negative effect as the number of dead hearts or white ears ranged from 7 to 17 dead hearts or white ears during rainy period which occurred from 33rd-38th standard week(6.00-22.57 mm) as against 8-49 white ears per twenty hill during non-rainy periods (39-42 standard week). In the year 1991, the pest infestation was more than the preceeding year. The quantum of white ears was maximum during 41st standard week (49 white ears/20 hills) coinciding with flowering and earhead formation stage of the crop. The appearance of dead hearts started from 33rd standard week (August) i.e. one week after transplanting. Among the major abiotic factors, Sunshine hours showed significant positive correlation

TABLE 1

Influence of major abiotic factors on the infestation caused by *Scirpophaga incertulas* Walker to paddy (Var-GR-3) during kharif seasons of 1990 and 1991.

Standard Week	*No. of dead hearts or white years per 20 hills (Y)*	ABIOTIC FACTORS *Temp (°C) Max. (X1)*	*Min. (X2)*	*RH (%) (X3)*	*Total rainfall (mm) (X4)*	*Sun-shine (hours) (X5)*
1990						
34	8.0	29.2	25.10	93.5	20.37	2.1
35	15.0	29.4	24.90	93.5	10.20	2.1
36	15.0	26.2	25.00	91.5	9.77	4.9
37	37.0	30.5	24.10	89.5	9.22	4.8
38	17.0	31.5	23.60	84.0	4.74	4.7
39	10.0	28.0	24.00	90.5	32.34	6.6
40	12.0	31.6	23.78	80.5	00.00	6.9
41	6.0	33.0	24.20	77.5	6.90	7.9
42	2.0	35.7	20.40	66.5	0.00	9.5
1991						
33	7.0	30.4	25.4	86.5	15.57	1.5
34	7.0	28.9	24.9	90.0	22.57	1.3
35	9.0	29.9	25.0	90.5	15.57	1.4
36	13.0	28.7	24.8	89.0	6.00	2.4
37	17.0	31.6	22.6	78.5	0.00	8.0
38	12.0	31.9	23.1	77.5	6.57	5.6
39	8.0	33.1	23.1	77.0	0.00	6.8
40	42.0	29.1	16.6	64.0	0.00	7.9
41	49.0	29.6	18.4	68.0	0.00	7.9
42	26.0	29.5	18.2	57.0	0.00	9.5

TABLE 2

Correlation coefficient and regression equation values for average dead heart or white ears per 20 hills (Y) with respect to weather parameters (X1 to X5) during kharif season of 1991.

Particulars	*No. of dead heart of white ears per 20 hills*	*Temp(°C)*		*RH (%)*	*Total rainfall (mm)*	*Sunshine (hours)*
		Max.	*Min.*			
	(Y)	*(X1)*	*(X2)*	*(X3)*	*(X4)*	*(X5)*
Correlation Coefficient	1.000	-0.4250	-0.9023^{xx}	-0.7458^{x}	-0.6061	0.6609^{x}
Regression Coefficient		-1.682923	-6.654759	1.025525	-0.359738	0.188826
R2	0.9184					
R	0.9583					
$\hat{Y}$ =	139.2543	-6.654759(X2)	+ 1.025525	(X3) + 0.188825 (X5)		

X : Significant at 5% level of significance.

XX : Significant at 1% level of significance.

with pest infestation. Whereas, minimum temperature and relative humidity had significant negative correlation. The positive correlation with Sunsine hours was also evident from the peak recorded on 41st standard week when the Sunshine hours were also high (7.9). The negative correlation with minimum temperature and relative humidity was also evident from higher incidence of pest infestation which occurred during 40-42 standard week when the minimum temperature (less than 20°C) and relative humidity (less than 70%) was lower while with increase in minimum temperature (about 25°C) and relative humidity (more than 85%) the pest infestation was low (33-34 standard week). Thus, less than 20°C minimum temperature and 70 per cent relative humidity as well as more than 7 hours Sunshine had favoured for multiplication of the pest. Similarly, Rao and Padhi (1981) reported that out break of *Scirpophaga incertulas* had the lowest amount of rainfall, number of rainy days and highest Sunshine hours. Further, they concluded that rainy days adversely affected mating, flight, oviposition, egg hatchability, larval survival and tiller penetration. The joint contribution of those abiotic factors which were significant in simple correlation (Table-2) exhibited significant impact on pest infestation showing as high as 91.84 per cent variation in dependent variable which can be explained by these factors. The multiple regression equation was worked out as:

$$\hat{Y} = 139.2543 - 6.654759\ (X2) + 1.024424\ (X3) + 0.188826\ (X5)$$

Thus, based on appearance and peak activity of the pest the control against this pest may be taken from 33rd or 34th standard week onwards in khariif sown paddy.

REFERENCES

Balasubramaniam, G.; Gopalan, M.; Balasubramaniam, M. and Kulandaivelu, R. (1982). Influence of weather parameters on the incidence of stem borer in rice. *Ind. J. Pl. Prot.* **9** (1) 82-87.

Ishhaque, N. M. M. and Rahman (1983). Seasonal incidence of rice stem borer, *Tryporyza incertulas* Walker in Assam. *Pesticides* **17** (1) ; 25-27.

Rao, P. S. P. and Padhi, G. (1987). Forecasting outbreaks of the yellow rice borer (YRB) *Scirpophaga incertulas* Walker on kharif paddy based on climate. *Rice Research News Letter.* **8** (2-3); 9-11.

Roy, P. and Sinha, P. K. (1979). Seasonal activity of paddy stem borer, *Tryporyza incertulas* Walker in West Bengal, *J. ento. Res.*: **3** (1) : 104-106.

New Record of *Aphis gossypii* Glover (Aphididae : Homoptera) As a Pest of Coriander (*Coriandrum sativum* Linnaeus) in Gujarat*

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During rabi 1991, coriander crop, *Coriandrum sativum* Linnaeus was found severely attacked by aphids. The nymphs and adults were found resting on the under surface of the leaves. They were also found on entire leaf surface, flowers, fruits and mainly on umbels in case of severe infestation. They suck the cell sap, which resulted in distoration of leaves and excreted the honey dew like substances on which, the sooty mould developed. The development of sooty mould inhibits the photosynthetic activity of the plants as a result the growth of the plants retarded. The infested plants yielded the shrivelled fruits of poor quality. The *aphids* collected from severly infested coriander plants were identified as *Aphis gossypii* Glover by the Commonwealth Institute of Entomology, London.

A study of literature revealed that the *A. gossypii* has not been reported earlier as a pest of coriander crop from any where under Indian conditions. However, it has been reported as a pest of cumin (Anonymous, 1970) under Rajasthan conditions and as a pest of umbelliferous crop by Blackman and Eastop (1984). Therefore, *A. gossypii* has reported for the first time as a pest of coriander crop in Gujarat.

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REFERENCES

Anonymous, 1970. Twenty years of Agriculture Research in Rajasthan. Deptt. of Agriculture, Bikaner. PP. 1 - 171.

Blackman, R. L. and V. F. Eastop, 1984. Aphids on the world's crop : An identification Guide, Pub. by John Wiely & Sons., New York. P. 281.

* Part of M. Sc. (Agri.) thesis submitted by senior author to the Gujarat Agricultural University, S. K. Nagar.

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Record of Two Egg Parasitoids of the Okra Jassid *Amrasca biguttula biguttula* (Ishida)

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Two mymarids, *Arescon enocki* (Subba Rao and Kaur) and *Stethynium empoascae* Subba Rao were found parasitizing the eggs of the jassid, *Amrasca biguttula biguttuala* (Ishida) infesting okra, *Abelmoschus esculentus* Moench at Entomological Farm, College of Agriculture, Junagadh (Gujarat) during 1990-91. They have also reported earlier as egg parasitoids of *Empoasca devastants* Distant infesting okra, castor and cotton (Subba Rao *et al.* 1965, Subba Rao, 1966 and Subba Rao *et al.* 1968). Since both the species were recorded for the first time in Gujarat as egg parasitoids of *A. biguttula* the observations on its activity and morphological study were made.

The okra leaves infested with the jassid eggs were taken from the unsprayed field and kept in glass jar. the leaf petiole was wrapped with the moist cotton. The observations on the adult emergence of both the jassid and parasitoid were recorded. The percentage parasitism was calculated on the basis of total number of jassid and parasitoid adults emerged out.

It was observed that the adult parasitoids emerged out early in the morning (8.00 to 9.00 a.m.). Among both the parasitoids, *A. enocki* was found the dominant. The sexes in *A. enocki* could be distinguished easily by difference in the antennal segments, abdominal shape and colouration. The male parasitoid has 11 segmented antennae while female parasitoid possessed 7 segmented antennae and its last segment being global shaped. The male was black in colour and the female was yellow in colour. The black marks were seen on the dorsum prothorax of the female. The abdomen of the male was blunt and pointed in case of the female. Out of 110 *A. enocki* adults examined, 60 males and 50 females were observed and thus the sex ratio was 1.20 males : 1.00 female. The parasitism by both the parasitoids ranged from 32.26 to 54.54 per cent i.e. 32.26 per cent in second week, 54.54 per cent in third week and 48.01 per cent in fourth week of October, 1990. Subba Rao *et al.* (1965) reported that the parasitism on okra ranged from 39.08 to 66.48 per cent in June to July.

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REFERENCES

Subba Rao, 1966. Records of known and new species of mymarid parasites of *Empoasca devastants* Distant from India. *Indian J. Ent.*, **28** (2) : 187-196.

Subba Rao, B. R. ; Baldev Prashad, Atma Ram : R. P. Singh and M. L. Srivastava. 1965. Studies on the parasites and predators of *Empoasca devastants* Dist. (Jassidae : Hemiptera). *Indian J. Ent.*, **27** : 104-106.

Subba Rao, B. R. ; B. Prashad ; A. Ram ; R. P. Singh and M. L. Srivastava, 1968. Distribution of *Empoasca devastants* and its parasites in the Indian Union. *Entomol. exp. appl.*, **11** (2) : 250-254.

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Relative Susceptibility of Different Promising Sugarcane Varieties to Shoot Borer, *Chilo infuscatellus* (Snellen)

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With the development of sugar industries and irrigation facilities in Gujarat State, the sugarcane had gained the due importance among commercial crops. In Gujarat State, the crop occupies an area of 1.40 lakh hectares with the cane production of 77.4 lakh tonnes.

Among the various insect pests attacking the sugarcane crop *Chilo infuscatellus* is an important pest. Earlier Khan *et al.* (1956) reported that the shoot borer destroys 26-65 per cent mother shoots and 6.4, 27.1 and 75.00 per cent primary, secondary and tertiary tillers, respectively. Shoots aged 45-60 days are most susceptible to the shoot borer (Sithanatham *et al.* (1975). According to Jaipal *et al.* (1991) the variety Cos 767 was the least susceptible against shoot borer in Haryana. Tanwar and Bajpal (1993) reported that the infestation of shoot borer was severe during March to June and remains in increasing trend. An attempt was therefore made to test the recommended and promising varieties for their susceptibility to the sugarcane shoot borer.

A study on screening of different promising varieties of sugarcane for susceptibility to shoot borer was carried out under field conditions at Sugarcane Research Station, Gujarat Agricultural University, Junagadh Campus, Junagadh during the year 1991. The field trial was conducted in a randomized block design using 24 different varieties. The varieties were sown in two replications with the plot size of 7.0 m x 1.8 m. The incidence of shoot borer was recorded by counting the number of healthy plants and dead hearts from gross plot area at 45 and 90 days after germination. The data were converted to per cent damage and subjected to statistical analysis and are presented in Table-1.

The varieties were catogarized in different groups for their reaction to this pest by following the method given by Rao and Krishnamoorthy (1973) as under :

1. Less susceptible 0 - 15 per cent dead hearts.
2. Moderately susceptible 15.1 - 30 per cent.
3. Highly susceptible above 30 per cent.

Twenty four sugarcane varieties (Table : 1) were screened against the shoot borer. The data on per cent dead hearts due to shoot borer revealed that the lowest per cent dead hearts at 45 days after germination was recorded (0.92%) in variety 80-R-41 and it was at par with the variety CON-84136, CO-86043, CO-84133, CO-85246, CO - 86036, CO-86002 and CO-7914.

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TABLE 1

Per cent dead hearts due to shoot borer in promising varieties of sugarcane during - 1991.

Sr. No.	*Promising Varieties*	*Per cent dead hearts due to shoot borer*		
		45 days after germination	*90 days after germination*	*In tiller stage*
1.	CO-85004	12.87 *(4.98)	18.23 (9.80)	25.13 (18.04)
2.	CO-85010	11.70 (4.12)	20.01 (11.70)	27.78 (21.73)
3.	CO-85012	10.82 (3.55)	14.21 (6.02)	17.16 (8.70)
4.	CO-86002	8.00 (1.75)	22.00 (14.07)	48.42 (55.94)
5.	CO-86004	13.00 (5.07)	24.34 (17.00)	46.90 (53.31)
6.	CO-86010	14.21 (6.04)	14.89 (6.60)	18.67 (10.25)
7.	CO-7201	12.42 (4.65)	14.58 (6.34)	18.74 (10.32)
8.	80-R-41	5.50 (0.92)	19.89 (11.58)	34.46 (38.70)
9.	CO-671	9.09 (2.50)	17.75 (9.30)	25.06 (17.94)
10.	CO-8338	11.91 (4.29)	24.46 (17.12)	33.92 (31.15)
11.	CON-84131	9.14 (2.55)	23.91 (16.42)	35.32 (33.43)
12.	CON-84133	6.34 (1.25)	22.34 (14.44)	32.40 (28.72)
13.	CON-84134	10.18 (3.16)	24.96 (17.81)	35.63 (33.93)
14.	CON-84136	6.08 (1.14)	17.24 (8.78)	23.61 (16.03)
15.	CON-84138	11.27 (3.81)	20.69 (12.50)	31.01 (26.54)
16.	CO-85016	11.37 (3.68)	21.53 (13.46)	36.01 (34.55)
17.	CO-85246	6.62 (1.32)	18.25 (9.80)	25.71 (18.81)
18.	CO-86032	18.28 (9.84)	21.94 (13.95)	25.35 (18.32)
19.	CO-86034	12.61 (4.75)	19.63 (11.30)	27.12 (20.80)
20.	CO-86036	7.07 (1.52)	20.79 (12.60)	28.40 (22.62)
21.	CO-86043	6.26 (1.19)	18.23 (9.80)	23.92 (16.44)
22.	CO-7914	8.37 (2.13)	21.37 (13.27)	29.23 (23.85)
23.	CO-6304	10.48 (3.30)	13.78 (5.67)	16.82 (8.38)
24.	CO-7527	11.75 (4.29)	20.03 (11.73)	28.14 (22.25)
	S.Em. ±	1.06	1.20	3.32
	C.D. at 5%	3.10	3.52	9.71
	C.V. %	20.94	12.14	16.12

* (Figure in paranthesis are rentransformed values).

The highest infestation (9.84%) was recorded in the variety CO-86032.

The incidence of shoot borer increased with time and ranged from 5.67 to 17.81 per cent in different varieties at 90 days after germination. The minimum per cent dead hearts (5.67%) was observed in variety CO-6304 and it was statistically at par with the variety CO-85012, CO-7201, CO-86010 and CON-84136. While, it was maximum in variety CON-84134 and was at par with CO-8338, CO-86004, CON-84131, CON-84133, CO-86002, CO-86032 and CO-85016. Thus, the ninety days after germination the variety CO-6304 was considered to be the least susceptible followed by CO-85012, CO-7201, CO-86010 and CON-84136, whereas, varieties CON-84134, CO-8338, CO-8604 and CON-84131 were moderately susceptible to shoot borer under Junagadh conditions.

During tillering stage, the infestation increased in all the varieties. A close perusal of the data (Table : 1) indicated that the lowest infestation (8.38%) was observed in the variety CO-6304 which was at par with CO-85012, CO-86010, CO-7201, CON-84136, CO-86043, CO-671, CO-85004, CO-86032 and CO-85246. Whereas, it was the highest (55.94%) in variety CO-86002 and it was at par with CO-86004 (53.31%).

Thus, during tiller stage varieties CO-6304, CO-85012, CO-86010, CO-7201 were proved to be the least susceptible to shoot borer as compared to other varieties. Whereas, varieties CO-86002, CO-86004, 80-R-41, CO-85016, CON-84134, CON-84131, CO-8338 were observed highly susceptible.

From the results, it can be concluded that the infestation of shoot borer was very low at 45 day after germination. But, it increased during tillering stage as the per cent dead hearts were very high (55.94 %) during this stage, in comparision to mothers shoots. Similar observations for the damage at different period after germination and tiller stage of the crop were also reported by Khan *et al.* (1956), Sithanatham *et al.* (1975) and Tanwar and Bajpai (1993).

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REFERENCES

Jaipal, S., H. L. Sehtiya, J. P. S. Dendsay., A. K. Dhawan, (1991). Reactions of some sugarcane accessions and cultivars to shoot borer, *Chilo infuscatellus*. *Annals of Applied Biology*, **118** (Supplement) 118-119.

Khan, M. Q. and B. H. Krishnamurthy Rao (1956). Assessment of loss due to *Chilotraea infuscatellus* Snell in sugarcane., *Proc. int. Soc. Cane Technol.* **7** : 870-879.

Rao, Seshagiri, C. and B. H. Krishnamoorthy Rao, (1973). Studies on loss in yield of sugarcane due to shoot borer (*Chilo infuscatellus*). *Indian Sug.*, **22** : 867-868 and 871.

Sithanathan, S., R. Durai and S. Muthaswamy, (1975). Incidence of sugarcane shoot borer in relation to planting time. *Indian Sug.*, **24** : 867-870.

Tanwar, R. K. and P. K. Bajpai, (1993). Relative abundance of borer species in relation to environmental factors at shoot stage of sugarcane. *Indian Sug.*, **12** : 243-248.

Influence of Light Trap on Incidence of Yellow Stem Borer in Rice

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The photopositive nature of yellow stem borer, *Scirpophaga incertulas* (Wlk.) has been reported by earlier workers (Israel and Rao, 1970; Banerjee and Mookerjee, 1976; Saroja and Raju, 1981 and Manjunath, 1982). Since yellow stem borer is the major pest of rice in Gujarat, the influence of light trap on its infestation was studied.

A chinsura type light trap fitted with a 200 w fluorescent lamp was installed in a field cropped with GR 11 variety of rice. The trap was operated at the National Agricultural Research Project Farm, Gujarat Agricultural University, Navsari from March, 1986 to May 1986, from 1800 to 0600 hours. The incidence of dead-heart and white earhead were assessed by selecting 10 hills in diagonal lines at 1, 5, 10, 15 and 20 m from the trap, and in fields located far away from the trap where the light could not be seen by yellow stem borer. Every morning, 10 hills were randomly selected at 1 m from the trap and the number of yellow stem borer moths settled on the hills was estimated. Counts were made for 16 days during peak infestation period, and correlation coefficient was worked out.

The highest incidence was recorded at 1 m around the trap (Table 1). As distance from the light trap increased, per cent incidence declined. The increased infestation at 1 m around the trap was due to settlement of yellow stem borer months and higher incidence even at the distance of 10 m indicated that the moths may have migrated to surrounding areas during day time and caused more damage in that area. Further, there existed a highly significant positive correlation (r 0.96) between the number of yellow stem borer moths on 10 hills and the daily light trap catch (Table 2). The moths which were attracted to the light but did not enter the trap settled near it. The results of the present study indicate that it may be wise to spray around the trap area with a suitable insecticide to reduce field damage. The present findings are in concurrence with earlier study (Mohan and Janarthanan, 1984).

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TABLE 1

Yellow stem borer incidence at different distances from the light trap.

Date	*Incidence (%)*					
	1m	*5m*	*10m*	*15m*	*20m*	*Light shadow region*
1 March 1986	18	15	12	10	7	5
8 March 1986	24	20	14	12	10	8
15 March 1986	32	24	19	16	13	10
22 March 1986	36	29	22	17	16	12
29 March 1986	39	33	26	22	18	13
5 April 1986	43	38	28	25	22	17
12 April 1986	44	40	31	28	24	19
19 April 1986	49	44	34	30	28	23
26 April 1986	53	47	37	33	29	24
3 May 1986	58	49	39	36	32	27
10 May 1986	62	54	43	37	33	29
17 May 1986	69	24	18	15	11	7
24 May 1986	72	26	22	18	14	9
31 May 1986	75	32	27	19	17	12
Mean Analysis	48.14	33.93	26.57	22.71	19.57	15.36
		F = 41.66**[a]				
		CD at 5% = 5.13				

[a]Significant at 1% level.

TABLE 2

Correlation between light trap catch and settlement of yellow stem borer.

Date	*Moths settled (no./10 hills)*	*Light trap catch (no.)*
13 May 1986	45	212
14 May 1986	52	220
15 May 1986	54	225
16 May 1986	63	251
17 May 1986	71	394
18 May 1986	69	375
19 May 1986	70	383
20 May 1986	85	490
21 May 1986	76	399
22 May 1986	61	261
23 May 1986	61	269
24 May 1986	45	100
25 May 1986	40	62
26 May 1986	32	39
27 May 1986	35	45
28 May 1986	49	70
	r = +0.96**[a]	

[a]Significant at 1% level.

REFERENCES

Banarjee, S. N. and Mookerjee, A. L. 1976. Studies on the changes in population of paddy stem borer *Tryporyza incertulas* (Wlk.) in relation to preceding weather conditions. *Indian J. Plant Prot.*, **4** (2) : 130-148.

Israel, P. and Rao, Y. S. 1970. Influence of the method of cropping, date of planting, season, age of crop and crop climate on the incidence of rice pests. Tech. Report, Central Rice Research Institute, Cuttack, 123 p.

Manjunath, T. M. 1982. Light trap catches of the rice yellow stem borer. *Int. Rice Res. Newsl.*, **7** (5) : 20.

Mohan, S. and Janarthanan, R. 1984. Relation between light trap catch and settlement of YSB around the trap. *Int. Rice Newsl.*, **9** (5) : 16.

Saroja, R. and Raju, N. 1981. Fluctuation of stem borer moth populations. *Int. Rice Res. Newsl.*, **6** (6) : 20.

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Screening for Susceptibility of Rice Cultivars to Leaffolder, *Cnaphalocrocis medinalis* Guenee

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Varietal resistance plays a vital role in the overall context of the integrated pest management system and has several advantages like no adverse effect on the acasystem and easy adoption by the grower since no extra cost is involved. Since, leaffolder, *Cnaphalocrocis medinalis* Guenee is the major pest of wetland rice in South Gujarat, particularly during wet season, an attempt has been made to evaluate the available cultivars against its attack.

A set of 11 rice cultivar (Table 1) grown in a randomized block design replicated thrice were screened for their susceptibility to leaffolder at the National Agricultural Research Project Farm, GAU, Navsari during wet season of 1986. The susceptibility from view point of damaged plants and damaged leaves was recorded at an interval of 15 days commencing from transplanting and continued upto 90 days after transplanting. The data thus obtained were averaged out and analysed statistically to know the overall performance of each cultivar. The grain yield was also recorded.

The results revealed that all the 11 cultivars were more or less susceptible to the leaffolder (Table 1). The susceptibility from view point of damaged plants and damaged leaves ranged from 52 to 87.4 per cent and 5.6 to 20.3 per cent in different cultivars, respectively. A late maturing non-scanted cultivar, 1-30-1-1 was less susceptible to the pest (Anonymous, 1985), recording the highest grain yield. Our results are in close agreement with those of Upadhyay *et al.*, (1975), reporting late maturity varieties to be less susceptible to leaffolder. However, inspite of being late maturity ones, the three scented cultivars, 3-1-5-1-1, GR 101 and Pankhali 203 were more susceptible to the pest may be due to their succulancy. Similarly, Ghose *et al.*, (1960) reported that in general no variety was resistant, but scented varieties recorded a higher incidence than green non-scented varieties at Cuttack. Medium and late maturing non-scented cultivars (GR 4, GR 11, 2-21-1-1, IR 22, CR 138-928 and 1-30-1-1) were comparatively less susceptible to the pest than early maturing ones (GR 3 and Ratna).

TABLE 1

Susceptibility of rice cultivars to leaffolder.

Cultivars	*Plants infested (%)*		*Leaves infested (%)*		*Grain yield*	*Duration (days)*
GR 3	58.44	(72.60)	21.13	(13.00)	4.30	130
GR 4	49.20	(57.30)	55.55	(06.80)	5.60	140
GR 11	50.65	(59.30)	58.69	(07.30)	5.30	140
Ratna	57.73	(71.50)	20.96	(12.80)	4.50	133
2-21-1-1	53.91	(65.30)	84.26	(09.90)	4.90	135
IR 22	48.10	(55.40)	54.33	(06.60)	6.30	140
CR 138-928	47.24	(53.90)	49.60	(05.80)	6.80	150
1-30-1-1	46.15	(52.00)	48.45	(05.60)	7.30	152
3-1-5-1-1	68.53	(86.60)	26.71	(20.20)	3.30	146
GR 101	69.21	(87.40)	26.78	(20.30)	2.00	146
Pankhali 203	66.58	(84.20)	25.33	(18.30)	2.80	150
C.D. at 5%	01.20		01.00		1.00	

Figures in parentheses are retransformed values in angular transformed values.

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REFERENCES

Anonymous, 1985. Varietal screening. Page 24, in Report of the Entomological Research Work, Regional Research Station (Paddy), NARP, GAU, Navsari for the 20th meeting of Plant Protection Sub-Committee of Research Council.

Ghose, R. L. M., Ghatge, M. S. and Subrahmanyan, V. 1960. Pest of rice, Pages, 248-257, in Rice in India, Indian Council of Agricultural Research, New Delhi.

Upadhyay, V. R., Desai, N. D. and Shah, A. H. 1975, Extent of damage and varietal susceptibility by rice leaffolder. *Pesticides*, **9** (5) 27-28.

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A Note on the Shelf Life Studies in Gaillardia*

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Gaillardia (*Gaillardia pulchella* Fouger) is one of the hardiest annual flower crop which can be grown in variety of soil and climatic conditions. Information on the influence of nitrogen and phosphorus fertilizers on shelf life in gaillardia is presently not available. Efforts were therefore made in the present study to collect the above information.

The field trial was conducted during the year 1990 kharif season at University of Agricultural Sciences, Dharwad in red sandy loam soils. Four levels of nitrogen that is 0, 50, 100 and 150 kg/ha i.e. N_0, N_1, N_2 and N_3 respectively in combination with three levels of phosphorus that is 0, 50 and 100 kg/ha i.e. P_0, P_1 and P_2 respectively and constant k (60 kg/ha) were included. The experiment was conducted in a factorial design, consisting of 12 treatment combinations with three replications. Flowers were harvested from each net plot for shelf life observation.

Hundred grams weighed flowers were kept for the shelf life study in two conditions. One lot was in open condition weighout covering. Second lot was kept in 150 gauge thick polythylene bag having, holes for the aeration. At every 12 hrs interval flowers were weighed and the per

TABLE I

Per cent weight loss during shelf life of flowers as influenced by N and P levels in gaillardia.

Polyethylene pack

	12hr				*24 hr*				*36 hr*				*48 hr*			
Treatment	P_0	P_1	P_2	*Mean*	P_0	P_1	P_2	*Mean*	P_0	P_1	P_2	*Mean*	P_0	P_1	P_2	*Mean*
N_0	1.50	0.75	0.90	1.05	3.79	1.77	1.91	2.49	5.35	4.29	2.99	4.21	4.65	5.34	3.42	4.47
N_1	0.80	0.97	0.90	0.89	1.62	2.17	1.97	1.92	3.26	4.71	4.52	4.15	3.94	5.75	5.09	4.93
N_2	0.75	1.20	1.50	1.15	1.77	3.18	3.68	2.88	4.39	5.12	5.72	5.08	5.37	5.31	5.91	5.53
N_3	1.60	2.10	1.40	1.70	3.58	4.44	3.05	3.69	4.13	5.07	5.14	4.80	4.71	5.13	5.44	5.11
Mean	1.17	1.25	1.17	1.20	2.69	2.89	2.65	2.74	4.29	4.80	4.59	4.56	4.67	5.29	4.97	5.01
	S.Em ±		C.D.at 5%		S.Em ±		C.D.at 5%		S.Em ±		C.D.at 5%		S.Em ±		C.D.at 5%	
N	0.04		0.11		0.09		0.26		0.11		0.31		0.11		0.32	
P	0.03		NS		0.08		NS		0.09		0.27		0.09		0.20	
N x P	0.07		0.19		0.15		0.45		0.18		0.54		0.19		0.56	

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in open

Treatment	12hr				24 hr				36 hr			
	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean	P_0	P_1	P_2	Mean
N_0	8.10	8.20	9.10	8.47	10.73	17.55	19.30	18.85	28.08	25.29	26.66	26.68
N_1	8.70	10.00	9.40	9.37	17.66	21.90	21.39	20.35	25.04	28.37	26.75	26.71
N_2	8.13	10.70	10.50	9.78	17.66	22.57	22.37	20.87	26.52	28.73	28.08	27.72
N_3	10.10	10.10	9.30	9.83	21.78	21.22	19.65	20.89	27.09	27.35	27.77	27.40
Mean	8.76	9.75	9.57	9.36	19.21	20.83	20.68	23.24	26.63	27.44	27.31	27.13
	S.Em ±		C.D.at 5%		S.Em ±		C.D.at 5%		S.Em ±		C.D.at 5%	
N	0.05		0.15		0.10		0.31		0.10		0.29	
P	0.04		0.13		0.09		0.26		0.09		0.26	
N x P	0.09		0.26		0.18		0.53		0.17		0.51	

N.S. = Non Significant

cent weightloss was worked out at 12, 24, 36 and 48 hrs after harvest.

The per cent weight loss during shelf life of flower was more in open condition than in polyethylene pack at all the observation periods (Table-1). Nitrogen levels exhibited significant effect on per cent weight losses during all observations periods of both the conditions. Higher level of nitrogen (N_3) lost significantly more weight during early 24 hrs in polyethylene pack, while in open it was at par with N_2 level. At the end of 48 hrs in polyethylene pack weight loss was 5.53 per cent, while in open after 36 hrs it was 27.72 per cent with N_2 level. Control (N_0) recorded minimum wight loss of 4.41 per cent in polyethylene pack and 26.68 per cent in open condition. Phosphorus did not show any significant effect in early hours in polyethylene pack. But at later hours significantly more weight loss was noticed with P_1 level. And that was true with open condition also. Interaction between N and P showed significant differences during all the observation periods of both the conditions. Minimum weight loss was noticed at last stage with N_0P_2 (3.42 per cent) and N_0P_1 (25.29 per cent) respectively, for polyethylene pack and open conditions. This is an agreement with Waters (1967) in case of chrysanthemum.

He also observed that the increasing nitrogen levels decreased the shelf life.

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REFERENCE

Waters, W. E., 1967, The effect of coated fertilizers on growth, keeping quality, decease susceptibility and chemical composition of field grown (*Chrysanthemum morifolium*) *Proc. Fla. Sta. Hort. Sci.*, **78** : 383-386.

Abstracts of Ph.D. Thesis

Biogas Fermentation and Phase Separation Studies of Some Plant Materials

Submitted to Gujarat Agricultural University

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Fermentation studies on four vegetative materials (ipomea leaves, water hyacinth, neem leaves and rice straw) were carried out in duplicate sets with 6.67 per cent solids at 37°C or at room temperature. For biphasic studies, acidogenic and methanogenic phases were physically separated.

Ipomea and neem leaves gave the highest gas production 260 ml and 332.2 ml/g dry matter at room temperature when respectively treated with 2% N + 10% $CaCO_3$ and 2% N + 20% $CaCO_3$.

Higher biogas yields (40% and 58%) were recorded in 3:2 cowdung : 3-day presoaked green ipomea mix and 2:3 cowdung : 7 day presoaked green ipomea mix as compared with that from cowdung alone.

The highest VFA yields in I-phase (batch) of two phase system was 7.80 g/l as acetic acid from dried ipomea leaves in 3 days retention time and biogas yield was 433 ml/g dried material in the II-phase with 62% methane.

In the I-phase of semicontinuous biphasic study, higher VFA production and biogas yield was achieved from waterhyacinth and ipomea leaves, respectively.

Optimum VFA was produced from rice straw established at C/N = 13.8, 6.67% solids and at pH 6.5 whereas, for ipomea leaves 6.67% total solids and pH 7.0. Higher lignin content gave lower amount of VFA from rice straw.

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A Study on Research Management Ability of Research Scientists Working as Head of the Department/Station/Project/Scheme in Gujarat Agricultural University

Submitted to Gujarat Agricultural University

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The agricultural research management in India is relatively a new area. The head of department/stations/projects/schemes of the agricultural university have to perform many research management functions. Thus, to make a research organisation more productive, the proper research management practices should be adopted by the research leaders. However, it is observed that the scientists who are working as the head have neither education nor experience in the field of management before they become head, eventhough, they have to carry the responsibilities of management aspects too.

In all, one dependent variable i.e. research management ability and 27 independent variables were studied. The salient findings of the study were : (1) Majority (71.67 per cent) of the heads exhibited medium level of research management ability (2) the span of control and research experiments to be conducted by the heads had negative and highly significant relationship with their research management ability. (3) The age, interpersonal communication, departmental/ station climate, image (characteristics) of the head, personality (extrovert), attitude towards delegation of authority, job involvement and style of supervision (developmental) of heads had positive and highly significant relationship with their research management ability. (4) About, 86.92 per cent (R^2 = 0.8692) contribution to the variation in dependent variable (research management ability index) was accounted by seven variables from highest to lowest were (i) Image (characteristics) of the head (ii) Attitude towards delegation of authority (iii) Research experiments to be conducted (iv) Interpersonal communication (v) Job involvement (vi) Family size (vii) Absence at headquarters (5) The major variables contributing the maximum direct and positive effect on RNAI (Research Management Ability Index) were image (characteristics) of the head, attitude towards delegation of authority, age and interpersonal communications. Whereas the variable research experiments to be conducted contributing maximum negative direct effect on RMAI.

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Fertilizer Management of Marginal Salt Affected Soil at Devataj, Gujarat

Submitted to Gujarat Agricultural University

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A field experiment was conducted on saline sodic soil, adjoining the coastal area of Cambay gulf. The field was first treated with two levels of gypsum and two levels of FYM and super imposed with four levels of N and three levels of P growing kharif paddy and rabi wheat. The overall results showed that application of gypsum and FYM has significantly reduced the pH over control, during both the crops at both the depths of (0.15 and 15.30 cms) of soil.

Combined application of gypsum and FYM as well as their individual application were effective in lowering the soil pH, EC and ESP which resulted in increase in yield of paddy and wheat, in both the year. However, the increase in yield during the second year was of higher magnitude, compared to that of first year. This might be due to prolonged action of gypsum and FYM treatments as the action of both the amendments is generally slow. Fertilizer N and P did not change the soil pH and EC significantly. However, the optimal dose of N + P fertilizers was $N_{160}P_{80}$ treatment whch gave highest yield of paddy and wheat.

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