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Influence of Irrigation and Fertility Levels on the Yield, Quality and Economics of *Rabi* Fennel (*Foeniculum vulgare* Mill.)

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ABSTRACT

Effect of three levels each of irrigation (0.6, 0.8 and 1.0 IW : CPE ratios), nitrogen (60, 90 and 120 kg/ha) and phosphorus (30, 45 and 60 kg/ha) on yield, quality and economics of fennel were studied during *rabi* season of 1994-95 and 1995-96 at Sardar Krushinagar. Seed, stover and oil yields increased significantly with increase in irrigation and nitrogen levels up to 0.8 IW : CPE ratio and 90 kg N/ha respectively. Volatile oil, sugar and crude fibre in seed remained unaffected due to irrigation, nitrogen as well as phosphorus levels except protein content. Protein content was maximum under application of 120 kg N/ha and was at par with 90 kg N/ha but these were significantly superior to 60 kg N/ha. The maximum net ICBR was accured by scheduling irrigation at 0.8 IW : CPE ratio and fertilizing with 90 kg N/ha. However, the highest net realization was recorded when crop was irrigated at 1.0 IW : CPE ratio with 120 kg N/ha.

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INTRODUCTION

Fennel (*Foeniculum vulgare* Mill.) is one of the important condiment of Gujarat and Rajasthan. Green colored seed with uniform size are preferred by consumer and in market due to its better quality which is used in pharmaceutical, food, soap and cosmetic industries. Among the various factors contributing towards the attainment of potential yield, quality and economics of fennel. Irrigation and mineral nutrition has considerable pratical importance. Therefore, an attempt was made to evaluate the effect of irrigation, nitrogen and phosphorus on yield, quality and economics of fennel.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 1994-95 and 1995-96 at Agronomy Instructional Farm, Sardar Krushinagar (Gujarat). The soil of the experimental field was loamy sand in texture with slightly alkaline in reaction (7.6 pH), low in available nitrogen (181 kg/ha) and organic carbon (0.20%), medium in available phosphorus (44 kg/ha) and high in available potash (290 kg/ha). 27 treatments combinations of three levels each of irrigation (0.6, 0.8 and 1.0 IW : CPE ratios) as main plots and nitrogen (60, 90 and 120 kg/ha) and phosphorus (30, 45 and 60 kg/ha) as sub plots

were replicated four times in split plot design. Cultivar GF-1 was sown on 4th week of October at 45 cm row spacing and harvested at end of March during the period of investigation. All the cultural practices were applied as per crop requirement and recommendation. Seeds obtained from each plot were biochemically analyzed for the quality attributes as per standard methods.

RESULTS AND DISCUSSION

Seed and Stover yields

Seed and stover yields increased with increased in IW : CPE ratios from 0.6 to 1.0 but significant increase was observed up to 0.8 ratio during both the year and in pooled data also (Table 1). Scheduling of irrigation at 1.0 IW : CPE ratio recorded the highest seed and

TABLE 1

Seed and stover yields (kg/ha) as influenced by irrigation, nitrogen and phosphorus levels.

Treatments	*Seed yield*			*Stover yield*		
	1994-95	*1995-96*	*Pooled*	*1994-95*	*1995-96*	*Pooled*
Irrigation (IW : CPE ratio)						
0.6	1286	1166	1226	2120	2044	2082
0.8	1600	1401	1501	2363	2202	2283
1.0	1659	1428	1544	2435	2254	2344
CD at 5%	188	132	102	77	126	66
CV %	21.55	17.17	19.80	5.81	10.05	8.09
Nitrogen levels (kg/ha)						
60	1384	1183	1284	2163	2003	2083
90	1541	1397	1469	2347	2218	2283
120	1619	1415	1517	2408	2279	2343
CD at 5%	87	84	59	101	133	82
Phosphorus levels (kg/ ha)						
30	1493	1324	1409	2279	2164	2221
45	1533	1326	1429	2312	2165	2239
60	1519	1245	1432	2327	2171	2249
CD at 5%	NS	NS	NS	NS	NS	NS
CV %	12.19	13.44	12.78	9.32	13.06	11.23

stover yields, whereas 0.6 ratio recorded the lowest yields. The average increase in seed yield due to 0.8 and 1.0 IW : CPE ratios was 22 and 26 per cent over 0.6 ratio respectively. Optimum moisture supply has promoting effects on physiological processes and consiquently on plant growth which resulted in higher yield. Similar findings were also recorded by Patel *et al.* (1988) and Sharma and Prasad (1990). The highest seed and stover yields were recorded with application of 120 kg N/ha and was at par with 90 kg N/ha but both were significantly higher than 60 kg N/ha during period of investigation and in pooled results. Overall improvement in vegetative growth at higher levels of nitrogen which has favourable influence on flowering and ultimately resulted in increase of seeds per plot. Significant response with higher nitrogen levels were also reported by Bhati (1990) and Ammen Ahmed *et al.* (1998).

Quality attributes

Quality parameters like oil, sugar, protein and crude fiber content of seed were not influenced significantly due to irrigation treatments (Table 2). Though

TABLE 2

Quality attributes and economics as influenced by irrigation nitrogen and phosphorus levels (mean data of two years).

Treatments	*Oil content (%)*	*Oil yield (kg/ha)*	*Protein content (%)*	*Crude fiber content (%)*	*Sugar content (mg/g)*	*Gross realization (Rs/ha)*	*Net realization (Rs/ha)*	*CBR*	*Net ICBR*
Irrigation (IW : CPE ratios)									
0.6	1.40	17.12	14.86	25.24	19.80	24728	12149	0.97	—
0.8	1.40	21.08	14.62	25.27	19.64	30248	17451	1.36	1:24.32
1.0	1.40	21.66	14.50	25.33	19.71	31114	17881	1.35	1:08.76
CD at 5%	NS	1.48	NS	NS	NS				
CV %	1.31	20.35	8.74	3.73	6.11				
Nitrogen levels (kg/ha)									
60	1.40	17.96	14.37	25.29	19.70	25888	13273	1.05	—
90	1.40	20.60	14.74	25.31	19.64	29608	16738	1.30	1:13.59
120	1.41	21.30	14.87	25.24	19.80	30574	17449	1.33	1:08.19
CD at 5%	NS	0.85	0.38	NS	NS				
Phosphorus levels (kg/ha)									
30	1.40	19.75	14.66	25.23	19.75	28402	15754	1.25	—
45	1.40	20.04	14.65	25.31	19.75	28804	15933	1.24	1:00.80
60	1.40	20.06	14.67	25.30	19.63	28865	15771	1.20	1:00.04
CD at 5%	NS	NS	NS	NS	NS				
CV %	1.81	13.05	7.92	4.93	5.68				

protein and sugar content decreased with increase in IW : CPE ratios from 0.6 to 1.0. Oil yield increased with increase in irrigation levels but significant increase was found up to 0.8 IW : CPE ratio. The oil yield was higher to the tune of 26 and 23 per cent with 1.0 and 0.8 IW:CPE ratios, respectively, as compared to 0.6 ratio. Increase in oil yield due to higher irrigation levels were also reported by Buntain and Chung (1994). There was no significant change in quality parameters viz; oil, sugar and crude fiber content in seed due to nitrogen levels but these attributes showed an increasing trend with increase in nitrogen levels (Table 2). These results were also confirmed by Bhati *et al.* (1988). Application of 90 and 120 kg N/ha were equally effective but recorded significantly higher protein content and oil yield than 60 kg N/ha. Ammen Ahmed *et al.* (1988) also observe significance response of nitrogen to protein content and oil yield. Phosphorus fertilization did not exhibit any significant effect in respect of quality parameters viz; oil, protein, sugar and crude fiber content of seed as well as oil yield.

Economics

Gross and net return increased with each successive increase in irrigation and nitrogen levels (Table 2). The highest growth and net return were recorded under IW : CPE ratio of 1.0 (11 irrigations) which is closely followed by 0.8 ratio (9 irrigations). On the contrary, maximum BCR and net ICBR were registered at 0.8 IW : CPE ratio followed by 1.0 ratio. The maximum growth and net return as well as BCR were realized by application of 120 kg N/ha. Unlike this the highest net ICBR of 1:13.59 was obtained with 90 kg N/ha followed by 120 kg N/ha. These findings are in agreement with the reports of Bhati *et al.* (1989).

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Influence of Conjunctive Use of Surface and Sub-Surface Water on Chemical Properties of Soil

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ABSTRACT

Field investigation to study the influence of conjunctive use of canal and ground water on chemical properties of soil during winter of 1995-'96 and 1996-'97 in Ghataprabha Command Area of Northern Karnataka indicated that application of only ground water as irrigation led to increase in pH, EC, Sodium Absorption Ratio (SAR), Exchangeable Sodium Percentage (ESP) compared to only canal water irrigation which recorded the lowest values of all these parameters. However, conjunctive use pattern having at least four canal water irrigations under direct mode of the total six irrigations and alternation of canal and ground water either in 1:1 or 2:1 ratios was found safer when compared to the best of the treatments i.e. only canal water irrigation.

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INTRODUCTION

Despite the fact that water is the scarcest input in agriculture we find indiscriminate use of irrigation in India resulting in water logging, salinity and alkalinity. Data provided by the Ministry of Water Resources indicates that the problem of water logging has developed in 2.46 m ha salinity in 3.06 m ha and alkalinity in 2.4 lakh ha making a total of 5.76 m ha (Rana, 1997).

Although the above said harmful processes are, in general, common to any irrigated land, the situation is particularly worse in command areas, wherein, lack of proper attention to the irrigation and conveyance systems has resulted in substantial loss of precious water (Appa Rao, 1990). However, it goes without saying that in many irrigation project areas of India, water availability is rather limited particularly during later parts of winter and summer as a result of which the farmers of command areas are forced to supplement the surface water (canal) needs of their crops through the usage of under ground water limiting to its quality. Added to this problem, the sit-

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uation of farmers at the tail end is the worst and are left with no choice but to put into use the under ground water sources they have at their disposal. Usually the quality of ground water in command area is of poor quality, use of only this kind of water for irrigation during the periods of canal water shortages might lead to deterioration of physical and chemical properties of soil and reduces crop yields.

Keeping aforesaid problems in mind a field investigation was carried out within the Ghataprabha Left Bank Canal (GLBC) Command Area to study the effect of various modes of conjunctive use of canal and ground water on the chemical properties of soil.

METERIALS AND METHODS

An experiment was conducted to study the effect of conjunctive use of underground water and surface water on chemical properties of soil during rabi seasons of 1995-'96 and 1996-'97 in Ghataprabha Command Area of Raibag taluk at Alakanur village located in arid tract of North Karnataka situated on a latitude of 16° 24' N and a longitude of 71° 34' E and at an altitude of 641 m above the mean sea level.

The soil of the experimental site was sandy clay loam in nature. Composite soil samples from 0-30 cm depth were collected from the experimental area before initiation of experiment and analysed for various physico-chemical properties and are presented in table-1.

TABLE 1

Initial soil physico-chemical properties of the experimental site.

Sl. No.	*Properties*	*Value*	*Sl. No.*	*Properties*	*Value*
	Physical properties				
1.	Sand	15.60			
2.	Silt	31.60			
3.	Clay	52.80			
4.	Bulk density (mg/m3)	1.21			
5.	Infiltration rate (cm/hr)	1.36			
6.	Water soluble aggregates (> 0.25 mm)	47.12			
	Chemical properties				
1.	pH	8.38	1.	Ca (m eq/1)	2.92
2.	EC (dS/m)	2.33	2.	Mg (m eq/1)	1.43
3.	Organic Carbon (%)	0.50	3.	Na (m eq/1)	16.62
4.	Available N (kg/ha)	255.40	4.	K (m eq/l)	0.14
5.	Available P(kg/ha)	18.80	5.	Cl (m eq/l)	9.48
6.	Available K (kg/ha)	464.60	6.	HCO_3 (m eq/l)	6.00
7.	CEC (c mol/kg)	48.40	7.	SO_4 (m eq/l)	4.10
			8.	SAR (m eq/l)	11.32

Similarly the composition of ground and canal water is given in table - 2. The experiment included following twelve treatments :

T1 = 1CW : 5GW T7 = Only GW
T2 = 2CW : 4GW T8 = 1CW : 1GW
T3 = 3CW : 3GW T9 = 1GW : 1CW
T4 = 4CW : 2GW T10= 2CW : 1GW
T5 = 5CW : 1GW T11 = 1CW : 2GW
T6 = Only CW T12 = 2GW : 1CW

Note : CW = Canal Water and
GW = Ground Water

For treatments T1 to T5 irrigation was applied in direct mode i.e., as per the treatment first only canal water and then ground water while, for T8 to T12 in cyclic mode i.e., canal and ground water in cycles as per the treatment details. The experiment was laid out in randomised block design with three replications. Treatments and replications were separated by buffer area of 1m and 2m, respectively.

Wheat crop (var. DWR - 162) was sown with application of recommended fertilizer dose of 100 : 75 : 50 kg $N:P_2O_5:K_2O$ per ha. Fifty per cent nitrogen along with full dose of P and K were applied at the time of sowing and rest 50 per cent of nitrogen was top dressed at 30 days after sowing. Irrigation water was measured with the help of Parshall-flume with a throat size of 7.5 cm. All the treatments received totally six irrigations each of 6 cm depth in different critical stages of crop growth. Chemical properties namely pH, electrical conductivity (EC) and organic carbon were recorded in both the seasons after the harvest of wheat crop at physiological maturity stage.

RESULTS AND DISCUSSION

Soil pH

Application of only canal water (T6) recorded significantly lower pH (8.42) than the plots supplied with only ground water (8.80). Similarly the treatments T1 (1CW : 5GW), T2 (2CW : 4GW) and T3 (1GW' : 1CW) under direct mode and T9 (1GW:1CW), T11 (1CW:2GW) and T12 (2GW:1CW) under cyclic mode of irrigation recorded significantly higher pH

TABLE 2

Chemical composition of ground and canal water.

Sl. No.	*Parameter*	*Ground water*	*Canal water*
1.	pH	8.10	7.60
2.	EC (dS/m)	3.60	0.20
3.	Na^+ (m eq/l)	34.64	0.60
4.	K^+ (m eq/l)	0.06	0.02
5.	Ca^+ (m eq/l)	2.10	0.70
6.	Mg^+ (m eq/l)	2.20	0.40
7.	CO^{3-} (m eq/l)	–	–
8.	HCO^{3--} (m eql)	6.00	0.95
9.	Cl^- (m eq/l)	24.65	0.50
10.	SO_4– (m eq/l)	6.24	0.38
11.	SAR (m eq/1)	19.52	0.76
12.	RSC (m eq/l)	1.70	0.25

values than the best treatments (T6). This might be due to higher sodium adsorption ratio (SAR) values associated with these treatments (Table 4). Similar results were observed by Bajwa *et al.* (1986), Bajwa and Josan (1989), Khandelwal and Lal (1991) and Minhas and Gupta (1993). Bajwa and Josan (1989) reported increase in soil pH with an increase in alkalinity of irrigation water while with cyclic use of these waters a reverse trend was noticed. Accordingly, in the present study the lowest pH, on par with the best treatment (T6) was recorded with T10 treatment applied with canal and ground water in 2 : 1 ratio in alternation.

TABLE 3

Effect of conjunctive use of irrigation on pH, EC and organic carbon content of soil.

Treatment	*pH*			*EC (dS/m)*			*Organic carbon (%)*		
	'95-'96	*'96-'97*	*Mean*	*'95-'96*	*'96-'97*	*Mean*	*'95-'96*	*'96-'97*	*Mean*
T1	8.70	8.77	8.74	4.71	7.21	5.96	0.50	0.49	0.50
T2	8.63	8.70	8.67	4.62	6.97	5.80	0.50	0.49	0.50
T3	8.57	8.67	8.62	4.37	5.85	5.11	0.51	0.49	0.50
T4	8.57	8.53	8.55	3.17	3.45	3.31	0.51	0.50	0.51
T5	8.50	8.43	8.47	2.49	2.80	2.65	0.52	0.51	0.52
T6	8.40	8.43	8.42	2.39	2.53	2.46	0.52	0.52	0.52
T7	8.77	8.83	8.80	5.10	7.27	6.19	0.49	0.48	0.49
T8	8.47	8.50	8.49	3.18	3.45	3.32	0.52	0.51	0.52
T9	8.57	8.63	8.60	3.22	3.52	3.37	0.52	0.50	0.51
T10	8.47	8.47	8.47	2.86	3.12	2.99	0.51	0.52	0.52
T11	8.57	8.63	8.60	4.65	6.93	5.79	0.51	0.49	0.50
T12	8.67	8.73	8.70	4.71	6.97	5.84	0.50	0.50	0.50
S.Em. +/-	0.03	0.04	0.04	0.27	0.32	0.29	0.02	0.02	0.02
CD at 5%	0.10	0.13	0.12	0.78	0.78	0.88	N.S.	N.S.	N.S.

Note : CW = Canal Water and GW = Ground Water

T1 =1CW : 5GW	T5 = 5CW : 1GW	T9 = 1GW : 1CW
T2 = 2CW : 4GW	T6 = Only CW	T10 = 2CW : 1GW
T3 = 3CW : 3GW	T7 = Only GW	T11 = 1CW : 2GW
T4 = 4CW : 2GW	T8 = 1CW : 1GW	T12 = 2GW : 1CW

TABLE 4

Effect of conjunctive use of irrigation on Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP) of soil.

Treatment	*SAR*			*ESP*		
	95-96	*96-97*	*Mean*	*95-96*	*96-97*	*Mean*
T1	17.04	19.21	18.13	19.27	21.31	20.29
T2	16.09	18.82	17.91	19.22	20.95	20.09
T3	16.48	17.13	16.81	18.72	19.36	19.04
T4	14.53	14.91	14.72	16.78	17.17	16.98
T5	12.51	12.52	12.52	14.65	14.68	14.67
T6	11.82	10.59	11.21	13.92	12.55	13.24
T7	17.60	19.19	18.40	19.80	21.29	20.55
T8	14.91	14.84	14.88	17.17	17.10	17.14
T9	14.98	14.98	14.98	17.27	17.24	17.24
T10	12.32	12.22	12.27	14.46	14.35	14.41
T11	16.73	18.50	17.62	18.97	20.65	19.81
T12	16.89	18.76	17.83	19.12	20.89	20.01
S.Em. +/-	0.43	0.65	0.53	0.42	0.72	0.56
CD at 5%	1.28	1.95	1.95	1.26	2.12	1.65

Note : CW = Canal Water and GW = Ground Water

T1 = 1CW : 5GW	T5 = 5CW : 1GW	T9 = 1GW : 1CW
T2 = 2CW : 4GW	T6 = Only CW	T10 = 2CW : 1GW
T3 = 3CW : 3GW	T7 = Only GW	T11 = 1CW : 2GW
T4 = 4CW : 2GW	T8 = 1CW : 1GW	T12 = 2GW : 1CW

Electrical Conductivity (E.C.)

Irrigating with only ground water recorded significantly higher EC values (6.19 dS/m) than with only canal water (2.46 dS/m). Similarly, the EC values recorded in T1 (1CW : 5GW), T3 (3CW : 3GW) under direct mode and T9 (1GW : 1CW), T11 (1CW : 2GW) and T12 (2GW : 1CW) in cyclic mode recorded significantly higher EC compared to the best treatment (T6). This could have been the result of higher salt content of ground water (Table 2). A direct relation between EC of ground water and of the soil has also been recorded earlier by

TABLE 2

CU & WUE as influenced by various treatments.

Treatments	Consumptive use		Water use efficiency kg seed cotton/ha.mm	
	1992-93	*1993-94*	*1992-93*	*1993-94*
Irrigation methods				
I_1 : Irrigation in all furrow	317	247	8.07	12.27
I_2 : Irrigation in alternate furrow alternatively	293	233	8.69	12.81
Irrigation scheduling				
R_1 : 0.3 IW/CPE ratio	208	139	10.53	17.91
R_2 : 0.5 IW/CPE ratio	331	263	7.32	10.50
R_3 : 0.7 IW/CPE ratio	376	317	7.31	9.21
Mulching				
M_0 : No mulch	323	255	7.13	10.62
M_1 : Soil mulch	309	245	8.26	12.36
M_2 : Paddy straw mulch @ 5 t/ha	284	220	9.76	14.64

TABLE 3

Number of irrigation, interval between successive irrigation turns and average interval between two irrigation as per IW/CPE ratio.

	Number of irrigation	*Interval between*					*Average interval*
		Commomn-1	*1-2*	*2-3*	*3-4*	*4-5*	
				1992-93			
R_1 (0.3)	3	41	56	-	-	-	49
R_2(0.5)	5	23	30	34	28	-	29
R_3(0.7)	6	16	18	24	24	22	21
				1993-94			
R_1(0.3)	2	69	-	-	-	-	69
R_2(0.5)	4	36	44	26	-	-	36
R_3(0.7)	5	23	30	30	20	-	26

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Performance of Castor *(Ricinus communis)* Genotypes Under Various Sowing Times and Row Spacings in Summer Season

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ABSTRACT

A field experiment was conducted during the summer season of 1995 and 1996 at Junagadh to find out optimum time of sowing and row spacing for castor *(Ricinus communis* L.) genotypes. Sowing on 15 January favoured most of the yield attributes (capsules/main spike, seed weight/ main spike, spikes/ plant, capsules/ plant, test weight and seed weight/ plant) and resultantly seed yield. The level of spacing did not affect growth and yield attributes, however, there was a significant increase in branches/ plant, spikes / plant, capsules / plant, seed weight/ plant and seed yield with wider row spacing (90 cm). The variety GCH 4 recorded the highest seed yield with improved growth and yield attributes.

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INTRODUCTION

Castor (*Ricinus communis* L.) is generally grown in rainy (kharif) season. There is also a greater scope of growing castor in summer season (Saran and Giri, 1987). The crop matures within 100 to 135 days in summer as compared to 210 to 240 days in *kharif* season, therefore, it is possible to take other crop in kharif season. Moreover, summer crop is less infested by insect-pests as compared to kharif crop, hence total monetary returns could substantially increased. Looking to the predominancy of kharif groundnut in the south Saurashtra region of Gujarat, the present experiment was undertaken to evaluate the performance of castor genotypes under various sowing times and row spacings in summer season.

MATERIALS AND METHODS

The field experiment was conducted during the summer season of 1995 and 1996 at the Instructional Farm, Department of Agronomy, Gujarat Agricultural University, Junagadh on clayey soil (vertisol). It had pH 7.9, E.C. 0.3 dS/m, organic carbon 0.66-0.75 %, available nitrogen 251.5-260.7 kg/ ha, phosphorus 20.9-27.5 kg/ha and potassium 216.4-237.7 kg/ha. The experiment was laid out in split plot design with 4 replications, having 3 times of sowing (15 January, 30 January and 15 February) in main plots and 2 row spacings (60 and 90 cm) and 3 genotypes (GAUC 1, GC 2 and GCH 4) in sub-plots. The crop was sown at 60 cm x 60 cm and 90 cm x 60 cm with seed rate of 15 and 10 kg/ha, respectively and fertilized with 75 kg N + 50 kg P_2O_5/ha. A whole dose of P and half dose of N in the form of diammonium phosphate and urea were applied at the time of sowing and remaining half dose of N as urea was top-gressed in two equal splits at 45 and 65 days of sowing.

and 1999-2000. The soil analysis indicated that the soils of experimental plots are loamy in texture having slightly alkaline in reaction (7.87 pH), low in N (185 kg/ha) and P (55 kg/ha) and high in K (265 kg/ha). Twenty-eight treatment combinations comprising of seven weed control methods and four levels of nitrogen fertilizer were tried in factorial randomized block design with three replications. The treatment details are given in Tables. Frenchbean variety DPR 86-6-4 was sown on November 17 in 1998 and November 23 in 1999 and was harvested on March 7, 1999 and March 13, 2000, respectively. Seeds were sown @ 120 kg/ha, adopting 30 cm x 15 cm spacing. Half the doses of nitrogen as per treatments along with full dose of P_2O_5 (60 kg/ha) were applied at the time of sowing. The remaining dose of nitrogen was applied as a top dress at 30 DAS. Plant sampling for fresh weight and leaf area were done at 30th, 60th DAS and at harvest of the crop. Growth parameters were computed at regular intervals. Five common irrigations were applied to the crop during both the years. Pre-emergence herbicides were sprayed with the help of manually operated knap-sack sprayer fitted with flat fan nozzle using 600 liters of water per hacter one day after sowing. The other agronomic practices were followed as per the package of practices of the University.

RESULTS AND DISCUSSION

Effect of weed control methods

Weed free treatment recorded effect of weed control methods higher fresh and dry matter production at all the

TABLE 1

Fresh wt., dry matter and LAI of frenchbean as affected by weed control methods and nitrogen levels (pooled data).

Treatments	Fresh wt. (g/plant)			Dry matter (g/plant)			LAI		
	30 DAS	60 DAS	at harvest	30 DAS	60 DAS	at harvest	30 DAS	60 DAS	at harvest
Weed management (W)									
W_1 - Weedy check	4.28	10.92	31.57	0.52	1.57	6.57	0.67	5.12	4.17
W_2 - Weed free	7.76	19.69	50.14	0.86	3.35	11.99	1.05	6.65	6.40
W_3 - Two HW at 30 and 45 DAS	3.88	17.09	44.04	0.45	3.06	9.33	0.80	6.34	5.85
W_4 - Pendimethalin @ 0.75 kg a.i./ha	6.72	16.33	43.2	0.77	2.78	8.82	0.94	6.04	5.32
W_5 - Fluchloralin @ 0.50 kg a.i./ha	5.76	15.79	38.53	0.60	2.66	8.12	0.79	5.77	4.97
W_6 - W_4 + HW at 45 DAS	6.31	17.87	44.82	0.71	3.17	9.53	0.94	6.46	6.09
W_7 - W_5+HW at 45 DAS	5.90	16.96	43.51	0.62	2.91	8.99	0.86	6.09	5.60
C.D. at 5%	1.55	1.09	3.10	0.09	0.20	1.09	0.11	0.31	0.53
Nitrogen levels (N)									
N_1 - 0 kg/ha	5.02	14.06	39.28	0.50	2.25	7.77	0.66	5.37	4.72
N_2 - 40 kg/ha	5.55	15.47	40.27	0.58	2.55	8.30	0.78	5.72	5.13
N_3 - 80 kg/ha	5.92	16.20	40.53	0.68	2.83	8.99	0.86	6.13	5.45
N_4 - 120 kg/ha	6.42	16.62	41.52	0.78	3.22	9.61	1.04	6.54	5.92
C. D. at 5%	0.12	0.25	0.36	0.06	0.12	0.25	0.07	0.20	0.44
Interaction effect of W x N	NS	NS	NS	NS	NS	NS	NS	NS	NS

HW : Hand weeding, DAS : Days after sowing, NS : Not significant.

stages (30, 60 and at harvest) of growth followed by application of pendimethalin @ 0.75 kg a.i./ ha + HW at 45 DAS and at two HW in 30 and 45 DAS. Ramachandra *et al.* (1998) also reported similar results. The LAI under different weed control methods increased consistently up to 60 DAS and thereafter, it was decreasing due to the senescence of the leaves (Table 1). Higher LAI was recorded with weed free condition. However, it was statistically at par with application of pendimethalin @ 0.75 kg a.i./ ha + HW at 45 DAS. Watson (1952) also stated that too high LAI would indicate a relatively higher plant population, which may have shading effect and therefore, a poor photosynthesis.

NAR was significantly higher under weed free condition at 30, 60 DAS and at harvest of crop. Positive response due to sufficient availability of water, light, nutrients and space resulting in fewer crops weed competition, which in turn, helped in nutrient absorption and increase in LAI, consequently influenced the dry matter production. These results are supported by the earlier studies of Wallace and Munger (1965).

CGR was slow in the early vegetative phase and reached a maximum at 45 DAS harvest. Higher CGR was recorded under weed free and it was at par with application of pendimethalin @ 0.75 kg a.i/ha + HW at 45 DAS. The increase in CGR might be due to increase in LAI. This favored light inter-ception and increased LAI, which was due to increase in leaf area and leaf number.

The data of RGR stated that higher RGR was recorded in early growth stage of crop (30-59 DAS) in all the weed control treatments and this rate decreased steadily with advance in age (60 DAS - harvest) of the crop owing to decrease in NAR and dry matter accumulation per plant. Pandey *et al.* (1979) reported decline in RGR as season advanced in black gram. Significantly higher RGR values were recorded with weed free might be attributed to more absorption of nutrients, better availability of moisture and light due to less crop-weed competition and in turn helped in expansion of leaf lamina and thereby dry matter production.

Effective weed control achieved under weed free condition improved the physiological parameters this improvement ultimately regulated in higher grain yield with weed free condition. Saxena and Verma (1994) also reported similar results.

Effect of Nitrogen Levels

The growth attributes and yield increased significantly as the nitrogen levels increased upto 120 kg/ha . Higher fresh and dry weight per plant was obtained with 120 kg N/ha at all the growth stages viz., 30, 60 DAS and at harvest. Ali and Khushwaha (1987) have reported favorable response of on frenchbean to nitrogen application.

Results with respect to LAI indicated that, LAI increased with increasing level of nitrogen consistenlty up to 60 DAS and thereafter, it was decreased due to senescence of leaves. Application of 120 kg N/ha recorded higher LAI. The LAI at 60 DAS with 120 kg N/ha was higher as compared to 0 kg N/ha to the tune of 17.89 per cent. Rana and Singh (1998) also observed higher LAI with increasing rate of niitrogen.

TABLE 2

NAR, CGR, RGR and grain yield of frenchbean as affected by weed control methods and nitrogen levels (pooled data).

Treatments	*NAR (mg/cm² LA/day)*		*CGR (g/m²/day)*		*RGR (mg/g.dm/day)*		*Grain yield*
	30-59 DAS	*60 DAS-harvest*	*30-59 DAS*	*60 DAS-harvest*	*30-59 DAS*	*60 DAS-harvest*	*kg/ha*
Weed management (W)							
W_1 - Weedy check	1.60	3.93	1.47	3.43	15.58	11.71	587.31
W_2 - Weed free	3.04	6.29	2.69	6.14	27.14	19.93	1403.7
W_3 - Two HW at 30 and 45 DAS	2.66	5.36	2.29	5.19	21.58	15.59	1150.56
W_4 - Pendimethalin @ 0.75 kg a.i./ha	2.32	5.17	2.22	4.70	22.14	15.13	1037.53
W_5 - Fluchloralin @ 0.50 kg a.i./ha	2.17	4.49	1.84	4.29	20.53	14.13	884.85
W_6 - W_4 + HW at 45 DAS	2.63	5.54	2.35	5.33	23.25	16.98	1211.24
W_7 - W_5+HW at 45 DAS	2.34	5.18	2.10	4.89	20.67	14.87	1061.15
C.D. at 5%	0.19	0.67	0.21	0.81	1.71	1.63	148.11
Nitrogen levels (N)							
N_1 - 0 kg/ha	1.84	4.37	1.64	4.27	19.28	13.12	895.98
N_2 - 40 kg/ha	2.13	4.80	1.86	4.41	20.35	14.4	962.11
N_3 - 80 kg/ha	2.41	5.16	2.09	4.69	21.09	15.22	1000.33
N_4 - 120 kg/ha	2.71	5.46	2.41	5.12	22.41	16.63	1091.77
C. D. at 5%	0.12	0.14	0.14	0.24	0.41	0.38	35.94
Interaction effect of W x N	NS	NS	NS	NS	NS	NS	NS

NAR, RGR and CGR were significantly increased with increase in each level of nitrogen. The increase in NAR, CGR and RGR recorded at 60 DAS harvest under 120 kg N/ha over 0 kg N/ha was to the tune of 21.11, 13.80 and 8.88 per cent, respectively. The data further revealed that RGR values were maximum up to 30-59 DAS and then onwards the values were decreased under all nitrogen levels. The result is supported by the earlier studies of Wallace and Munger (1965). Remarkable increase in frenchbean yield with each increase in nitrogen level indicated that the application of nitrogen @ 120 kg N/ha was beneficial for harvesting higher grain yield of frenchbean. Rana and Singh (1998) also reported similar positive results of higher dose of nitrogen in frenchbean.

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Phenotypic Stability of Sesame *(Sesamum indicum)* for Yield and Yield Attributes

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ABSTRACT

Fourteen promising genotypes of sesame and two checks Kanke white and Krishna were studied for stability parameters for plant height, number of branches / plant, number of capsules / plant days to maturity and seed yield. Significant differences were observed among genotypes and environments. TC 326, OMT 11-6-5 and RT 57 were the stable genotypes for most of the characters. No genotype showed average stability for all the traits. On the basis of environment index, monsoon 1989 (environment I) was the most favourable for expression of all characters.

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INTRODUCTION

Sesame *(Sesamum indicum)* varieties had large fluctuations in their performance when grown under varied agro-climatic conditions. Some genotypes perform well over a vast range of environments, while others require specific environmental conditions to express their full genetic potential. Although, studies have been made on the released cultivar (Kanke white, TC 25 and Krishna), the information is scanty on the stability of promising genotypes in advance generations. A group of high yielding promising lines were evaluated with this objective over three subsequent years (environments), to assess the amount and nature of genotype - environment interatction, evaluate and identify the potential genotypes having consistent performance and select genotypes existing good performance in a specific environment.

MATERIALS AND METHODS

The experimental materials comprised of 14 promising genotypes two standard checks Krishna and Kanke white of sesame were sown in randomised complete block design with 3 replications under rainfed condition in four

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subsequent monsoon season 1989 to 1992. Six rows of 4 m length of each treatment were sown with 30 x 10 cm spacing between rows and plants. The observations were recorded on five random selected competitive plants for plant height (cm), number of branches / plant, number of capsules / plant, days to maturity and seed yield (kg/ha). The analysis proposed by Eberhart and Russell (1966) and Perkins and Jinks (1968) were used to study the linear and non-linear parameters of phenotypic stability.

RESULTS AND DISCUSSION

Pooled analysis of variance (Table-1) for seed yield and its attributes revealed that mean differences among genotypes and environments were significant for all the attributes indicating that there was large variability among the genotypes and environments. The highly significant genotypes x environments (G x E)

TABLE 1

Pooled analysis of variance for different components of variation and environmental index for different characters in sesame.

Source of variation	*df*	*Mean sum of square of different characters*				
		Plant height	*Number of branches*	*Number of capsules*	*Days to maturity*	*Seed yield*
EBERHART AND RUSSELL (1966) MODEL						
Genotype (G)	15	107.208**	0.347**	26.232*	6.180**	8244.068**
Environment (E)	3	5046.853**	5.823**	908.919**	265.125**	251798.686**
G x E	45	161.056**	0.476**	48.969**	5.802**	3205.771**
E + (G x E)	48	162.123**	0.671**	49.699**	5.913**	3208.927**
Environment (lin.)	1	15440.559**	18.370**	2724.756**	795.375**	755396.058**
G x E (linear)	15	78.336**	0.210*	50.814**	5.740**	6447.245**
Pooled deviation	32	46.328**	0.149	16.918**	5.468**	1345.345**
PERKINS AND JINKS (1968) MODEL						
Genotype	15	107.208**	0.347**	26.232**	6.180**	8244.068**
Environment / joint regression	3	5046.831**	5.811**	908.892**	265.101**	251797.836**
G x E	45	160.066**	0.476**	48.796**	5.802**	3205.759**
Heterogeneity between regression	15	78.387**	0.220*	51.714**	5.475**	1346.835**
Remainder	30	46.839**	0.153	16.979**	5.489**	1345.889**
Pooled error	128	36.700	0.178	16.061	0.485	151.405
ENVIRONMENT INDEX						
Seasons and years						
Kharif (rainfed) 1989		26.271	0.700	11.397	3.969	178.381
Kharif (rainfed) 1990		-12.466	-0.801	-3.321	3.052	-34.312
Kharif (rainfed) 1991		3.427	0.125	-4.608	-3.531	-52.648
Kharif (rainfed) 1992		10.378	-0.025	-3.648	-3.490	-111.423

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

TABLE 2

Estimates of stability parameters of individual genotypes for yield and yield attributes in sesame.

Variety	Characters							
	Plant height				Number of branches / plant			
	Mean	b_i^{ER}	β_i^{PJ}	$S^2 d_i$	Mean	b_i^{ER}	β_i^{PJ}	$S^2 d_i$
1. Kanke white	107.48	0.92	-0.07	-34.76	2.09	0.39*	-0.61	-0.15
2. OMT 11-6-3	93.34	0.63*	-0.37	37.88	2.47	1.63*	0.63	-0.07
3. TC 25	94.12	1.07	0.07	39.11	2.28	0.80	-0.20	0.02
4. OMT 34	98.52	1.11	0.11	149.77	2.42	1.41*	0.41	-0.05
5. OMT 26	91.36	1.19	0.19	-2.73	2.69	0.99	-0.01	0.46
6. RT 57	89.93	1.06	0.06	-18.64	2.25	0.57*	-0.43	-0.16
7. RT 167	91.00	1.45*	0.45	-0.65	2.11	0.78	-0.22	-0.02
8. TC 326	95.83	0.97	0.03	-12.41	.2.33	0.53*	-0.47	-0.09
9. RT 55	90.31	0.49*	-0.51	-35.37	2.09	0.58*	-0.42	-0.09
10. OMT 10	97.59	1.48*	0.48	-18.43	2.65	1.41*	0.41	0.15
11. OMT 11-6-5	94.11	0.58*	-0.42	118.09	2.53	1.74*	0.74	-0.14
12. TC 407	91.08	1.11	0.11	-32.66	2.07	0.96	-0.04	0.03
13. OMT 11	90.36	0.76*	-024	5.83	2.40.	1.10	0.10	-0.04
14. TNAU 28	97.76	0.88	-0.12	-17.41	3.12	1.56*	0.56	-0.01
15. BT 9-4-1	102.37	1.26*	0.26	28.76	1.94	0.78	-0.22	-0.12
16. Krishna	102.06	1.02	0.02	5.19	2.38	0.76	-0.24	-0.17
Population Mean	95.45				2.37			
S. Em. ±	3.93	0.32			0.22	0.36		

Where ER stands for Eberhart and Russell and PJ is for Perkins and Jinks.

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

TABLE 2 (Contd.)

	Characters											
	Number of capsules / plant				Days to maturity				Seed yield			
	Mean	b_i^{ER}	β_i^{PJ}	S^2 d_i	Mean	b_i^{ER}	β_i^{PJ}	S^2 d_i	Mean	b_i^{ER}	β_i^{PJ}	S^2 d_i
1.	24.56	0.41*	-0.59	-10.50	76.92	1.25	0.25	-0.15	275.52	1.66*	0.66	3362.26**
2.	25.67	1.49*	0.49	8.69	75.35	0.94	-0.06	0.07	174.51	1.34*	0.34	2782.00**
3.	26.96	1.08	0.08	53.20	75.25	0.90	0.10	2.11	167.34	1.41*	0.41	212.35
4.	23.24	1.10	0.10	-12.62	75.83	0.84	-0.16	6.08	158.06	1.32*	0.32	432.65
5.	26.84	1.61*	0.61	-7.80	75.91	0.70	-0.30	2.19	163.46	1.34*	0.34	208.12
6.	25.78	0.89	-0.11	-13.10	75.17	0.71	-0.29	6.04	135.00	1.14	0.14	141.06
7.	25.39	1.31	0.31	7.46	77.00	1.18	0.18	-0.32	117.41	1.18*	0.18	1450.23**
8.	21.72	1.14	0.14	-11.91	75.50	1.02	0.02	1.25	168.05	0.96	-0.04	-14.06
9.	24.00	1.21	-0.21	-15.71	73.67	0.72	-0.28	3.54	115.57	1.01	0.01	990.82**
10.	28.88	1.76*	-0.24	-7.85	77.58	1.03	0.03	3.55	111.57	0.87	-0.13	472.14**
11.	27.99	1.04	0.04	-11.80	75.75	0.79	-0.21	-0.46	186.26	0.93	-0.07	98.87
12.	24.06	1.65*	0.65	3.62	75.00	0.82	-0.18	4.76	146.57	0.77*	-0.23	2458.03**
13.	24.94	0.63*	-0.37	12.53	76.49	0.65*	-0.35	0.19	101.86	0.66*	-0.34	272.35
14.	22.44	0.24*	-0.76	-9.46	78.58	1.79*	0.79	30.08	129.56	0.52*	-0.48	4569.50**
15.	18.50	0.59*	-0.41	-41.29	77.67	0.93	-0.07	0.22	106.28	0.45*	-0.55	437.28*
16.	27.42	-0.16*	-1.16	40.27	75.25	1.72*	0.72	20.59	74.34	0.36*	-0.64	410.39*
Population Mean	24.86				76.05				141.69			
S. Em. ±	2.38	0.31			1.35	0.33			21.18	0.17		

Where ER is stand for Eberhart and Russell and PJ is for Perkins and Jinks.

*, ** Signficant at 5 and 1% probability levels, respectively.

interaction showed variable response of genotypes to environments. Similar results have been reported earlier by Maheim Bohn Faith and Mohamoud (1983), Henery and Daulay (1987) and Kumar (1988) in sesame, Verma *et al.*, (1994) Kundu and Khurana (1988) in *toria.* The combined environment and variety x environment interaction was significant for all the attributes, indicating that the genotypes interacted considerably with environmental conditions that existed at the three environments (years). Significant linear component of variation observed for all the characters indicated that the differences among the regression coefficients pertaining to various genotypes on the environmental mean were real. However, non-significant pooled deviation and remainder mean square for number of branches / plant revealed that the major component of the difference in stability was linear regression and not the deviation from the linear function. Significant variances due to pooled deviation (non-linear) were recorded for all characters, except number of branches / plant, reflect considerable genetic diversity in the material. Such non-linear deviation may also be of practical value to construct and test the utility of multiple regression models to know more critically the complex mechanism of adaptations. The heterogeneity between regression was highly significant for all attributes and significant for number of branches / plant, indicating high predictability of the genotypes.

The values of environmental index (Table-1) indicated that environment I (monsoon 1989) was considered best for the expression of plant height, number of branches / plant, number of capsules / plant, days to maturity and seed yield as it had positive value of environmental indices for all these traits. The rainfall was wide spread and intermittent during the crop growth period of sesame in monsoon 1989 which favoured the crop growth of sesame. Seed yield is a polygenic trait and depends on many attributes, the most important being number of branches / plant and capsules / plant. Luthra and Singh (1974) proposed that stability of yield in a variety is determined to a great extent, by the relatives stabilties of different components. Grafius (1956) suggested that selection for stable genotypes could be augmented through selection of individual yield components.

None of the genotypes tested showed average stability for seed yield and all its component attributes (Table 2). However, TC 25 has stable performance for plant height, number of branches / plant, number of capsules / plant, and days to maturity, and OMT 11-6-5 for number of capsules / plant, days to maturity and seed yield. The stability for these attributes is important because they have substantial indirect contribution to yield, RT 57 and TC 326 for seed yield, Kanke white, OMT 26, OMT 34, TNAU 28 and Krishna for plant height, OMT 11 and Krishna for number of branches / plant, and OMT 34, RT 55, RT 57 and RT 167 for number of capsules / plant were stable genotypes with numerically better yield and significantly more plant height, number of branches / plant, and number of capsules / plant. The genotypes identified suitable for favourable environmental conditions were TC 25 and OMT 26 for seed yield, OMT 11-6-3, RT 57, OMT 10, OMT 11-6-5 and RT 9-4-1 for

plant height, Kanke white, OMT 11-6-3, OMT 34, RT 57, TC 326, RT 55, OMT 10, OMT 11-6-5 and TNAU 28 for number of branches / plant, OMT 11, TNAU 28 and Krishna for days to maturity and Kanke white, OMT 10, OMT 11, OMT 11-6-3, OMT 26, BT 9-4-1, TC 407, TNAU 28, and Krishna for more number of capsules / plant. The most stable genotypes having high mean, b_i close to one and $S^2 d_i$ nonsignificant and minimum value - were OMT 11-6-5 for seed yield, Krishna for plant height, TC 25 for number of branches / plant, OMT 11-6-3 for days to maturity and RT 167 for number of capsules / plant. Kanke white gave the highest seed yield, plant height, TNAU 28 for number of capsules / plant and RT 55 for the shortest days to maturity. The existence for large variation in regression coefficient for yield attributes indicated that genotypes had different degree of environmental responses.

In the present study both the models used in the analysis are associated with each other so that mean and squared deviation from regression (S^2d_i) are similar and regression coefficient of the Perkins and Jinks model is equivalent to b^E-1. The index B^E is the regression coefficient of the Eberhart and Russell model. Consequently, the ranking pattern of the genotypes under the Perkins and Jinks model will be similar to the pattern under the Eberhart and Russell model. The results of the present investigation show that both the models can be used equally applied for selecting stable genotypes under different environments.

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Genetic Analysis of Yield and Yield Components over Environments in Indian Bean (*Dolichos lablab* (L.))*

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ABSTRACT

The combining ability analysis of 06 hybrids based on four females and fiteen males over three locations for nine characters in Indian bean (*Dolichos lablab* (L.)) revealed the importance of both additive and non-additive genetic components. However higher magnitude of sca variance over gca variance indicated preponderance of non-additive genetic variance in the expression of all the traits. The parents NVS-62, NVS-31 and Kokan bhusan were found to be good general combineres for seed yield per plant as well as other yield attributes viz. branches per plant, pods per plant and pod length. High yielding hybrids Red paria X AKW-9305, 125-36 X NVS-121 and NVS-61 X NVS-102 showed significant high sca effects for seed yield per plant and one or more its components.

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INTRODUCTION

The selection of suitable parents is one of the most important step in a hybridization programme, because selection of the parents on the basis of phenotypic performance alone is not a sound procedure, since phenotypically superior lines may yield poor recombinants in the segregating generations. Therefore collecting information of the nature of gene effects and their expression in terms of combining ability is necessary. The scope of such studies was limited as they were mostly based on one location of testing. Hence, the present study was undertaken to analyse combining ability of parents and hybrids in Indian bean over three locations.

MATERIALS AND METHODS

In the present investigation, four females and fifteen males (Table 2) were crossed in a Line x Tester fashion by hand emasculation and hand pollination at Pulses Research Station, Gujarat Agricultural University, Navsari during *rabi*, 1994-95. They were grown in randomized block design with three replications in sigle row plots of 3m length at three locations viz. Navsari, Vyara and Achhalia of Gujarat Agricultural University during *rabi*, 95-96. Five competitive plants were selected at

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random at all the three locations from each row to record data on days to 50 per cent flowering, plant height, number of branches per plant, number of pods per plant, pod length, 100-seed weight, seed yield per plant, protein content and days to maturity. The combining ability analysis and estimation of variance components were done as per Line x Tester mating design developed by Kempthorne (1957). The mean values over replications over locations for different traits were used for estimation of pooled heterosis.

RESULTS AND DISCUSSION

Analysis of variance for combining ability over locations (Table-1) revealed that the mean squares due to females were significant for days to 50 % flowering, 100-seed weight, protein content and days to maturity, while mean squares due to males were significant for days to 50 % flowering only. In contrast to these, the mean squares due to females x males interactions were highly significant for all the traits studied, indicating the importance of non-additive gene effects. The mean squares due to locations were highly significant for all the traits suggesting sufficient diversity among locations. The mean squares due to females x locations for days to 50 % flowering, pod length and days to maturity and males x locations for protein content were significant indicating the general combining ability of parents were influenced by the locations for these traits. On the other hand, mean squares due to females x males x locations interactions were highly significant for all the characters which indicated that the specific combining ability of hybrids were inconsistant across locations.

The high ratios of sca:gca variances were recorded for all the traits studied which suggested that non-additive components played predominant role in the inheritance of all the characters. Singh *et al.*, (1979) in lablab bean and Thiyagragan *et al.*, (1990) in cowpea reported similar type of results.

The gca effects for parents (Table-2) revealed that among females, Red paria and NVS-62 were found to be good general combiners for seed yield per plant and number of pods per plant. In addition to this, Red paria possessed negative (desirable) gca effects for days to 50 % flowering as well as days to maturity, while NVS-62 had high gca effects for branches per plant. Among males, kokan bhusan and NVS-31 were found to be good general combiners for seed yield per plant, pod length, pods per plant and branches per plant. In addition to these, both the parents also exhibited significant desirable gca effects for days to maturity. Pawar (1983) in field bean and Patel (1995) in pigeon pea reported similar results.

Indian bean is not fully exploited and has received relatively less attention for all the aspects of genetic studies except some quaitative characters (Singh 1978). Very little varietal improvement work has been made in Indian bean in Gujarat. Selection 125-36 is the only variety being grown widely in South Gujarat. Hence in order to obtain information of the yield superiority of hybrids over this widely adopted variety, heterosis over 125-36 was also estimated as it was included as one of the female parents in

TABLE 1

Analysis of variance (mean squares) for combining ability variance for nine characters in Indian bean for pooled over locations.

Source	d.f.	Days to 50% flowering	Plant height (cm)	No. of branches/ plant	No. of pods /plant	Pod length (cm)	100 seed weight (g)	seed yield/plant (g)	Protein content (%)	Days to maturity
Locations	2	2.495**	6391.833**	39.476**	1053.674**	0.127**	51.152**	1262.239**	2.514**	176.872**
Females	3	134.424**	213.498	16.725	1175.753	12.042	335.292*	238.450	287.091**	277.677**
Males	14	102.977**	557.722	4.893	375.269	1.240	28.309	248.456	32.464	97.019
Females x Males	42	35.400**	811.109**	5.756**	337.939**	0.724**	34.741**	262.655**	36.656**	45.647**
Females x Locations	6	10.165*	231.443	2.918	129.486	1.102**	1.924	112.285	0.217	61.220**
Males x Locations	28	5.742	250.281	1.045	49.064	0.198	0.672	43.739	0.768**	10.588
Females x Males x Locations	84	4.213**	265.852**	1.995**	61.619**	0.254**	0.975**	59.363**	0.362**	7.545**
Pooled error	354	1.487	26.049	0.079	5.774	0.005	0.454	3.387	0.037	0.317
σ^2 gca		0.930	4.684	0.059	4.794	0.064	1.716	0.442	1.438	1.325
σ^2 sca		12.256	172.384	1.372	101.695	0.285	14.687	66.878	14.974	15.352
σ^2 sca / σ^2 gca		13.178	36.802	23.175	21.212	4.453	8.558	151.307	10.413	11.586

*, ** Significant at 5 and 1 per cent probability levels, repectively.

TABLE 2

Estimates of general combining ability (gca) effects of parents for nine charactres in indian bean for pooled over locations.

Parents	Days to 50% flowering	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	Pod length (cm)	100 seed weight (g)	Seed yield /plant(g)	Protein content (%)	Days to maturity
Females									
NVS-61	-0.61**	-1.58**	0.03	-3.91**	0.36**	2.27**	-0.63**	0.76**	-1.83**
NVS-62	1.23**	1.15**	0.48**	0.71**	0.09**	-0.15**	0.50**	-0.25**	1.62**
125-36	0.36**	0.89**	-0.33**	-0.01	-0.11**	-1.07**	-1.46**	1.42**	0.42**
Red Paria	-0.98**	-0.46	-0.17**	3.21**	-0.34**	-1.06**	1.59**	-1.93**	-0.21**
SEm ±	0.08	0.33	0.02	0.16	0.001	0.04	0.12	0.01	0.04
Males									
Kokan bhusan	-1.57**	4.82**	0.87**	6.73**	0.35**	-0.68**	4.65**	1.23**	-2.06**
AKW-9312	-1.07**	-5.32**	-0.13**	-0.67**	0.06**	0.04	-2.05**	-0.87**	-1.09**
AKW-9311	-0.13	3.59**	0.20**	-0.96**	0.20**	0.49**	-0.83**	-0.02	-0.62**
AKW-9306	2.18**	-1.83*	0.20**	-0.74*	0.11**	1.68**	0.44	-0.89**	1.74**
AKW-9305	4.10**	-0.98	0.29**	-0.66	0.18**	1.39**	1.36**	0.55**	3.60**
AKW-9304	-2.10**	1.30	-0.02	-0.63	0.04**	0.09	-0.32	0.79**	-2.01**
AKW-9303	-1.10**	-3.34**	-0.10**	-3.79**	-0.03**	0.34**	-2.33**	0.74**	-0-84**
AKW-9301	-1.57**	-9.53**	-0.49**	-1.29**	-0.15**	-1.06**	-3.20**	1.07**	-1.04**
NVS-141	0.04	1.93**	-0.23**	-3.41**	-0.20**	0.62**	-2.07**	1.35**	-0.12
NVS-121	-0.35*	3.66**	-0.03**	3.16**	0.01	-1.22**	1.69**	-1.09**	-0.51**
NVS-102	-1.04**	-0.38	-0.60**	-1.22**	-0.10**	-0.73**	-1.71**	-0.57**	-0.93**
NVS-102	2.10**	0.01	0.12**	4.60**	-0.20**	-1.28**	2.77**	0.59**	2.71**
NVS-50	-0.57**	-0.95	-0.32**	-4.64**	-0.30**	0.47**	-3.39**	-0.43**	0.10
NVS-42	0.93**	2.62**	-0.14**	-0.47	-0.17**	-0.12	0.19	-0.95**	1.24**
NVS-31	0.15	4.43**	0.40**	3.99**	0.19**	-0.04	4.80**	-1.48	-0.18*
SEm±	0.17	0.72	0.04	0.34	0.01	0.09	0.26	0.03	0.08

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

the experiment. The fifteen promising hybrids which exceeded significantly over their respective better parents and over 125-36 in respect of seed yield and heterosis are listed in Table-3. The magnitude of heterotic effects in these hybrids varied from 20.06 to 48.59 per cent over their respective better parents and from 18.39 to 39.10 per cent over 125-36. Interestingly, all the fifteen promising hybrids exhibited significant positive sca effects with a range from 1.18 to 10.08 and depicted significant positive heterosis over their respective better parents as well as over 125-36.

It is evident that hybrids having high heterotic estimates for seed yield involved either both or atleast one good

TABLE 3

Promising hybrids for seed yied per plant with heterosis over better parent (BP) and their specific combining ability (sca) effects based on combined analysis in Indian bean.

Sr. No.	Hybrids	Seed yield/ plant (g)	Heterosis over		sca effects
			125-36	BP	
1.	Red Paria x AKW-9304	49.08	39.10**	48.59**	10.08**
2.	Red Paria x NVS-31	48.88	38.51**	47.99**	4.77**
3.	NVS-61 x NVS-102	48.47	37.34**	27.27**	8.60**
4.	125-36 x NVS-121	47.50	34.60**	34.60**	9.54**
5.	Red Paria x NVS-102	46.65	32.19**	41.22**	4.56**
6.	NVS-62 x Kokan bhusan	46.30	31.19**	33.06**	3.43**
7.	NVS-61 x NVS-42	44.92	27.29**	17.97**	7.64**
8.	NVS-62 x AKW-9305	44.60	26.38**	28.17**	8.01**
9.	Red Paria x AKW-9305	44.26	25.41**	33.98**	3.58**
10.	Red Paria x AKW-9312	43.38	22.92**	31.33**	6.11**
11.	125-36 x Kokan bhusan	43.37	22.89**	22.90**	2.45**
12.	NVS-62 x NVS-106	43.24	22.53**	24.28**	6.73**
13.	NVS-61 x NVS-71	43.07	22.05**	13.11**	1.18**
14.	NVS-61 x AKW-9306	42.55	20.57**	11.73**	5.01**
15.	NVS-62 x AKW-9311	41.78	18.39**	20.06**	4.38**
16.	125-36	35.29	--	--	--
	SEm ±	0.73	0.73	7.68	0.45

*,** Significant at 5 and 1 per cent probability levels, repectively.

general combiner indicating an additive x dominance type of gene interaction. These crosses could be utilized to produce desirable transgressive segregants in subsequent generations. Crosses NVS-61 x NVS-42 and NVS-61 x AKW-9306 involved both parents with low gca effects indicating a dominance x dominance type of gene effect while three crosses viz. Red paria x NVS-31, Red paria x NVS-102 and Red paria x AKW-9305 which showed high estimates of heterosis and high significant sca effects involved both high general combiners which suggested role of additive x additive gene action and they

could be exploited by conventional breeding methods.

A substantial degree of heterosis and non-additive effects for seed yield and related traits reflected that development of hybrids would be more benificial. However, in absence of genetic male sterility system in case of Indian bean, it becomes cumbersome to produce hybrid seed commercially. Hence in order to accumulate additive gene effects and breaking of undesirable inkages, Bi-parental cross technique suggested by Joshi and Dhawan (1966) may prove to be helpful. Diallel selective mating system suggested by Jonson (1970), could also be used as a recurrent selection for bringing together series of gene pools from which a desirable selection could be made.

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Impact of Mowing Sunnhemp on the Survival of Two Arthropod Predators, *Geocoris ochropterus* Fieber and *Paederus fuscipes* Curtis

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ABSTRACT

A field experiment was conducted during 1999 at Gujarat Agricultural University Farm, Anand to know the effect of mowing on the fate of two important arthropod predators *Geocoris ochropterus* Fieber and *Paederus fuscipes* Curtis in sunnhemp, *Crotalaria juncea* L. that harbours these predators in large numbers during summer months. The results revealed that sizeable population of *G. ochropterus* and *P. fuscipes* perish during mowing of sunnhemp done by the tractor-mounted disc harrow. In view of this, mowing by tractor mounted disc harrow should be avoided to conserve the natural enemy population.

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INTRODUCTION

Sunnhemp, *Crotalaria juncea* L. is commonly grown for green manuring purpose in Anand region. This crop was found harbouring as many as 18 species of natural enemies belonging to six orders and 14 families (Urmila Sharma and Yadav, 1997). Among them *Geocoris ochropterus* Fieber and *Paederus fuscipes* Curtis are important predators associated with many insect pests different in agro-ecosystems. During earlier days, farmers use to follow manual *insitu* incorporation of sunnhemp. With mechanization of Agriculture, tractor mounted disc harrows are in use. To know the impact of tractor mowing on the fate of these two predators *G. ochropterus* and *P. fuscipes* the present study was undertaken.

MATERIALS AND METHODS

Sixty days old sunnhemp crop (0.2 ha field) located at University Farm, Anand was selected for this purpose. Pre-mowing counts of *G. ochropterus* and *P. fuscipes* were recorded per sq. m area from five randomly selected spots. Immediately after mowing by tractor these spots were covered with mosquito net (6' × 6' × 6'). Parallely the crop was

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cut using sickle and again five spots were covered with mosquito net. Number of *G. ochropterus* nymphs and adults *P. fuscipes* adults were counted in both the cases after half-an-hour.

Nymphs and adults of *G. ochropterus* and adults of *P. fuscipes* were collected from the same field and confined in separate plastic jars and then soil collected from the same area was spread over them is such a manner that all the bugs and beetles were confined with the soil. Number successfully came out from the soil was recorded after 24 hrs.

RESULTS AND DISCUSSION

Effect of mowing on the survival of *G. ochropterus*

The results (Table 1) revealed that there is significant difference in the premowing and post mowing counts of *G. cochropterus* in the area where mowing of sunnhemp was carried out with tractor mounted disc harrow. Where as in manual cutting the counts of *G. ochropterus* were non-significant, indicating the less survival rate of the predator in tractor mowing. The probable reasons for this may be the deep placement of the predator in to the soil and more compaction of soil by tractor mowing which unable the predator to come out of the soil. Adults because of their ability to fly may escape to some extent, but the nymphal stages suffer more. Further, the laboratory experiment showed that as many as 30 per cent *G. ochropterus* nymphs and 36.6 per cent adults were able to come out of the soil. (Fig. 1).

TABLE 1

Effect of tractor mowing of *C. juncea* on the survival of *G. ochropterus* and *P. fuscipes*

	G. ochropteus				*P. fuscipes*			
	Tractor mowing		*Manual cutting*		*Tractor mowing*		*Manual cutting*	
Sr. No.	*Pre mowing count*	*Post mowing count*	*Pre mowing count*	*Post mowing count*	*Pre mowing count*	*Post mowing count*	*Pre mowing count*	*Post mowing count*
1.	12	6	15	9	23	13	26	19
2.	15	5	12	7	24	10	24	20
3.	13	4	8	6	21	12	26	19
4.	14	7	9	8	20	10	20	18
5.	12	3	10	9	22	11	19	18
Mean	13.2	5.0	10.8	7.8	22	11.2	23.0	18.8
't' value		6.35*		1.55		8.37*		1.94

* Significant at 5% probability level.

Effect of moving on the survival of *P. fuscipes*

The results presented in the Table 1 revealed that there is significant difference in the pre-mowing and post mowing counts of *P. fuscipes* in the area

where mowing of sunnhemp was carried out with tractor mounted disc harrow. Where as in manual cutting the counts of *P. fuscipes* were non-significant, indicating the less survival rate of the predator in tractor mowing. The probable reasons for this may be the deep placement of the predator in to the soil and more compaction of soil by tractor mowing which unable the predator to come out of the soil. This predator is a soil insect and its immature stages exists in the soil to a depth of 1-3 cm. Due to mowing these stages will get exposed to sun or they may be placed still deeper in the soil affecting their survival. Further, the laboratory experiment showed that as many as 45 per cent *P. fuscipes* adults were able to come out of the soil (Fig. 1).

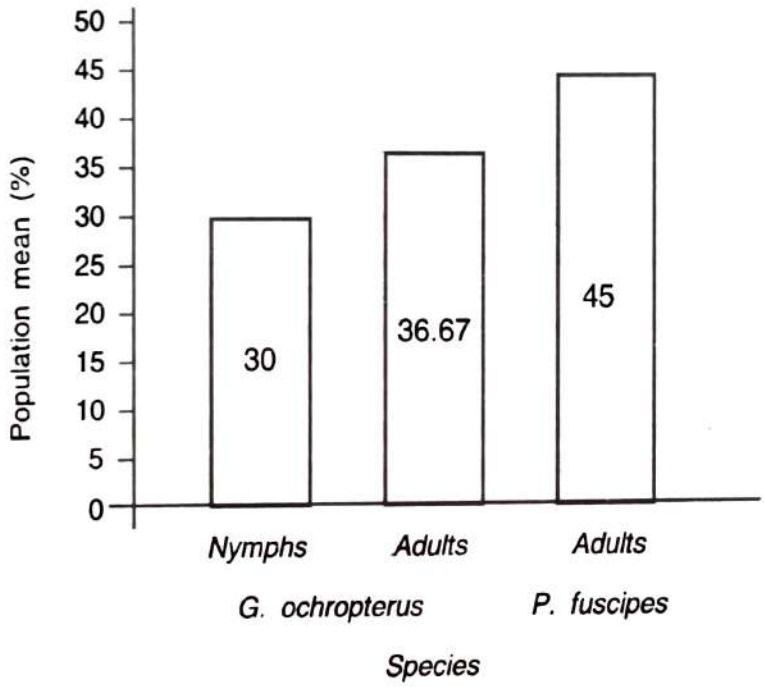

Fig. 1. Mean percentage of *G. ochropterus* and *P. fuscipes* came out successfully when confined in the soil in laboratory cages.

The results indicated that sizeable population of *G. ochropterus* and *P. fuscipes* peirsh during mowing operation done by the tractor-mounted disc harrow. Urmila Sharma and Yadav (1997) speculated large scale mortality of *G. ochropterus* in sunnhemp due to mowing. Harris and Phillips (1986) observed the reduction in population of *G. ochropterus* and other predators to the tune of 45 to 60 per cent as a result of mowing of weed hosts during off - season. In order to conserve such an important predatory fauna manual cutting of sunnhemp is better than tractor mounted disc harrow.

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Imidacloprid (Gaucho) a New Seed Dresser Against Early Sucking Pests of Cotton

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ABSTRACT

Imidacloprid (Gaucho) 70 WS [1-(6-Chloronicotiny1)-2 nitroimino-imidazolidine] is a new type of insecticide belonging to nitroguanidines group possessing potential activity against early sucking pests and has a novel mode of action (Sinzo Kagabu, 1996) as a seed dressing agent. To evaluate the efficacy of this insecticide an experiment was conducted alongwith spray insecticides Difenthuron 50 WP and standard check Methy1-o-demeton 25 EC against early sucking pests on G. Cot. Hy-10 cotton during 1997-98 and 1998-99 at MCRS, Gujarat Agricultural University, Surat. Observations on aphid and jassid populations were recorded from 30 days after germination. Results clearly showed that Imidacloprid (Gaucho) 70 WS at 10 g/kg of seeds treatment recorded aphids and jassids below ETL level i.e. up to 35 days in case of aphids and 50 days in case of jassids. The other two doses of imidachloprid 70 WS i.e. 5 g & 7.5 g/kg were at par with 10 g/kg treatments. It also enhanced the growth of cotton plants. It also suits in IPM strategy as it encourages natural enemy population on cotton.

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INTRODUCTION

Cotton is one of the most important cash crop of India widely grown in the country is being ravaged by several insect pests causing drastic reduction in yield. So far about 1326 insects and mites from all over the world (Hargreaves, 1948) and about 200 in India (Anonymous, 1981) have been recorded. In Gujarat, fifteen major pests have been reported to infest the crop. Out of which aphid (*Aphis gossypii* Glover), jassids (*Amrasca biguttula biguttula* Ishida), thrips (*Thrips tabaci*) and whitefly (*Bemisia tabaci*) are the most important sucking pests infesting the crop at early stage and cause heavy losses. Several workers have tested number of insecticides in different formulations. The pesticides usage on cotton in both extensive and intensive. This is evident from the fact that 48 per cent of the pesticide consumption is used by cotton alone (Balkrishna, 1992). An accountable share of pesticide is consumed towards the control of sucking pests viz., aphids, jassids, thrips and whitefly. There is an immediate need for an ecofriendly method for managing these pests. One such method is seed dressing of cotton seed with new molecule Imidacloprid 70 WS as a systemic insecticides to control crop pests have been visualised as an alternative over soil and foliar application

of insecticides because of several factors such as low cost, less pollution, earliness and simplicity in application, selectivity and least interference in natural fauna. The new molecule Imidacloprid (Gaucho) 70 WS belongs to nitroguanidine group, possessing potential activity against sucking pests and have novel mode of action. In the present study an experiment was conducted to evaluate dose response relation of Imidacloprid (Gaucho) 70 WS as a seed dressing chemical against sucking pests on cotton.

MATERIALS AND METHODS

The field experiment was conducted to evaluate Imidachloprid 70 WS (Gaucho - Bayer India Ltd.) as seed dressing at different doses @ 5.0, 7.5 and 10 g per kg seeds on G. Cot. Hy. 10 at Main Cotton Research Station, Gujarat Agricultural University, Surat under irrigated conditions during 1997-98 and 1998-99. Cotton seeds were properly treated with Imidacloprid 70 WS (Gaucho) with starch which was used as a sticker. It was compared with new foliar insecticide Difenthuron 50 WP (Polo) and standard recommended insecticide Methyl-o-demeton 25 EC and without seeds treatment i.e. untreated control. The number of aphids, jassids and thrips were counted on (upper, middle and lower) leaves from each of the randomly selected five plants at 10 days interval starting from 30 days after germination of crop. Based on ETL, spray were given as foliar insecticidal treatment and standard check. The mean population per 3 leaves per plant was estimated and subjected to statistical analysis.

RESULTS AND DISCUSSION

I. BIO-EFFICACY OF IMIDACLOPRID 70 WS (GAUCHO) AS A SEED DRESSER :

1. Aphids and Jassids :

(a) 1997-98 :

The data presented in Table-1 revealed significant treatment differences for aphids and jassids population during different periods of observation and pooled over period. The first observation was recorded on 30th days after germination of crop which showed negligible population of aphids and jassids in the plots treated with Imidacloprid 70 WS @ 5.0, 7.5 and 10 g/kg seeds. Plots treated with systemic insecticides spray with Methyl-o-demeton @ 300 g ai/ha kept as a standard check and untreated plot which also kept as a control crossed the ETL level. At 35 to 70 DAG of crop, the treatment Imidacloprid @ 10 g/kg seeds was found significantly superior over standard check and control in reducing aphids and jassids population. However, it was at par with seed dressing treatments of Imidacloprid 70 WS @ 5 g/kg seeds at 35 to 45 DAG and with 7.5 g/kg seeds at 35 to 55 DAG of crop in case of aphids, while it was at par with Imidachloprid @ 5.0 g & 7.5 g/kg at 35 to 70 DAG of crop in case of jassids. The results on pooled over period indicated that the treatment Imidacloprid @ 10 g/kg seeds was found significantly effective in reducing aphids and jassids in comparison to 5 g & 7.5 g/kg seeds treatments of Imidacloprid, though, it was at par with 7.5 g/kg seeds in case of aphids and with 5 g & 7.5 g/kg seeds treatments in case of jassids. Significantly

TABLE 1

Effect of Imdiacloprid 70 WS seed treatment on G. Cot. Hy-10 cotton against aphid and jassid population during 1997-'98.

Sr. No.	Treatments	Dos-age	Mean sucking pest population/3 leaves at indicated DAG																		Pooled over period	
			30		35		40		45		50		55		60		65		70 Dag			
			Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid
1.	Seed treatment with Imidacloprid 70 WS	5 g/kg	3.16 (10)	1.00 (1)	4.18 (17)	1.35 (2)	4.39 (19)	1.09 (19)	4.77 (23)	1.53 (2)	4.73 (22)	1.00 (1)	3.42 (12)	1.32 (2)	3.22 (10)	0.94 (1)	3.42 (12)	1.80 (3)	2.76 (8)	2.70 (7)	3.88 (15)	1.47 (2)
2.	Seed treatment with Imidacloprid 70 WS	7.5 g/kg	2.44 (6)	1.14 (1)	3.85 (15)	1.21 (1)	3.88 (15)	1.19 (1)	3.52 (12)	1.28 (2)	2.93 (9)	0.91 (1)	3.06 (9)	1.20 (1)	2.27 (5)	1.06 (1)	2.37 (6)	1.75 (3)	1.37 (2)	2.40 (6)	2.91 (8)	1.33 (2)
3.	Seed treatment with Imidacloprid 70 WS	10 g/kg	1.97 (4)	1.00 (1)	3.21 (10)	1.03 (1)	3.65 (13)	0.82 (1)	2.75 (8)	1.20 (1)	1.10 (1)	0.82 (1)	1.26 (2)	1.08 (1)	1.42 (2)	0.85 (1)	1.39 (2)	1.35 (2)	0.45 (0)	1.95 (4)	1.90 (4)	1.15 (1)
4.	Polo 50 WP	300 g ai/ha	6.00 (36)	3.14 (10)	5.35 (29)	1.65 (3)	3.21 (10)	1.06 (1)	4.78 (23)	1.54 (2)	1.09 (1)	1.11 (1)	3.39 (6)	1.23 (2)	0.51 (0)	0.81 (1)	0.45 (0)	0.74 (1)	0.45 (0)	0.62 (1)	2.25 (5)	1.10 (1)
5.	Polo 50 WP	600 g ai/ha	6.24 (39)	2.79 (8)	5.54 (31)	1.13 (1)	3.17 (10)	1.09 (1)	4.39 (19)	1.38 (2)	1.05 (1)	0.82 (1)	1.61 (3)	0.78 (1)	0.45 (0)	0.45 (1)	0.45 (0)	0.62 (1)	0.45 (0)	0.45 (1)	2.11 (4)	0.98 (1)
6.	Methyl-o-demeton	300 g ai/ha	5.98 (36)	2.99 (9)	6.67 (44)	1.89 (3)	4.93 (24)	1.60 (3)	6.21 (39)	2.05 (4)	2.86 (8)	1.81 (3)	3.09 (10)	2.36 (6)	2.26 (5)	2.14 (5)	2.75 (8)	2.14 (5)	1.67 (3)	2.00 (4)	3.32 (15)	1.97 (4)
7.	Untreated control		6.60 (44)	2.51 (6)	9.87 (96)	3.66 (13)	10.65 (113)	2.35 (6)	12.76 (123)	2.61 (7)	6.04 (36)	3.03 (9)	4.48 (19)	2.82 (8)	3.92 (15)	3.12 (10)	4.51 (20)	3.23 (10)	4.18 (17)	3.11 (10)	6.60 (44)	2.74 (8)
	S.Em ±		0.21	0.18	0.79	0.22	0.72	0.15	.1.34	0.12	0.91	0.22	0.45	0.19	0.23	0.12	0.15	0.24	0.26	0.35	0.27	0.16
	C. D.@ 5%		0.66	0.51	2.44	0.64	2.22	0.46	4.13	0.37	2.80	0.68	1.38	0.59	0.72	0.36	0.47	0.74	0.81	1.08	1.18	0.45
	C.V.%		7.69	13.7	26.97	25.88	25.64	19.19	40.43	12.44	56.19	28.38	28.09	21.15	20.19	14.72	12.14	24.85	27.96	32.19	36.71	24.16
	Interaction C.D.@ 5%		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figures in the parenthesis are square root retransformation.

TABLE 2

Effect of Imidacloprid 70 WS seed treatment on G. Cot. Hy-10 cotton against aphid and jassid population during 1998-'99

Sr. No.	Treatments	Dosage	Mean sucking pest population/3 leaves at indicated DAG														Pooled over period	
			35		45		55		65		75		85		95			
			Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid	Aphid	Jassid
1.	Seed treatemtn with Imidacloprid 70 WS	5 g/kg	4.35 (10)	1.01 (1)	5.16 (26)	1.50 (2)	3.02 (6)	1.64 (3)	3.29 (10)	1.76 (3)	1.52 (1)	1.64 (3)	–	2.18 (5)		1.94 (4)	3.16 (9)	1.78 (3)
2.	Seed treatment with Imidacloprid 70 WS	7.5g/ kg	4.11 (16)	1.01 (1)	5.63 (31)	1.70 (3)	3.16 (9)	1.73 (3)	4.02 (15)	1.24 (2)	1.49 (1)	2.25 (5)		2.51 (7)		2.16 (5)	3.58 (12)	1.94 (4)
3.	Seed treatment with Imidacloprid 70 WS	10g/ kg	3.41 (11)	1.00 (1)	5.43 (28)	1.60 (3)	3.00 (9)	1.31 (2)	2.31 (4)	1.20 (1)	1.52 (1)	1.57 (5)		2.57 (7)		2.10 (4)	3.10 (9)	1.64 (3)
4.	Polo 50 WP	300g ai/ha	9.69 (93)	2.98 (9)	9.06 (81)	2.00 (4)	1.64 (2)	1.13 (1)	1.32 (0)	1.11 (1)	1.0 (0)	1.07 (1)		2.31 (5)		1.59 (3)	3.22 (9)	1.53 (2)
5.	Polo to WP	600g ai/ha	9.27 (85)	3.15 (10)	9.06 (81)	2.07 (4)	1.43 (1)	0.77 (1)	1.72 (2)	1.15 (1)	1.0 (1)	0.82 (1)		2.47 (7)		1.65 (3)	3.10 (9)	1.49 (2)
6.	Methyl-O-demeton	300g ai/ha	9.93 (98)	3.73 (14)	6.90 (47)	2.16 (5)	1.44 (1)	1.68 (3)	2.45 (5)	1.29 (2)	1.24 (0)	1.48 (2)		2.63 (7)		2.14 (5)	3.00 (8)	1.90 (4)
7.	Untreated control		9.78 (95)	3.58 (13)	11.69 (137)	4.07 (17)	8.00 (64)	4.24 (18)	4.38 (18)	3.67 (13)	4.50 (19)	3.95 (16)		4.12 (17)		3.87 (15)	7.03 (49)	3.99 (16)
	S.Em. ±		0.34	0.22	0.83	0.17	0.76	0.32	0.66	0.25	0.26	0.21		0.20		0.25	0.64	0.15
	C.D.@ 5%		1.03	0.67	2.39	0.49	2.19	0.94	1.92	0.74	0.75	0.61		0.58		0.72	1.83	0.41
	C.V. %		8.05	14.65	20.31	14.18	49.05	41.17	47.66	33.73	31.82	25.35	–	15.18		22.77	33.97	24.04
	Interaction C.D. @ 5 %																1.87	0.66

Figures in the parenthesis are root retransformation.

TABLE 3

Effect of Imidacloprid 70 WS seed treatment against Aphid and Jassid, Pooled over year (1997-'98 and 1998-'99), seed cotton yield and economics.

Sr. No.	Treatments	Dos-age	Population/3 leaves (Pooled over year)		Seed cotton yield (kg/h)			Net Profit (Rs/ha)	ICBR
			Aphid	Jassid	97-98	98-99	Pooled		
1	Seed treatment with Imidacloprid 70 WS	5 g/kg	3.76 (13)	1.60 (3)	2242	1935	2088	14660	1:40.59
2	Seed treatment with Imidacloprid 70 WS	7.5g/ kg	3.22 (9)	1.61 (3)	2513	1749	2131	15540	1:30.75
3	Seed treatment With Imidacloprid 70 WS	10g/ kg	2.48 (5)	1.43 (2)	2815	1794	2305	19020	1:29.38
4	Polo 50 WP	300g ai/ha	2.82 (7)	1.29 (2)	2600	1587	2094	12630	1:5.98
5	Polo 50 WP	600g ai/ha	2.63 (7)	1.19 (1)	2778	1563	2176	12400	1:3.16
6	Methyl-o-demeton	300g ai/ha	3.91 (14)	1.94 (4)	2094	1721	1907	9725	1:7.3
7	Untreated control		6.63 (43)	2.66 (7)	1502	1203	1354		
	S.Em. ±		0.35	0.11	91	122	103		
	C.D. @ 5%		0.99	0.32	2.81	354	287		
	C.V. %		33.39	23.98	6.68	11.41	7.98		
	Interaction C.D. @ 5%		1.96	0.64	-	-	2.62		

Price of seed cotton Rs. 20/kg.

higher population of aphids and jassids was recorded in untreated control right from 30 to 70 DAG of crop.

(b) 1998-99 :

The data presented in Table-2 on population of aphids and jassids also indicated significant differences during different periods of observations and pooled over period. The first observation was recorded on 35th DAG which showed comparatively less aphids and jassids population in the plots treated with Imidacloprid @ 5.0, 7.5 & 10 g/kg treatments. While the treatments with systemic insecticides spray with Methyl-o-demeton @ 300 g ai/ha kept as a standard check and untreated control which crossed ETL level. The observations recorded at 45 to 75 DAG of crop and pooled over period showed significant differences against aphids and jassids population among the treatments. The treatment Imidacloprid @ 10 g/kg seeds was found significantly better in reducing aphids and jassids over standard check Methyl-o-demeton and control, though, it was at par with Imidacloprid 70 WS @ 5.0 and 7.5 g/kg and also in results of pooled over period. Similar to previous year the higher population of aphids and jassids was recorded among all the treatments right from 35 to 75 DAG of crop.

(c) The data (Table-3) on pooled over year indicated that Imidacloprid (Gaucho) 70 WS @ 10 g/kg seeds treatment was found significantly more effective in controlling aphids and jassids as compared to standard check Methyl-o-demeton @ 300 g ai/ha and control. The results further showed that the effect of seed dressing in controlling aphids and jassids with Imidacloprid 70 WS with different doses was observed upto 35 DAG in case of aphid and upto 50 DAG of crop in case of jassids. However, the population of aphids and jassids showed an increasing trend in all the treatments after 35 and 50 days in case of aphids and jassids, respectively. Patil *et al.* (1999) observed the effectiveness of Imidacloprid 70 WS (Gaucho) on leaf hopper upto 40 days after sowing. Where as Joginder Singh *et al.* (1996) observed the effectiveness of Imidacloprid 70 WS (Gaucho) on leaf hopper upto 121 days. Mote *et al.* (1995) observed the effectiveness of Imidacloprid (Gaucho) 70 WS upto 60 days after germination on aphids, jassids and thrips. While the incidence of thrips whitefly was very low during both the years.

2. Yield :

The data on seed cotton yield presented in Table-3 showed significant differences among the treatments over years and in pooled results. The two years pooled data showed that all the seed dressing treatments of Imidacloprid 70 WS (Gaucho) and standard check Methyl-o-demeton recorded significantly higher seed cotton yield than untreated control. The seed dressing treatment with Imidacloprid 70 WS (Gaucho) @ 10 g/kg seeds stood first (2305 kg/ha) followed by Imidacloprid @ 7.5 g and 5 g/kg seeds treatments as against 1354 kg/ha in untreated control.

3. Economics :

From the economic point of view, (Table-3) Imidacloprid @ 5 g/kg

seeds treatment recorded highest ICBR 1:40.50 with Rs. 14327/ha net profit followed by Imidacloprid @ 7.5 g/kg (ICBR 1:30.75 with net profit Rs. 15540/ha) and Imidacloprid @ 10 g/kg seeds (ICBR 1:29.38 with Rs. 19020/ha net profit).

On the basis of the results of two years, it can be concluded that seed treatment of Imidacloprid 70 WS at 10 g/kg recorded aphids and jassids population below ETL upto 35 days in case of aphids and 50 days in case of jassids on G.Cot. 10 hybrid cotton. Lower dose of Imidacloprid i.e. 5 g and 7.5 g were also effective being at par with 10 g/kg treatment. Enhanced growth of cotton plants in Imidacloprid seeds treated plots was also observed. Imidacloprid 70 WS (Gaucho) suits very well in IPM strategy as it encourages natural enemy population on cotton which also helps to check early sucking pests population of cotton.

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Varietal Resistance in Castor to *Spodoptera litura* Fabricius

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ABSTRACT

GCH-4 and GCH-5 were found least preferred for oviposition by *S. litura* than rest of the varieties. VI-9 and GAUCH-1 were more preferred for oviposition. VP-1, CO-1 and JI-35 had lower oviposition than SH-72, SKI-73, 48-1, Geeta and DCS-9. The lowest larval population was found on GCH-4 and GCH-5, whereas highest population on VI-9 and GAUCH-1. The leaf damage was found higher in VP-1, SH-72, 48-1 and Geeta than rest of the varieties tested (CO-1, DCS-9 and JI-35). The lowest leaf damage was found in GCH-4 and GCH-5, whereas highest leaf damage in SKI-73, VI-9 and GAUCH-1. The higher seed yield was found in GCH-4 and GCH-5 in comparison to VP-1, JI-35, VI-9, GAUCH-1 and SKI-73.

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INTRODUCTION

The leaf eating caterpillar, *Spodoptera litura* (F.) is a serious polyphagous pest in India. It's feeding response to different hosts were studied by some research workers *viz.*, Bhalani and Talati, 1984 and Patel *et al.*, 1987. Deshmukh *et al.*, (1967) reported that its menance is continuously increasing in the country for the last few years, perhaps due to shift in planting and high yielding varieties under larger areas which are more prone to its attack. Breeding crop varieties resistant to insect pests will go a long way in the pest management. Host plant resistance helps in suppressing the pest population at low cost and with least disturbance to the ecosystems. The search for sources of insect resistance in crop plants and the use of varieties having such resistance in reducing the population of insects and the damage caused by them is one of the well known approaches in plant protection research. Considering the economic importance and polyphagous nature of *S. litura* it is very necessary to develop a resistant variety of castor.

MATERIALS AND METHODS

To screen the available castor varieties for their resistance to *S. litura*

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an experiment was conducted in Randomized Block Design with three replications in pesticide free open field condition at college farm of B. A. College of Agriculture, Gujarat Agricultural University, Campus Anand during 1997-'98 and 1998-'99. Twelve castor varieties were chosen for the studies on host plant resistance.

To screen castor varieties for resistance to *S. litura*, five randomly selected and tagged castor plants were observed for egg mass (es) laid by female *S. litura* moths and number of larva (e) present on three leaves of each randomly selected plant, *S. litura* damaged and healthy leaves were also observed and recorded at weekly interval starting from one week of germination to harvesting of the varieties. The yield for each plot was recorded and converted to yield per hectare (q/ha) for comparison.

RESULTS AND DISCUSSION

The weekly pooled data of 1st year on ovipositional preference by *S. litura* to castor varieties (Table-1) revealed significantly lower preference to GCH-4 (0.69) and GCH-5 (0.60) followed by VP-1 (1.24), JI-35 (1.30), DCS-9 (1.30) and Co-1 (1.35). The later four castor varieties were more preferred for oviposition by *S. litura* than GCH-4 and GCH-5 but found significantly less preferred than SH-72 (1.75), SKI-73 (2.03), Geeta (2.06), 48-1 (2.06), VI-9 (2.53) and GAUCH-1 (2.78). The later two varieties had significantly higher ovipositional preference by *S. litura* than rest of the varieties.

Second year, egg masses laid by *S. litura* female moths on different varieties (Table-1) revealed significantly lower preference for GCH-4 (0.73) and GCH-5 (0.67) followed by CO-1 (1.32), JI-35 (1.32), VP-1 (1.35) and DCS-9 (1.35) which remained at par. SH-72 (1.78) was significantly less preferred than Geeta (2.12) but both are at par to 48-1 (2.09) and SKI-73 (2.09). The significantly higher preference was observed for VI-9 (2.56) and GAUCH-1 (2.85).

The pooled results overs years on egg masses showed significantly lower oviposition on GCH-4 (0.71) and GCH-5 (0.62) than rest of the varieties. SH-72 (1.75), SKI-73 (2.06), 48-1 (2.09) and Geeta (2.09) were more preferred by *S. litura* moths for oviposition than VP-I (1.29), JI-35 (1.29), CO-1 (1.32) and DCS-9 (1.32) but found less preferred than VI-9 (2.56) and GAUCH-1 (2.81), which were found having significantly higher number of eggs.

The results of 1st year on larval population of *S. litura* revealed significantly higher larval activity on GAUCH-1 (10.45) and VI-9 (9.86) than rest of the varieties. GCH-4 (4.25) and GCH-5 (4.60) were found with significantly lower larval population than rest of the varieties followed by VP-1 (6.73) which was found significantly less infested with *S. litura* larvae than all the varieties except CO-1 (7.22), SH-72 (8.38) and SKI-73 (8.62) which were found significantly more infested than DCS-9 (7.73), Geeta (7.73), JI-35 (7.62), CO-1, VP-1, GCH-4 and GCH-5.

Second year, larval population revealed significantly higher larval population on GAUCH-1 (10.78) and VI-9 (10.12) than rest of the varieties. GCH-4 (4.60) and GCH-5 (4.83) were found significantly to have lower larval population than rest of the varieties

TABLE 1

Relative preference of castor varieties by *S. litura*.

Variety	Av. no. of egg masses / 3 leaves			Av. no. of larvae / 3 leaves		
	1997-'98	*1998-'99*	*Pooled*	*1997-'98*	*1998-'99*	*Pooled*
Geeta	1.60* (2.06)**	1.62 (2.12)	1.61 (2.09)	2.87 (7.73)	2.92 (8.02)	2.90 (7.91)
48-1	1.60 (2.06)	1.61 (2.09)	1.61 (2.09)	2.92 (8.02)	2.97 (8.32)	2.95 (8.20)
VP-1	1.32 (1.24)	1.36 (1.35)	1.34 (1.29)	2.69 (6.73)	2.74 (7.00)	2.72 (6.90)
VI-9	1.74 (2.53)	1.75 (2.56)	1.75 (2.56)	3.22 (9.86)	3.26 (10.12)	3.24 (10.00)
GCH-5	1.05 (0.60)	1.08 (0.67)	1.06 (0.62)	2.26 (4.60)	2.31 (4.83)	2.28 (4.70)
CO-1	1.36 (1.35)	1.35 (1.32)	1.35 (1.32)	2.78 (7.22)	2.83 (7.50)	2.81 (7.40)
SKI-73	1.59 (2.03)	1.61 (2.09)	1.60 (2.06)	3.02 (8.62)	3.08 (8.98)	3.05 (8.80)
JI-35	1.34 (1.30)	1.35 (1.32)	1.34 (1.29)	2.85 (7.62)	2.90 (7.91)	2.88 (7.80)
SH-72	1.50 (1.75)	1.51 (1.78)	1.50 (1.75)	2.98 (8.38)	3.03 (8.68)	3.00 (8.50)
GCH-4	1.09 (0.69)	1.11 (0.73)	1.10 (0.71)	2.18 (4.25)	2.26 (4.60)	2.22 (4.43)
DCS-9	1.34 (1.32)	1.36 (1.35)	1.35 (1.32)	2.87 (7.73)	2.92 (8.02)	2.90 (7.91)
GAUCH-1 (C)	1.81 (2.78)	1.83 (2.85)	1.82 (2.81)	3.31 (10.45)	3.36 (10.78)	3.34 (10.66)
S. Em. ±	0.04	0.04	0.04 0.02 0.06	0.04	0.04	0.07 0.03 0.10
C.D. (P=0.05)	0.10	0.10	0.12 NS NS	0.10	0.11	0.21 NS NS
C.V %	15.98	16.37	15.74	8.37	8.28	5.77

* $\sqrt{x + 0.5}$ transformed values.

** Figures in parentheses are retransformed values.

TABLE 2

Susceptibility to *S. litura* and yield of different castor varieties.

Variety	Av. number of leaves damage (%) / Plant			Yield (Q/ha)		
	1997-98	1998-'99	Pooled	1997-'98	1998-'99	Pooled
Geeta	22.89* (15.13)**	23.18 (15.49)	23.03 (15.30)	22.84	20.58	21.71
48-1	23.22 (15.54)	23.49 (15.89)	23.35 (15.71)	21.93	19.34	20.64
VP-1	19.72 (11.38)	20.13 (11.84)	19.92 (11.61)	.12.04	11.32	11.68
VI-9	27.67 (21.56)	27.93 (21.94)	27.80 (21.75)	10.14	13.79	11.96
GCH-5	12.85 (4.95)	13.62 (5.54)	13.24 (5.25)	25.49	26.34	25.92
CO-1	17.80 (9.34)	18.73 (9.72)	17.98 (9.53)	7.26	6.79	7.03
SKI-73	24.93 (17.77)	25.26 (18.21)	25.10 (17.99)	14.12	13.79	13.95
JI-35	17.93 (9.48)	18.17 (9.72)	18.05 (9.60)	13.84	14.61	14.23
SH-72	22.77 (14.73)	22.79 (15.00)	22.68 (14.87)	21.74	19.96	20.85
GCH-4	11.99 (4.32)	13.20 (5.21)	12.59 (4.75)	27.11	28.60	27.85
DCS-9	17.85 (9.40)	18.19 (9.74)	18.02 (9.57)	20.97	23.66	22.32
GAUCH-1 (C)	28.46 (22.71)	28.68 (23.03)	28.57 (22.87)	10.28	13.79	12.03
S.Em.±	0.38	0.25	0.56 0.23 0.80	2.33	1.97	1.44
C.D. (P=0.05)	1.04	0.69	1.61 NS NS	6.84	5.78	4.09
C.V.%	11.37	7.51	7.47	23.84	19.30	21.37

* Arcsin transformed values.

** Figures in parentheses are retransformed values.

followed by VP-1 (7.00) which was found significantly less infested with *S. litura* than all varieties except CO-1 (7.50) SKI-73 (8.98) was found significantly more infested than DCS-9 (8.02), Geeta (8.02), JI-35 (7.91), CO-1 (7.50), VP-1, GCH-5 and GCH-4.

The pooled data on larval populations revealed significantly lower number of larvae on castor plants of GCH-4 (4.43) and GCH-5 (4.70), than rest of the varieties. VP-1 (6.90) and CO-1 (7.40) had significantly lower larval population than SKI-73 (8.80), VI-9 (10.00) and GAUCH-1 (10.66) which were at par VP-1 was found significantly less preferred by the larvael of *S. litura* than 48-1, SH-72, SKI-73, VI-9 and GAUCH-1.

The results of 1st year on leaf damage (Table-2) showed significantly lower leaf damage in GCH-4 (4.32) and GCH-5 (4.95) than rest of the varieties. It was followed by CO-1 (9.34), DCS-9 (9.40) and JI-35 (9.48) which were at par but had significantly lower leaf damage than VP-1 (11.38), SH-72 (14.73), Geeta (15.13), 48-1 (15.54), SKI-73 (17.77), VI-9 (21.56) and GAUCH-1 (22.71) SH-72, Geeta and 48-1 remained at par had higher damage than VP-1 and lower damage than SKI-73.

During second year, lower leaf damage in GCH-4 (5.21) and GCH-5 (5.54) than rest of varieties. VP-1 (11.84) had significantly higher leaf damage than CO-1 (9.72), JI-35 (9.72) and DCS-9 (9.74) were at par but had lower damage than SH-72 (15.00), Geeta (15.49), 48-1 (15.89), SKI-73 (18.21), VI-9 (21.94) and GAUCH-1 (23.03) SKI-73 had significant lower leaf damge than VI-9 and GAUCH-1 but higher than rest of the varieties.

The pooled data indicated the lower leaf damage in GCH-4 (4.75) and GCH-5 (5.25) than rest of the varieties. It was followed by CO-1 (9.53), DCS-9 (9.57) and JI-35 (9.60) which remained at par SH-72 (14.87), Geeta (15.30) and 48-1 (15.71) remained at par but had significantly lower leaf damage than SKI-73 (17.99) and higher leaf damage than VP-1 (11.61).

The highest yield potential of GCH-4 (2785), GCH-5 (2592) than rest of varieties except DCS-9 (2232) which was found at par to GCH-5, Geeta (2171), SH-72 (2085) and 48-1 (2064), JI-35 (1423), SKI-73 (1395), GAUCH-1 (1203), VI-9 (1196) and VP-1 (1168) found at par in their yield potential but significantly lower yield than GCH-4, GCH-5, DCS-9, Geeta, SH-72 and 48-1. CO-1 found significantly lowest yielder among the twelve varieties.

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Management of Root Rot (*Fusarium solani*) of Cotton

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ABSTRACT

The effects of various systemic and non systemic fungicides, fungal biocontrol agent and oil cakes was studied against root rot of cotton caused by *Fusarium solani* under *in vitro* and pot conditions. Among systemic fungicides tested carbendazim, tridemorph and thiophanate methyl were effective in inhibiting the growth as well as sporulation of the fungus and gave 94.74, 87.12 and 85.28 per cent inhibition of their graded concentrations respectively. While in non systemic fungicides, thiram was found to be most effective in inhibiting the growth (89.23 %) and sporulation of the fungus followed by ziram. In pot trial, combined soil application of *Trichoderma harzianum* @ 5 g/pot + carbendazim (0.05 per cent) + neem cake 50 g/pot was effective in reducing plant mortality (9,999 %) over control (79.90 %).

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INTRODUCTION

Cotton (*Gossypium herbaceum* L.) is one of the most important fibre cash crops of India as well as the world. It is popularly known as ``white gold'. Cotton provides gainful employment to millions of people in the world, who are engaged in it's cultivation, trading, processing, manufacturing, fabricating and marketing. The king of apparel fiber is affected by number of diseases caused by fungi, bacteria, nematodes, viruses and phytoplasma. Root rot caused by *Fusarium solani* is an important disease. It has been observed in moderate to severe form in cotton fields in Rajkot district of Gujarat State. Attempts were made to manage root rot in an integrated way.

MATERIALS AND METHODS

The study was conducted in the Department of Plant Pathology, College of Agriculture, Gujarat Agricultural University, Junagadh. The fungus was isolated by tissue isolation technique and maintained on PDA. The efficacy of different fungicides was tested *in vitro* using poisoned food technique. Four concentrations, viz., one concentration below recommended dose and two concentrations above recommended dose were tried. The required quantities of fungicides were incorporated in sterilized 100 ml PDA medium in 250 ml conical flask (Tables 1 and 2). Twenty ml of poisoned medium was later poured into

each of the sterilized petriplates under aseptic condition and after solidification the plates were inoculated with mycelial disc of 4 mm diameter placed in centre of the plates and were incubated at 28 ± 1°C for seven days. Suitable control was also maintained by growing the fungus only.

The fungal colony growth was measured in two directions at right angle to each other after seven days of incubation, each with four replications and diameter was expressed in millimeter. Extent of sporulation was also recorded. The per cent inhibition of the fungus in each treatment was calculated.

A pot experiment was conducted to study the individual or combined effect of fungicide, neem cake, castor cake and *T. harzianum* for reduction of root rot pathogen. A susceptible cotton cultivar (G-Cot-13) was used in this experiment. All the post were filled with inoculated soil (approximately 6 kg/pot) in proportion to 100 g soil : 1 gm culture grown on sand maize meal medium. Neem cake and castor cake were added @ 50 g/pot before sowing and mixed well with soil. *T. harzianum* (Talc based culture) was applied @ 5 g/pot, subsequently 200 ml solution of carbendazim (0.05%) and thiophanate methyl (0.07%) were applied separately on same day as soil drench before sowing as per the treatment combinations (Table 5). On the next day sowing was done in treated pots, keeping five plants in a pot and was replicated four times. Observations were recorded on plant mortality and expressed percentage. The data was analyzed statistically and compared at 5 per cent level of significance.

RESULTS AND DISCUSSION

Under *in vitro* conditions, carbendazim proved to be significantly effective and inhibited the growth by 93.33% and sporulation of the test fungus *F. solani* even at lowest concentration tried i.e. 250 ppm, with a mean inhibition of 94.40 per cent and toxicity index of 378.95 nearer to maximum toxicity index of 400. The next best fungicide was tridemorph followed by thiophanate methyl with mean inhibition of 87.12 and 85.28 per cent respectively (Table-1). Among non-systemic fungicides, thiram was significantly best with 89.23 per cent mean inhibition and highest toxicity index of 356.91. Next best fungicide was ziram with 82.07% mean inhibition (Table 2). Gaur (1990) noticed that captan (0.2 %) and carbendazim (0.1%) gave satisfactory control of *F. solani* though chlorothalonil gave 72.71 per cent mean inhibition of the *F. solani*. Similarly Solunke and Kore (1993) also reported that carbendazim, captan and thiram gave maximum growth inhibition of *F. moniliforme* at 0.025 per cent concentration.

In the pot trial, soil amendment with different treatments and their combinations effectively reduced plant mortality over control (Table 3). The combination of *T. harzianum* + carbendazim + neem cake was found to be most effective in reducing plant mortality to the minimum (9.99 %) than other treatments viz., *T. harzianum* alone

TABLE 1

Per cent inhibition of growth and sporulation of *F. solani* at different concentrations of various systemic fungicides.*

Sr. No.	Systemic fungicide		Concentration in ppm C_1	C_2	C_3	C_4	Mean (%)	Toxicity index**
1.	Carbendazim (Bavistin-50% wp)	A	93.33	94.44	95.44	95.74	94.74	378.95
		B	-	-	-	-		
		C	-	-	-	-		
		D	-	-	-	-		
2.	Thiophanate-methyl (Topsin - 70% wp)	A	77.76	84.44	87.78	91.12	85.28	341.10
		B	++	+	++	++		
		C	++	+	++	++		
		D	+	-	+	+		
3.	Triadimefon (Bayleton-25% wp)	A	51.11	53.34	57.77	61.10	55.83	223.32
		B	+++	+++	+++	++		
		C	++	++	++	+		
		D	+	+	+	-		
4.	Tridemorph (Calixin-80 EC)	A	83.33	86.66	88.88	89.60	87.12	348.47
		B	+	+	-	-		
		C	+	-	-	-		
		D	-	-	-	-		
5.	Carboxin (Vitavax-75% wp)	A	55.56	63.34	64.44	66.66	62.50	250.00
		B	+++	++	++	++		
		C	++	++	++	++		
		D	+	-	+	-		
6.	Fosetyl-A1 (Aliette-80% wp)	A	53.33	56.66	60.00	63.33	58.33	233.32
		B	+++	+++	++	++		
		C	++	++	++	++		
		D	+	+	+	+		
7.	Metalaxyl (Ridomil-72% wp)	A	17.77	24.44	30.00	32.22	26.11	104.43
		B	++++	++++	++++	+++		
		C	+++	+++	+++	++		
		D	+++	+++	+++	++		
8.	Hexaconazole (Contaf-5 EC)	A	75.55	78.88	83.22	84.44	80.52	322.09
		B	++	++	++	+		
		C	+	+	-	-		
		D	+	+	-	-		
9.	Propiconazole (Tilt-25 EC)	A	80.11	84.44	86.55	86.66	84.44	337.76
		B	++	++	++	++		
		C	++	++	++	++		
		D	+	+	+	+		
10.	Difenconazole (Score-10% wp)	A	60.00	62.00	70.00	72.00	66.00	264.00
		B	++++	+++	+++	+++		
		C	+++	+++	++	++		
		D	++	++	+	+		
11.	Check	A	0.00	0.00	0.00	0.00		
		B	++++	++++	++++	++++		
		C	++++	++++	++++	++++		
		D	+++	+++	+++	+++		

* Average of four replications.

** Maximum toxicity index is 400.

A - Mean per cent inhibition, B-Microconidia,
C - Macroconidia, D -Chlamydospore
Sporulation
'-' Absent, '+' Scenty, '++' Moderate, '+++' Good, '++++' Abundant

	Between fungicide	Between conc. & Within fungicide
S.Em. +	0.373	0.746
C.D. at 5%	1.043	2.087

TABLE 2

Per cent inhibition of growth and sporulation of *F. solani* at different concentrations of various non-systemic fungicides.

Sr. No.	Non-Systemic fungicides		Concentration in ppm C_1	C_2	C_3	C_4	Mean	Toxicity index**
1.	Mancozeb	A*	54.86	61.33	66.52	67.80	62.63	250.51
	(Dithane-M-45-75 %	B	++++	+++	+++	+++		
	WP)	C	+++	++	++	++		
		D	++	++	++	++		
2.	Captan	A	68.66	72.22	79.66	80.00	75.14	300.54
	(Captaf - 50 % WP)	B	+++	+++	++	++		
		C	++	++	++	++		
		D	++	++	-	-		
3.	Thriam	A	83.33	88.77	92.28	92.53	89.23	356.91
	(Thiram-75% WP)	B	+	-	-	-		
		C	+	-	-	-		
		D	-	-	-	-		
4.	Chlorothalonil	A	68.88	72.22	74.44	75.55	72.77	291.09
	(Kavach-75 % WP)	B	+++	++	++	++		
		C	++	++	++	++		
		D	++	++	+	+		
5.	Ziram	A	77.77	82.22	83.83	84.44	82.07	328.26
	(Cuman-L-27% EC)	B	++	++	+	+		
		C	++	+	+	+		
		D	+	-	-	-		
6.	Control	A	0.00	0.00	0.00	0.00		
		B	++++	++++	++++	++++		
		C	++++	++++	++++	++++		
		D	+++	+++	+++	+++		

* Average of four replications.
** Maximum toxicity index is 400.
A - Mean per cent inhibition, B - Microconidia,
C - Macroconidia, D - Chlamydospore
Sporulation :
'-' Absent, '+' Scanty, '++' Moderate, '+++' Good, '++++' Abundant

	Between fungicide	Between conc.& Within fungicide
S.Em. +	0.298	0.596
C.D. at 5%	0.843	1.686

TABLE 3

Management of cotton root rot caused by *F. solani.***

Sr. No.	Soil amendments	Plant mortality (%)
1.	Carbendazim (0.05%)	29.49 (32.89)
2.	Thiophanate methyl (0.07%)	44.95 (42.10)
3.	*T. harzianum*	14.99 (22.78)
4.	Neem cake	34.63 (36.05)
5.	Castor cake	59.97 (50.75)
6.	Carbendazim (0.05%) + *T. harzianum*	19.98 (26.55)
7.	Thiophanate methyl (0.07%) + *T. harzianum*	34.63 (36.05)
8.	Neem cake + Carbendazim (0.05 %)	19.98 (26.55)
9.	Neem cake + Thiophanate methyl (0.07%)	34.63 (36.05)
10.	Castor cake + Carbendazim (0.05%)	39.98 (39.22)
11.	Castor cake + Thiophanate methyl (0.07%)	44.95 (42.10)
12.	*T. harzianum* + Thiophanate methyl (0.07 %) + Neem cake	24.98 (29.72)
13.	*T. harzianum* + Carbendazim (0.05%) + Castor cake	34.63 (36.05)
14.	*T. harzianum* + Carbendazim (0.05%) + Neem cake	9.99 (18.43)
15.	*T. harzianum* + Thiphanate methyl (0.07%) + Castor cake	44.95 (42.10)
16.	Control	79.90 (63.36)

S. Em. ± 3.238
C. D. at 5% 9.213

Figures in parenthesis are transformed values.

** Average of four replications.

(14.99%), neem cake + carbendazim (19.98%), drenching with carbendazim (29.49%) compared to control (79.90). Sharma *et al.* (1993) reported that *F. solani*, 1 infestation in soil was suppressed effectively by the presence of *T. harzianum* and *T. koningii*. Chakrabarti and Sen (1991) also recorded that addition of neem cake to soil effectively reduced the pathogenic population of *F. solani*. According to Dohroo and Gupta (1995) incidence of wilt and rotting of cotton seedlings effectively reduced by the addition of neem cake. Charati *et al.* (1998) noticed that cotton seed treated with talc based formulation of *T. viride* and *T. harzianum* at 4 and 6 g/kg seed gave maximum germination and the lowest wilt (14 %) incidence. Ehteshamul *et al.* (1996) observed that soil amended with neem cake effectively controlled the root rot of okra caused by *F. solani*.

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Existing Farming and Cultural Practices of Coconut Cultivation Followed by the Growers in Valsad District (South Gujarat)

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ABSTRACT

The existing farming and cultural practices of coconut cultivation followed by the growers in Valsad district (South Gujarat) situation, a diagnostic survey study was carriedout from the Department of Horticulture, N. M. College of Agriculture, Gujarat Agricutural University, Navsari Campus, Navsari during the year 1996-97. In all, 50 farmers were selected from 36 villages of six talukas in Valsad district (South Gujarat).

The study revealed that majority of the respondents (coconut growers) had grown mango, chiku, banana, papaya as major fruit crops in addition to coconut crop. Mostly, the cultivar `West Coast Tall' was in use for planting. The cultivators were equally aware of coconut varieties viz., Dwarf Green and West Coast Tall. Almost half (44 per cent) respondents had adopted recommended spacing and purchased seedlings from private nurseries. About 43.4 per cent of the respondents had adopted regular planting method, two third (68 per cent) respondents had observed bearing stage in coconut which belonged to medium group. Majority of the respondents (60.34 per cent) had adopted basin method of irrigation and plant protection measures. The maximum 96 and 84 per cent of the respondents had applied FYM and chemical fertilizers to coconut palms, respectively. Nearly three fourth of the respondents (72.72 per cent) had applied common salt around the coconut stem. It was interesting to note that 94 per cent of the respondents were of the positive opinion for adopting coconut cultivation. The major reason for low productivity of coconut was poor adoption of improved package of practices followed by the farmers. So it can be summarized that coconut farmers should adopt improved package of practices for more profit.

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INTRODUCTION

Coconunt (*Cocos nucifera* L.) is an important cash as well as oil seed crop. Its uses are too many and varied. It has been referred to as the "Man's most useful tree," "King of the tropical flora" and also known as "Kalpavriksha" (Markose *et al.*, 1993).

The option of farming in agriculture is governed by the farmer's farming choices in individual farm. These choices are directly governed by specific purpose for which the crops are being grown, which depend on geographical factors and socio-economic circumstances. For better monetary return the farmers shifted their farming pattern from food production to cash crops, especially to coconut cultivation in Gujarat.

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Gujarat occupies 1600 km seacoast out of 8129 km coastal length of the country. However, the coconut area and production share of nuts in Gujarat is less than 1 per cent. Thus, tremendous expansion possiblities exist to increase the area and production in Valsad district which is next to Saurashtra region (Anon., 1998).

In southern part of Gujarat, the horticultural and plantation crops are much popular. Higher production per unit area from the orchards coupled with higher profits is the primary goal of any farmer. For this, it is essential to adopt improved agro-management recommended practices based on research findings. In field survey, it was revealed that the knowledge on coconut production technology was found very poor among the farmers, hence the findings of this research suggest improved cultivation practices to be followed by them.

MATERIALS AND METHODS

The study was conducted through a field survey in Valsad district of South Gujarat during the year 1996-97 by using random sampling technique. In all, 50 coconut growers (Respondents) were randomly selected from 36 villages of six talukas. The randomization was done with the help of computer. The coconut growers were contacted individually on their farm and data were collected by using a interview schedule viz., major fruit crop grown, coconut variety planted, knowledge for coconut variety, spacing, source of seedlings, coconut planting system adopted, age when the palms come into bearing stage, irrigation method, use of FYM, fertilizer and plant protection measures. Additional information of farmer's innovations and their opinion regarding coconut cultivation were also collected.

RESULTS AND DISCUSSION

The data regarding existing farming and cultural practices were collected and are presented in Tables 1 to 3.

The data regarding major fruit crops grown by the respondents are presented in Table 1 (a). Majority of the respondents had grown mango to the extent of 40 per cent, while 33.70, 3.20, 2.10 and 21.00 per cent respondents were grown for chiku, banana, papaya and other fruit crops, respectively. These findings indicate that major fruit crops, mango and sapota are being grown in this region. Similar findings were reported by Desai (1994).

The data regarding coconut varieties planted by the respondents are presented in Table 1 (b). About 62 per cent of the respondents had planted coconut variety West Coast Tall followed by 34 per cent mix varieties of coconut. Only 4 per cent respondents had planted improved and high yielding hybrids of coconut, while Dwarf Green variety was not grown by any of the farmers probably, due to lack of information. It indicates that knowledge of crop varieties is of vital importance as it has direct relation with information technology.

The data regarding the knowlege of different coconut varieties of respondents are presented in Table 1 (c). It revealed that 32.48 per cent respondents had knowledge regarding Dwarf Green (Lotan) variety followed by 31.85, 25.48 and 10.19

TABLE 1

Distribution of the respondents according to (a) Fruit crops, (b) Coconut variety planted, (c) Knowledge of variety, (d) Spacing maintained.

Sr. No.	*Item*	*Results Respondents No. 50*	
		Number	*Per cent*
(a)	Fruit crop		
1.	Mango	38	40.00
2.	Sapota	32	33.70
3.	Banana	03	3.10
4.	Papaya	02	2.10
5.	Other	20	21.00
	Total	-	100.00
(b)	Variety planted		
1.	West coast tall (WCT)	31	62
2.	Dwarf Green	0	00
3.	Hybrids	2	04
4.	Mix varieties	13	34
	Total	50	100.0

Sr. No.	*Item*	*Results Respondents No. 50*	
		Number	*Per cent*
(c)	Knowledge of variety		
1.	West coast tall (WCT)	50	31.55
2.	Dwarf Green (also known as Bona, Lotan and Gudajali)	51	32.48
3.	Hybrids	40	25.48
4.	Gandevi selection	16	10.19
	Total	-	100.00
(d)	Spacing maintained		
1.	3.0 x 3.0	1	02
2.	4.5 x 4.5	22	44
3.	6.0 x 6.0	19	38
4.	7.5 x 7.5	5	10
5.	9.0 x 9.0	2	04
6.	12.0 x 6.0	1	02
	Total	50	100

per cent respondents had knowledge of WCT, hybrids and Gandevi Selection, respectively. These findings are in agreement with those of Naik (1972), Kapadiya (1994) and Shehan *et al.* (1995).

The data regarding the adoption of spacing between two palms are presented in Table 1 (d), which revealed that 52 per cent respondents had not adopted the recommended spacing for coconut crop, while 38 per cent respondents had adopted the recommended spacing of 6.0 m x 6.0 m and 10 per cent 7.5 m x 7.5 m in their coconut gardens. It showed that the respondents had tendency to keep narrow spacing than the recommended one to accommodate more number of trees per unit area. Similar findings were reported by Shehan *et al.* (1995).

Coconut is a highly cross-pollinated crop hence, selection of coconut seedlings play a vital role to increase the production. The data so collected are presented in Table 2 (a). It revealed that majority of the respondents (49.21 per cent) purchased seedings from private nurseries followed by Government and Gujarat Agricultural University nurseries (30.16 per cent) and from other farmers (15.87 per cent) while only 4.76 per cent respondents used their own seedings. However, workers like Thampan (1971) and Satyabalan (1984) reported that selection of quality seedlings alone can increase the yield by about 10 per cent and for the successful production of any crop, elite planting material has paramount importance.

The data regarding coconut cultivation system adopted by the respondents are presented in Table 2 (b). It indicated that 43.40 per cent respondents had adopted regular planting (sole crop) followed by 33.96 per cent, who had adopted irregular method of planting, while 22.64 per cent respondents had adopted border planting. As far as border planting is concerned, these findings are in conformity with those reported by Anonymous (1990) and Desai (1994).

In coconut crop main difficulty faced by the farmers is that it takes long gestation period for reaching bearing stage. So the information collected are presented in Table 2 (C). It showed that 68 per cent (highest) of the repondents had observed bearing stage in coconut which belonged to medium group (6.1 to 10 years), while 30 per cent respondents found to be in early group followed by late group (2 per cent). According to Menon and Pandalai (1960), closely planted palms take much more time to commence bearing than the palms planted at an optimum distance.

Regarding adoption of irrigation method followed in coconut orchards, the data collected are presented in Table 2 (d). It is clear from the data that 60.34 per cent respondents had adopted the basin method of irrigation, while 29.31 per cent respondents had adopted flood method, only 6.90 per cent and 3.45 per cent had adopted drip and sprinkler methods of irrigation, respectively. The present findings are in agreement with those of Naik (1972), Nair *et al.* (1988), Raveendran (1983) and Varadan and Madhavachandran (1991).

The data regarding use of farm yard manure by respondents were collected and are presented in Table 3 (a). It revealed that 96 per cent of the

TABLE 2

Distrbution of the respondents according to (a) Source of coconut seedling produced, (b) Planting system, (c) Age to attain bearing stage, (d) Method of irrigation adopted.

Sr. No.	*Item*	*Results Respondents No. 50*	
		Number	*Per cent*
(a)	Source of seedling		
1.	Private nurseries	31	49.21
2.	Government (G. A. U. nursery)	19	30.16
3.	Own prepared	3	04.76
4.	Other farmers	10	13.87
	Total	-	100.0
(b)	Planting system		
1.	Regular planting	23	43.40
2.	Irregular planting	12	22.64
3.	Border planting	18	33.96
	Total	-	100.00
(c)	Year taken to bearing		
1.	Up to 6 years (Early group)	15	30
2.	6.1 to 10 years (Medium group)	34	68
3.	Above 10 years (Late group)	1	2
	Total	50	100.00
(d)	Method of irrigation		
1.	Basin	35	60.34
2.	Flood irrigation	17	29.31
3.	Sprinkler irrigation	2	03.45
4.	Drip irrigation	4	06.90
	Total	-	100

TABLE 3

Distribution of the respondents according to use of (a) Farm yard manure, (b) Chemical fertilizers, (c) Plant protection measures, (d) Farmers innovations and (e) Their opinion for adopting coconut cultivation.

Sr. No.	*Item*	*Results Respondents No. 50*	
		Number	*Per cent*
(a)	Farm yard manure		
1.	Applied	48	76
2.	Not applied	02	04
	Total	50	100
(b)	Chemical feritilizers		
1.	Applied	42	84
2.	Not applied	08	16
	Total	50	100
(c)	Plant protection measures		
1.	Followed	30	60
2.	Not followed	20	40
	Total	50	100

Sr. No.	*Item*	*Results Respondents No. 50*	
		Number	*Per cent*
(d)	Innovations		
1.	To apply common salt around the plam basin	16	72.72
2.	To prepare the girdling on stem	2	09.08
3.	To rear bee in garden	1	04.55
4.	To apply ash around stem	1	04.55
5.	To apply castor cake around the stem	1	04.55
	Total	-	100
(e)	Farmers opinion		
1.	Yes	47	94
2.	No	03	06
	Total	50	100

respondents had applied farm yard manure, while only 4 per cent respondents had not applied farm yard manure in coconut gardens. The data regarding use of chemical fertilizers by respondents were collected and are presented in Table 3 (b). It revealed that 84 per cent respondents had applied chemical fertilizers, while only 16 per cent repondents did not apply chemical fertilizers. Various scientists like Santha *et al.* (1993), Shehan *et al.* (1995) and Kulpati *et al.* (1997) working on coconut noted similar trend in respect of use of manures and chemical fertilizers. It revealed that they followed scientific practices for coconut cultivation.

The data regarding plant protection measures followed by the respondents collected and are presented in Table 3 (e). It revealed that 60 per cent respondents had followed plant protection measures, while 40 per cent had not followed the same. These findings are in accordance with those reported by Naik (1972) working on mango and Shanmukappa (1978) working on arecanut. Contrary findings were reported by Singh (1968) working on fruit crops, Patel *et al.* (1981) working on mango and lemon and Kulpati *et al.* (1997) working on coconut. They further reported that most of the growers had not adopted plant protection measures.

For getting higher yield in coconut palm, respondents had used different innovations. The data so collected are presented in Table 3 (d). It indicated that 72.72 per cent respondents applied common salt (sodium chloride) around the coconut palm, followed by 9.08 per cent respondents prepared girdling on the stem. Other respondents responded equally (4.55 per cent) for rest of the innovations. The results in response to application of common salt for coconut are in agreement with those of Mathew *et al.* (1984), Rethinum (1987) and Joseph *et al.* (1993). According to their views, application of common salt up to 2 kg in basin around the palm dose hamper the physico-chemical properties of the soil. Further, it was observed that the common salt induced the trees more tolerance to leaf blight and also reduced the incidence of barren nuts.

It can be seen from the Table 3 (e) that, it was interesting to note that 94 per cent of the respondents have indicated positive opinions for adopting coconut cultivation. Their opinions were correct because congenial agro-climatic conditions, suitable soil, ample water facilities and availability of scientific knowledge of coconut cultivation inspired the cultivators to go for this crop. Hence, the growers have indination for coconut cultivation.

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Environmental Awareness and Mass Media Exposure : A Study Among Rural and Urban School Children

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ABSTRACT

The study on the awareness of school children about the enivronment and pollution was conducted at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The response of rural and urban school children to various media about the environment was assessed. Compared to rural school children the urban ones were found to have better exposure to mass communication, newspapers, magazines, radio and Television and general awareness about the environment and pollution. The suggestions to increase the awareness among the rural children have been made by introducing environment in the course curriculum at all levels of education, including primary level. The publication of literature on environmental issues and distribution of the same among rural and urban school children have also been suggested.

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INTRODUCTION

Now-a-days environmental imbalance is a serious problem due to increasing pollution from industries, traffic, deforestation and non matching a-forestation (Rana and Singh, 1997). Therefore, environmental issues have emerged as a major global concern for human survival. A large number of international and global organizations, with the collective wisdom of the scientists, economists and planners have joined to settle the environmental issues confronting the nations and the physical world-the basic life support system, namely, land, water, flora and fauna and the atmosphere are under severe threat both in developing and developed countries.

In view of deteriorating situation of environment and dwindling natural resources the Government of India, Non-Governmental organizations and International Agencies as well, are constantly putting the efforts to arrest the over exploitation of nature and to protect the environment. Recently in India, environmental considerations have influence governmental policies for development leading to increased awareness and action (Saha, 1997). The goals of envi-

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ronmental educaton are 'to develop a world population that is aware of, and concerned about total environment and its associated problems and commitment to work individually and collectively towards solution of current problems and the prevention of new ones'. (UNESCO, 1997).

An awareness campaign among rural and urban school children was launched in the Department of Extension Education of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi to find out stat of environmental awareness as how the rural and urban school children feel concern about this major health issue. The study was planned with the objective : (i) to know the level of mass media exposure of the selected school children, (ii) to assess the level of exposure of the selected children to different environmental issues through different mass media and (iii) to assesss the level of awareness of the selected children regarding general environmental issues and pollution.

MATERIALS AND METHODS

Two Community Development Blocks, namely, Kashi Vidyapeeth and Niyamtabad were randomly selected from the blocks for purposively selected Varanasi district. Then Bachchavan village of Kashi Vidyapeeth for selection of rural respondents and Ramnagar township of Niyamtabad for selecting urban respondents were selected. The Mahamana Malviya Inter College of Bachchavan village and Prabhu Narayan Rajkiya Inter College, Ramnagar township were selected purposively. Twenty students each from high school and intermediate classes, were selected on the basis of stratified random sampling method. Thus, the total number of respondents in the sample were 40 urban and 40 rural, making a total of 80 respondents. The data on the following responses were collected with the help of a structured interview scheduled, specially constructed for the present investigation.

1. Response to mass-media, such as newspaper, magazine, radio and TV/ VCR.
2. Exposure of respondents to environmental news through newspapers in respect of soil, air and water pollution, pollution control, aforestation, deforestation, ozone layer, clean environment and wild life.
3. Exposure of respondents to environmental news through magazines in terms of earth, river, soil, air, water, noise and light pollution and save ozone layer.
4. Exposure of respondents to programmes on TV and radio in terms of entertainment, children, general knowledge, agriculture, sports, environment, ladies and National and International programmes, news and quiz.
5. General awareness of respondents to environment and pollution.

The interpretation of results has been done through frequency distribution of events and finally by working out the percentage of frequency appearing in each class.

RESULTS AND DISCUSSION

The results of the present study have been interpreted and discussed under the following the four categories of responses by the rural and urban school children.

1. Response of school children to mass media :

The distribution of response of respondents to different mass media is given in Table-1.

TABLE 1

Distribution of respondents based on their mass-media participation.

Sl. No.	Kinds of multimedia	Frequency of participation				
		Rural (40)		Urban (40)		Total (80)
		H.Sc.	Intermediate	H.Sc.	Intermediate	
		(n = 20)	(n = 20)	(n = 20)	(n = 20)	(n = 80)
1.	Newspaper	7 (35.0)	9 (45.0)	16 (80.0)	19 (95.0)	51 (63.75)
2.	Magazine	5 (25.0)	11 (55.0)	13 (65.0)	15 (75.0)	44 (55.0)
3.	Radio	20 (100.0)	20 (100.0)	20 (100.0)	20 (100.0)	80 (100.0)
4.	T.V./V.C.R.	20 (100.0)	20 (100.0)	20 (100.0)	20 (100.0)	80 (100.0)

(Figures in parentheses indicate percentage).

It is clear from the frequency distribution given in Table 1 that all the selected rural and urban school children used to listen the Radio and Television regularly. As much as 35 and 25 per cent rural high school children were found reading newspapers and magazines, respectively. Among the urban high school children the corresponding figures were 80 and 85 per cent. In case of urban Intermediate children the percentage is even more as 95 and 75 per cent were found reading newspapers and magazines weekly. These figures clearly indicate that the exposure of the urban school children to mass media is better than of the rural areas. Also, the exposure of intermediate school children to mass-media is better than that of the high school children. This suggests that the environment and the level of education have direct effect on the exposure to mass media.

2. Exposure of school children to environmental news through newspapers :

The distribution of school children in terms of their exposure to environmental news through newspapers is given in Table-2.

The data given in Table 2 suggest that among the rural children 10, 7.5 and 2.5 per cent had come across the news on water pollution, a-forestation, pollution control, ozone layer and clean environment, respectively. From the newspapers *'Aaz'* and *'Dainik Jagran'* 5.0 and 2.5 per cent children had read news related to river and water pollution

TABLE 2

Exposure of respondents to news through newspapers.

Sl. No.	*Content Category*	*Frequency of Respondents*					
		Rural (n = 40)			*Urban (n=40)*		
		Name of newspapers			*Name of newspapers*		
		Aaj	*D. Jagran*	*T. of India*	*Aaj*	*D. Jagran*	*T. of India*
1.	Water pollution	4 (10.0)	1 (2.5)	0 (0.0)	2 (5.0)	1 (2.5)	0 (0.0)
2.	Air pollution	0 (0.0)	0 (0.0)	1 (2.5)	7 (17.5)	1 (2.5)	0 (0.0)
3.	River pollution	0 (0.0)	2 (5.0)	0 (0.0)	2 (5.0)	2 (5.0)	0 (0.0)
4.	Pollution control	1 (2.5)	0 (0.0)	0 (0.0)	1 (2.5)	2 (5.0)	0 (0.0)
5.	A-forestation	3 (7.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
6.	Deforestation	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)
7.	Ozone layer	1 (2.5)	1 (2.5)	1 (2.5)	1 (2.5)	2 (5.0)	2 (5.0)
8.	Soil pollution	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)	-	1 (2.5)
9.	Clean environment	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)
10.	Wild life	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)

(Figures in parentheses indicate percentage).

ınd ozone layer each. The Times of ıdia, being English newspaper does not hve easy access of the rural children a only 25 per cent had read about air plution and ozone layer. Regarding the ural children the trend in response to erent categories of newspapers was ost identical.

3. Exposure of school children to environmental news through magazines :

The data on the exposure of school children to environmental news published in magazines are given in Table-3.

TABLE 3

Exposure of respondents to environmental news through magazines.

Sl. No.	Content category	Frequency of Respondents												
		Rural (n = 40)					Urban(n = 40)							
		Name of Magazines					Name of Magazines							
		Pratiyogia Darpan	Vigyan Pragati	Saras Salil	Competetion Master	Sarita -	Panch Ganya	Vigyan Pragati	India Today	Saras Salil	Maya	Sarita	Prati-yogita Darpan	Science refresher
1.	Save ozone	11 (27.5)	17 (42.5)	0 (0.0)	5 (12.5)	0 (0.0)	0 (0.0)	22 (55.0)	0 (0.0)	1 (2.5)	0 (0.0)	1 (2.5)	18 (45.0)	9 (22.5)
2.	Earth Problem	2 (5.0)	5 (12.5)	0 (0.0)	1 (2.5)	0 (0.0)	0 (0.0)	8 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (10.0)	3 (7.5)
3.	River Pollution	9 (22.5)	8 (20.0)	3 (7.5)	2 (5.0)	1 (2.5)	0 (0.0)	11 (27.5)	2 (5.0)	2 (5.0)	2 (5.0)	2 (5.0)	17 (42.5)	8 (20.0)
4.	Soil Pollution	3 (7.5)	5 (12.5)	0 (0.0)	0 (0.0)	3 (7.5)	0 (0.0)	3 (7.5)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)	8 (20.0)	5 (12.5)
5.	Air Pollution	22 (55.0)	26 (65.0)	2 (5.0)	8 (20.0)	4 (10.0)	2 (5.0)	29 (72.5)	2 (5.0)	1 (2.5)	3 (7.5)	3 (7.5)	31 (77.5)	10 (25.0)
6.	Water Pollution	16 (40.0)	7 (17.5)	1 (2.5)	3 (7.5)	0 (0.0)	1 (2.5)	13 (32.5)	1 (2.5)	0 (0.0)	0 (0.0)	1 (2.5)	18 (45.0)	5 (12.5)
7.	Noise Pollution	4 (10.0)	3 (7.5)	0 (0.0)	1 (2.5)	0 (0.0)	0 (0.0)	3 (7.5)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)	4 (10.0)	3 (7.5)
8.	Light Pollution	0 (0.0)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (7.5)	0 (0.0)

(Figures in parentheses indicate percentage).

The data given in Table 3 suggest that all the aspects of environment had been read at least by few of the students from *"Pratiyogita Darpan"*, *"Vigyan Pragati"* and *"Competition Master"*. As *"Saras Salil"* and 'Sarita" are not science magazines a very few articles pertaining to environment are published. As many as 55.0 and 65.0 per cent of rural children had read about air pollution from *"Pratiyogita Darpan"* and *"Vigyan Pragati"* followed by other aspects of pollution.

Among the urban school children, air and river pollution were read from all the selected eight magazines at least by few respondents. Also, as many as 72.5 and 77.5 per cent of respondents had read about air pollution from *"Vigyan Pragati"* and *"Pratiyogita Darpan"* respectively. Save ozone layer being an important area of environment was read by 55, 45 and 22.5 per cent of urban childeren from *"Vigyan Pragati"* and *"Pratiyogita Darpan"* and *"Science Refresher"*, respectively. Other aspects of pollution were read by few students only.

It can be concluded from the data given in Table 3 that exposure of both rural and urban school children was below expectation, in case of rural school children it was more pronounced. There appears to be lack of interest towards environment related news or even difficulties in getting magazines or non-coverage of environment news by the magazines.

4. Exposure of school children to different programmes on radio and television :

The data related to exposure of school children to different programmes on environment through radio and television are given in Table-4.

TABLE 4

Exposure or respondents to different progrmmes on Radio and TV.

Sl. No.	Type of Programmes	Frequency of Respondents			
		Radio		Television	
		Rural (n = 40)	Urban (n = 40)	Rural (n = 40)	Urban (n = 40)
1.	Entertainment programme	29 (72.5)	37 (92.5)	21 (52.5)	39 (97.5)
2.	Children's programme	4 (10.0)	11 (27.5)	0 (0.0)	11 (27.5)
3.	G. K. programme	17 (42.5)	31 (77.5)	7 (17.5)	23 (57.5)
4.	News	29 (72.5)	18 (45.0)	13 (32.5)	16 (40.0)
5.	Agricultural programme	21 (52.5)	2 (5.0)	6 (15.0)	8 (20.0)
6.	Sports programme	8 (20.0)	33 (82.5)	14 (35.0)	36 (90.0)
7.	Environmental programme	7 (17.5)	26 (65.0)	13 (32.5)	29 (72.5)
8.	Ladies programme	4 (10.0)	0 (0.0)	3 (7.5)	7 (17.5)
9.	Quiz	0 (0.0)	0 (0.0)	6 (15.0)	22 (55.0)
10.	G. K. Programmes	0 (0.0)	0 (0.0)	7 (17.5)	11 (27.5)

(Figures in parentheses indicate percentage).

TABLE 5

Levels of awareness of respondents to general environmental issues and pollution.

Sl. No.	Issues on General Environment and Pollution	Frequency of Respondents			
		Rural (n = 40)		Urban (n = 40)	
		Aware	Not Aware	Aware	Not Aware
1.	Length of Ozone layer	5 (12.5)	35 (87.5)	21 (52.5)	19 (47.5)
2.	Profit of ozone layer	9 (22.5)	31 (77.5)	25 (62.5)	15 (37.5)
3.	Depletion of ozone layer	7 (17.5)	33 (82.5)	24 (60.5)	16 (40.0)
4.	Heating of earth	9 (22.5)	31 (77.5)	18 (45.0)	22 (55.0)
5.	Effect of heating earth	4 (10.0)	36 (90.0)	14 (35.0)	26 (65.0)
6.	Effect of acid rain	10 (25.0)	30 (75.0)	19 (47.5)	21 (52.5)
7.	Source of river and water pollution	14 (35.0)	26 (65.0)	33 (82.5)	7 (17.5)
8.	State of water surface in earth	2 (5.0)	38 (95.0)	31 (77.5)	9 (22.5)
9.	Forest cover in the earth	6 (15.0)	34 (85.0)	28 (70.0)	12 (30.0)
10.	Advantage of plants	19 (47.5)	21 (52.5)	37 (92.5)	3 (7.5)
11.	Endangered Animals	7 (17.5)	33 (82.5)	17 (42.5)	23 (57.5)
12.	Solar system	2 (5.0)	38 (95.0)	22 (55.0)	18 (45.0)
13.	No. of planets	13 (32.5)	27 (67.5)	38 (95.0)	2 (5.0)
14.	Importance of plants	19 (47.5)	21 (52.5)	40 (100.0)	0 (0.0)

(Figures in parentheses indicate percentage).

A perusal of the table reveals that majority of the rural children were listening to radio programme like news (72.5%), entertainment programmes and agricultural programme (52.5%) whereas environmental programmes were listened by only 17.5% of the rural respondents. Among the urban students, programme relating entertainment (92.5%), general knowledge (77.5%), sports (82.5%) and environment (65.0%) were preferred.

Among the T.V. programmes, most of the rural children were viewing entertainment programmme (52.0%), followed by sports programme (35.0%), news (52.5%) and environment programme (32.5%). Other programmes were not much preferred by this group of students.

Among the urban school children as many as 97.5% of them preferred entertainment programmes, closely followed by sports (90.0%). It is a matter of great satisfaction that as high as 72.5% of urban respondents were viewing environment related programme on telivision. Other programmes were hardly viewed by urban children.

5. Awareness of school children to general environmental issues and pollution :

The data related to awareness of school children to general environmental issue and pollution are given in Table-5.

The data given in the above table show that only 47.5% of the rural children were aware of the importance and advantages of plants, followed by sources of river and water pollution (35.05%) number of planets (32.5%), heating of earth (22.5%), project of ozone layer (22.5%), effect of acid rain (25.0%), and depletion of ozone layer (47.5%). On the other hand, among the urban school children the level of awareness was found highly satisfactory, barring few issues.

The above findings reveal that awareness about the environment and pollution was higher among the urban children than that in rural areas.

The above results clearly indicate that mass-media play a very important role in communicating and disseminating the environmental related issues, articles and programme. Therefore, to overcome the barriers in the way to successful conservation of environment, the environment education should be given proper emphasis in the course curriculum at all the levels of education, starting from primary level.

The literature, specially on environment may be printed and distributed among the school children with the help of mobile library. Also, the Govt. should prepare plan to implement the concept of environment savers club like *"Yuvak Mangal Dal"* and mobilize the environment protection activities.

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Attitude of Mango Orchard Growers Towards Drip Irrigation System

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ABSTRACT

The present study was conducted in six talukas of Junagadh district of Gujarat to know attitude of mango orchard growers towards Drip Irrigation system. The result of the research revealed that the majority of the mango orchard growers (66.86 per cent) had moderately favourable attitude towards drip irrigation system, followed by 18.28 per cent respondents with less favourable attitude. It is also apparent from the result of the study that attitude of the mango orchard growers towards drip irrigation system had positive and significant relationship with their technoeconomic consequences, innovation-decision process and extent of economic gain.

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INTRODUCTION

Land and water are the two basic inputs for progress in agriculture and economic development of any country. Gujarat State has a relatively lower share in the overall availability of water in India. In Gujarat, only 23 per cent of the total cultivable land of the state is under irrigation. Even with the fullest exploitation of the Sardar Sarovar Project, about 52 per cent of the state agriculture would be dependent on the mercy of monsoon, particularly erratic, inadequate and uncertain rainfall. Hence, it is necessary to economize the use of water for agriculture to bring more area under irrigation. This could be achieved by introducing the advanced method of drip irrigation. Keeping in the view the above said facts, it is high time to know the attitude of mango orchard growers towards drip irrigation system. Therefore this study was conducted in the Junagadh district of Gujarat State.

METERIALS AND METHODS

The present study was couducted in six talukas of Junagadh district namely Talala, Malia, Una, Medarada, Vanthli and Visavadar. These talukas the first six talukas in the district which were having maximum number of orchards. From each of the selected talukas, four villages having maximum mumber of

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drip sets installed in mango orchards were selected. The mango orchard growers, those who had installed and used drip irrigation system in their mango orchards for successively more than three years, were chosen at random from each identified village in such a manner that there would be proportional to total size of mango orchard growers in respective village fell under each of the six talukas. Thus, the sample consisted of 175 respondents for the study, which constituted 24 per cent of the total size of drip sets under mango orchards in the district. The data were collected by arranging personal interview with 175 mango orchard growers of the twenty four selected villages with the help of interview schedule.

Attitude towards drip irrigation system (DIS) :

Attitude refers to the 'degree of positive or negative affect associated with some psychological object' (Thruston, 1946). The psychological object for the present study has been conceptualization as drip irrigation system. Hence, the attitude in present study means negative or positive reaction of the mango orchard growers associated with drip irrigation system. It was measured with the help of scale developed by Ingle *et al.* (1989) for measurement of attitude of the respondents towards drip irrigation system. The scale consisted of 31 statements and the responses of the respondents were obtained against each statement on a five point continuum ranging from strongly agree to strongly disagree with scoring of 5, 4, 3, 2 and 1 for positive statements and vice-versa for nagative statements. The respondents were grouped into three categories viz., less favourable (below Mean - S.D.), Moderately favourable (in between Mean ± S.D.) and highly favourable (above Mean + S.D.)

RESULTS AND DISCUSSION

(A) Attitude towards drip irrigation system :

Farmers' attitude towards drip irrigation system was measured with the help of an attitude scale developed by Ingle *et al.* (1989). The respondents were grouped into three categories viz., less favourable (upto 90 score), moderately favourable (in between 91 to 114 score) and highly favourable (above 114 score). The data in this respect are presented in Table 1 and Figure-1.

TABLE 1

Distribution of Mango Orchard Growers according to their level of attitude towards drip irrigation system.

Sr. No.	*Level of Attitude*	*Score range*	*Frequency*	*Per cent*
1.	Less favourable	upto 90	32	18.28
2.	Moderately favourable	91 to 114	117	66.86
3.	Highly favourable	Above 114	26	14.86

Mean = 102.331. SD = 11.850

It is apparent from the Table 1 that majority of the mango orchard growers (66.86 per cent) had moderately favourable towards drip irrigation system, followed by 18.28 per cent respondents with less favourable attitude. Whereas, 14.86 per cent of them had highly favourable attitude towards drip irrigation system.

It can be inferred from the findings that majority (66.86 per cent) of the respondents had moderately favourable attitude towards drip irrigation system. This may be due to the facts that farmers might have been motivated through tremendous benefits of drip irrigation system under acute shortage of water as well as they are provided the financial incentives under central and state governments sponsored schemes for drip irrigation which in turn might have played a major role in building up favourable attitude among farmers towards drip irrigation system. The finding is in agreement with the findings of Konde (1987), Ingle and Sagane (1992), Mande *et al.* (1993) and Chaudhari (1995a).

(N = 175)

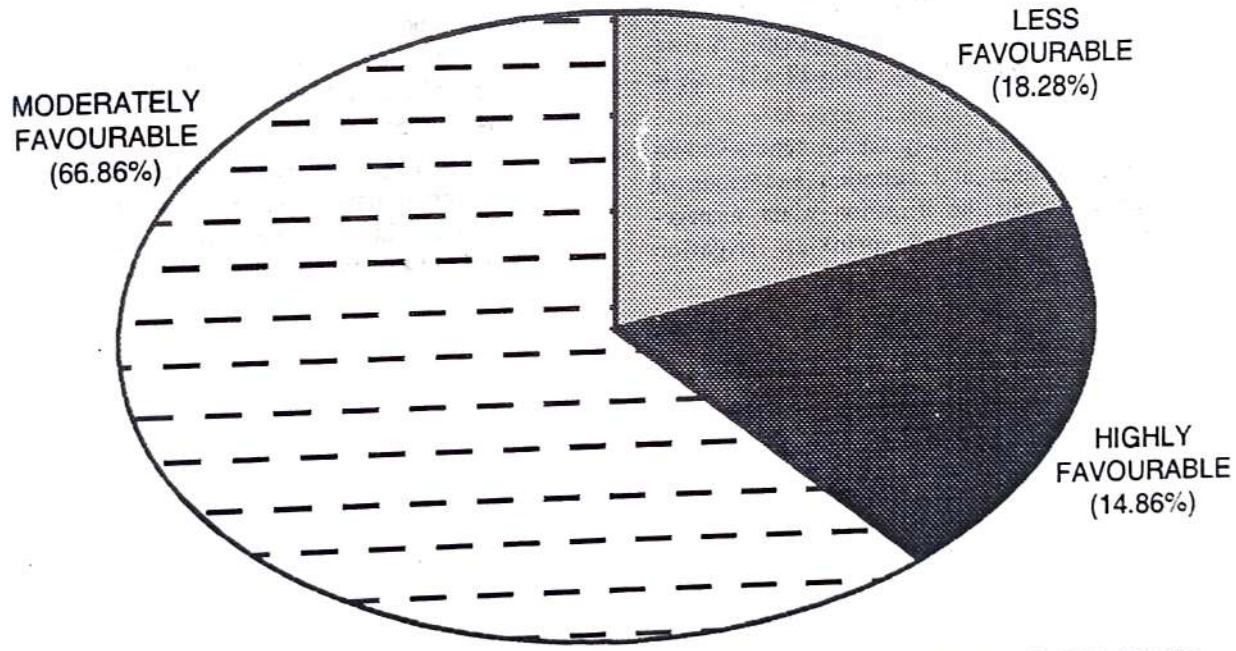

FIG. 1 : DISTRIBUTION OF MANGO ORCHARD GROWERS ACCORDING TO THEIR LEVEL OF ATTITUDE TOWARDS DRIP IRRIGATION SYSTEM.

(B) Relationship between attitude towards drip irrigation system and techno-economic consequences :

The calculated correlation coefficient (r = 0.2502) value was found to be positive and significant at 0.01 level. Hence, the null hypothesis was rejected.

It can be concluded that attitude of the mango orchard growers towards drip irrigation system had positive and significant relationship with their techno-economic consequences.

(c) Relation between attitude towards drip irrigation system and innovation decision process :

It is obvious from the study that attitude of mango orchard growers towards drip irrigation system had

positive and significant relationship with the innovation decision process.

(D) Relationship between attitude towards drip irrigation system and extent of economic gain :

It is evident from the study that attitude of mango orchard growers was found to have positive and significant relationship with extent of economic gain reaped by them through adoption of drip irrigation system.

This finding is in agreement with the findings of Patel and Pandya (1992), Patel and Patel (1992).

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On Comparison of Some Stability Analysis Models- A Case Study of Weedicide Experiment

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ABSTRACT

Three stability analysis models proposed by Eberhart and Russell (1966), Perkins and Jinks (1968) and Freeman and Perkins (1971) were compared empirically for their efficiency using data of weed control experiment wherein nine genotypes were under study. Considering the ranking pattern of genotypes based on stability parameters, degree of freedom associated with regression, information used in estimating stability parameters and smplicity in estimation, the Eberhart and Russell's model was recommended for stability analysis of genotypes tested in varying agronomic experiments.

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INTRODUCTION

Stability in performance is a desirable property for selection or recommendation of specific genotype in plant breeding programme. The concept of stability is either biological or agronomical (Becker, 1981). Biologically a genotype with minimum variance under different environments is considered as stable. An agronomically stable genotype has minimum interaction with environments but responds to favourable environment (s). Number of statistical methods have been proposed (Lewis, 1954; Wricke, 1962 and 1966; Finlay and Wilkinson, 1963; Eberhart and Russell, 1966; Perkins and Jinks, 1968; Freeman and Perkins, 1971; Tai, 1971; Shukla 1972 and Lin and Thompson, 1975) to evaluate phenotypic stability of genotypes.

Literature on use of stabilitry concept for comparing genotypes is available in plenty. But literature on comparison of stablility analysis models (Kaltsikes and Larter, 1970, Fripp, 1972, Luthra and Singh, 1974; Virk *et. al*, 1991 and Prajapati, 1994) is very scanty.

The present study aims to compare some stability analysis models empirically using grain yield data of nine genotypes of pearl millet tested under varying agronomically created environments by weed management treatments.

METERIALS AND METHODS

Experimental Details

Nine genotypes of pearl millet, viz., GHB 27 (G_1), GHB 30 (G_2), GHB 32 (G_3), GHB 181 (G_4), GHB 183 (G_5), GHB 184 (G_6), GHB 229 (G_7), MH 179 (G_8) and BK 560 (G_9) were studied under four weed management treatments, viz., unweeded - control (E_1), weed free-hand weeding (E_2), Atrazine @ 0.75 kg a.i./ha (E_3) and Atrazine 1.25 kg a.i./ha (E_4) by the Weed Control Research Project, B. A. College of Agriculture, GAU, Anand during kharif season of 1990, 1991 and 1992. The experiment was laid out in split plot design with four replications. Genotypes (subplot) were sown in the first week of July every year. Recommended cultivated practices were followed through out the period of experimentation. The grain yield data recorded on net plot basis-three rows each of 5.0 m length, the inter and intra row spacings were 45 cm and 10 cm respectively were subjected to statistical analysis.

Statistical Methods

Analysis of variance was followed for year wise and combined analysis. Further the stability analysis was carried out as per Eberhart and Russell's model (ER), Perkins and Jink's model (PJ) and Freeman and Perkin's model (FP) to estimate stability parameters. In ER model three stability parameters viz., mean performance (Y_i), regression of mean performance on environmental index (b^E_i) and mean square deviation form regression [$S^2_{di}(E)$] for each genotype were estimated. In PJ model also three stability parameters, viz., mean performance (Y_i), regression of Genotype x Environment (G x E) interaction on environmental index (B_i) and mean square deviation from regression [$S^2_{di}(P)$] were estimated (Note : $S^2_{di}(E)$ and [$S^2_{di}(p)$] have the same values). In case of FP model mean performance (Y_i), regression coefficient (B^F_i) and mean square deviation from regression [$S^2_{di}(F)$] were estimated wherein as per method, one replication was considered for measuring environmental index whereas remaining three replications were used for estimating stability parameters. Simple correlation coefficients (r) between stability parameters were worked out for studying association behaviour of the parameters and thereby signify the comparison of models.

RESULTS AND DISCUSSION

The variable effect of genotype (G), environment (E) and G x E interaction on grain yield was significant in individual year (Y) as well as in pooled analysis. The latter showed non-differential influence of Y x E and Y x G x E interaction. Results clearly indicated differential response of genotype to weed management treatments (environments) and also to seasonal variation. The presence of G x E interaction is causing problems in ordering the relative response of genotypes and also creating difficulties in demonstrating significant superiority of any genotype. Such situation signifies the need of stability analysis. The objective of the study was to compare stability analysis models hence the data were analysed accordingly. The results are presented in Table 1 and 2. The stability parameters (Table 1) revealed high heterogeneity among regression coefficients in individual year and also for pooled data. For bravity only pooled data are discussed here.

TABEL 1

Estimates of stability parameters based on four environments using various models for grain yield.

Year	*Genotype*	$\bar{Y}_i$	b^E_i	β_i	b^F_i	$S^2_{di}(E)$	$S^2_{di}(F)$
1990	G1	2.04	1.19**	0.19**	0.66	0.01	-0.30
	G2	2.06	1.20	0.20	1.12	0.07	-0.16
	G3	1.72	0.71	-0.29	0.33	-0.06	-0.12
	G4	2.44	1.13	0.13	1.20	0.21*	0.09
	G5	2.32	1.25*	0.25*	0.46	0.16*	0.26*
	G6	2.50	0.68	-0.32	0.47	-0.04	0.65**
	G7	2.63	1.06	0.06	1.22	-0.04	0.02
	G8	2.06	0.64*	-0.36*	0.63	0.16*	0.23
	G9	1.79	0.84	-0.16	0.94	0.08	0.05
	CD 0.05	0.53					
1991	G1	1.52	2.07**	1.07**	1.47	0.18*	0.26*
	G2	2.16	0.70	-0.30	0.48	0.06	-0.22
	G3	2.16	0.76	-0.24	-0.07	0.05	-0.09
	G4	2.70	1.12	0.12	0.46	-0.02	-0.20
	G5	2.11	1.26*	0.26*	0.65	-0.03	0.03
	G6	2.71	0.47*	-0.53*	-0.04	-0.02	-0.25
	G7	2.47	1.23	0.23	1.01	-0.08	-0.30
	G8	2.93	0.73	-0.27	0.41	-0.02	-0.16
	G9	1.93	0.55*	-0.45*	1.02	-0.04	-0.37
	CD 0.05	0.49					
1992	G1	2.62	1.36	0.36	1.71	0.03	-0.06
	G2	3.01	0.87	-0.13	1.85	-0.01	-0.07
	G3	2.24	0.66*	-0.34*	-0.47	0.18*	0.12*
	G4	3.47	1.26	0.26	1.09	-0.35	-0.07
	G5	2.95	0.78	-0.22	1.02	0.19*	0.03
	G6	2.79	1.40**	0.40**	2.08	-0.03	-0.20
	G7	3.13	1.05	0.05	1.11	0.01	-0.01
	G8	3.61	0.34*	-0.66*	2.32	0.16	-0.02
	G9	2.74	1.67**	0.67**	2.10	-0.08	0.13*
	CD 0.05	0.28					
Pooled	G1	2.06	1.24*	0.24*	1.19	0.22*	-0.05
	G2	2.41	1.15	0.15	1.22	0.28*	-0.09
	G3	2.04	0.62*	-0.28*	0.34	0.02	-0.09
	G4	2.88	1.34*	0.34*	1.29	0.02	-0.02
	G5	2.46	1.03	0.03	0.87	0.04	-0.01
	G6	2.67	0.52*	-0.48*	0.33	-0.06	-0.13
	G7	2.75	1.11	0.11	1.39	0.02	-0.10
	G8	2.88	1.10	0.10	0.94	-0.23	-0.31
	G9	2.51	1.04	0.04	1.19	0.20*	-0.09
	CD 0.05	0.46					

Legend : * Singnifcant at 0.05 probability level.
** Singnificant at 0.01 probability level.

The mean grain yield pooled over three years, ranged from 2.04 kg (G_3) to 2.88 kg (G_4 and G_8), the difference being significant. The four genotypes viz., G_1, G_3, G_4 and G_6 showed significant b^E_i and Bi values of which G_1 and G_4 with $b^E_i > 1$; $B_i > 0$, indicating that these two genotypes were responsive to favourable environments, while G_3 and G_6 had $b^E_i > 1$, $B_i < 0$ showing specific adaptation to poor environments. Three genotypes G_1, G_2 and G_9 deviated significantly from linearity as $S^2_{di}(E)>0$ for these genotypes. The ranking pattern for b^E_i and B_i were by definition (r=1.00 Table 2). Since b^E_i and Bi are related as $b^E_i = 1+B_i$, the simple correlations between these two parameters is the same suggesting that both the models (ER and PJ) were identical. The ranking pattern of genotypes using b^E_i values was nearer to similarity to that of ER and PJ models as r = 0.9510 (Table 2).

TABLE 2

Correlation matrix of stability parameters for grain yield.

1990	$\bar{Y}_i$	b^E_i	B_i	b^F_i	$\bar{S}2d\ (E)$
b^E_i	0.490				
B_i	0.490	1.000**			
b^F_i	0.352	0.732**	0.732**		
S2 di (E)	0.132	0.169	0.169	0.396	
S2 di (F)	0.608	0.736**	0.736**	0.340	-0.015
1991					
b^E_i	-0.535				
B_i	-0.535	1.000**			
b^F_i	-0.570	0.725**	0.725**		
S2 di (E)	-0.167	0.297	0.297	0.470	
S2 di (F)	-0.326	0.827**	0.827**	0.572	-0.641
1992					
b^E_i	-0.382				
B_i	-0.382	1.000**			
b^F_i	0.669	0.169	0.169		
S2 di (E)	0.417	0.428	0.428	-0.047	
S2 di (F)	-0.008	0.433	0.433	0.098	0.064
Pooled					
b^E	0.160				
B_i	0.160	1.000**			
b^F_i	0.169	0.951*	0.951**		
S2 di (E)	0.308	0.386	0.386	0.292	
S2 di (F)	0.486	0.807**	0.807*	0.294	-0.964**

Legend : * Significant at 0.05 probability level.
** Significant at 0.01 probability level.

However, cent per cent association was not observed in ranking pattern. In ER model, G_4 had the highest regression coefficient (1.34) while it was with G_7 in FP model (1.39). The lowest regression coefficient value was observed with G_6 in ER model (0.52) and FP model (0.33). None of the genotype exhibited significant deviation from regression under FP model i.e. $S^2_{di}(F) = 0$.

In PJ model a regression of G x E interacion on environmental index was worked out while in ER model regression on mean performance on environmental index was worked out. This is the basic difference between these two models. The sum of square due to evnironment (linear) in ER model has 1 degree of freedom whereas same estimate termed as joint regression in PJ model has E-1 degree of freedom. In normal analysis linearity component (regression s.s) has 1 degree of freedom. The ambiguity in degree of freedom associated with testing of regression component is likely to affect inference. Apparently from ranking pattern of genotypes and deviation from regression estimates, it can be generalised that PJ model does not give additional information in comparison to ER model.

The ranking pattern of genotypes based on responsiveness (b^F_i) in FP model was not similar to that of ER and PJ models. This deviation in ranking pattern was due to the fact that b^E_i and Bi were estimated using information of all replications, whereas b^F_i was based on few replications. Similarly $S^2_{di}(E)$ and $S^2_{di}(F)$ were obtained. The variation in sample size (replications) affected the estimates causing deviation in ranking pattern of genotypes in ER and FP models, very specifically with reference to S^2_{di} estimates of both the models (Table-2). Any estimate based on full set of data is more reliable and percise than that with partial data set. It is therefore, concluded that ER model be used for stability analysis for genotypes tested under varying environments. Luthra and Singh (1974) also recommended ER model on the ground of simplicity, computational convenience and give complete information.

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Short Communications

Effect of Phosphorus and Sulphur on Growth, Yield, Quality and Nutrient Content of Mustard (*Brassica juncea*)

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Sulphur requirement of oilseeds is quite large. Uptake of sulphur by the oilseeds is as much as that of phosphorus. Since phosphorus and sulphur are the constituents of protein, their relationship is of great importance both from quality as well as production point of view. In paucity of information regarding the effect of phosphorus vis-a-vis sulphur on yield and biochemical composition of mustard [*Brassica juncea* (L.) Czernj. and Cosson] in the South Saurashtra region of Gujarat, the present experiment was undertaken.

A field experiment was conducted during Winter (rabi) season of 1994-95 at Department of Agronomy, Gujarat Agricultural University, Junagadh. The soil was clayey with pH 8.0, low in available N (213 kg/ha) and medium in available P_2O_5 (37 kg/ha), K_2O (185 kg/ha) and S(10 ppm). The treatments comprising 3 levels of P_2O_5 (0, 25 and 50 kg/ha) and 4 levels of S (0, 25, 50 and 100 kg/ha) were laid out in factorial randomised block design with 4 replications. The variety 'Gujarat Mustard-1' was sown at 45 cm row spacing and plant to plant spacing of 10 cm was maintained by thinning 20 days after sowing. The crop was fertilized with phosphorus and sulphur as per the treatments and 50 kg N/ha as a common dose. Whole dose of P and S and half dose of N in form of diammonium phosphate, gypsum and urea were applied in furrows at the time of sowing and rest N was top-dressed 45 days after sowing.

Fresh leaf samples were collected at 50 per cent flowering stage of the crop and analysed for chlorophyll content (Arnon, 1949) and leaf sap pH. The chemical analysis of seeds was done for estimation of oil (AOAC, 1970), protein (Gupta *et al.*, 1974) and fatty acid (Oleic and Linoleic acid) composition (Mehta and Lodha, 1979) as well as N, P and S content.

Significantly the highest number of primary and secondary branches per plant, siliquae per plant, seeds per siliqua and test weight were recorded with 50 kg P_2O_5/ha (Table 1). Except secondary branches per plant, they were at par with 25 kg P_2O_5/ha.

Application of 50 kg P_2O_5/ha evoked significant response in terms of seed and stover yields but the later was found at par with that of 25 kg P_2O_5/ ha P application did not improve plant height. Increased mustard yield with P application could be ascribed to the overall improvement in plant growth and yield components. The results corroborate the work of Khafi *et al.* (1997).

TABLE 1

Growth and yield of wheat as influenced by sowing dates and fertility levels.

Treatments	*Plant height (cm)*	*Primary branches/ plant*	*Secondary branches/ plant*	*Siliquae/ plant*	*Seeds/ siliqua*	*1000-seed weight (g)*	*Seed yield (q/ha)*	*stover yield (q/ha)*
Phosphorus (kg P_2O_5/ha)								
0	178.7	6.1	10.7	234	10.8	3.35	10.47	35.09
25	181.9	6.6	11.0	258	11.2	3.46	13.40	37.27
50	182.3	6.9	12.6	278	12.1	3.54	15.43	39.44
S. EM. ±	1.4	0.2	0.4	9	0.3	0.05	0.32	0.77
C.D.(P = 0.05)	NS	0.5	1.1	26	1.0	0.14	0.93	2.23
Sulphur (kg S/ha)								
0	178.8	6.7	11.1	252	11.5	3.43	12.27	36.28
25	180.4	6.3	11.4	275	11.1	3.45	12.74	36.98
50	183.5	6.8	11.3	248	11.5	3.47	13.28	37.44
100	181.1	6.8	11.9	252	11.4	3.45	14.12	38.36
S. Em. ±	1.6	0.2	0.5	10	0.4	0.06	0.37	0.89
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	1.07	NS

Sulphur fertilization failed to affect the growth and yield attributes (Table 1). Application of sulphur caused significant variation in seed yield, wherein application of 50 and 100 kg S/ha being at par recorded significantly the highest seed yield. The stover yield not altered due to S application. Though growth and yield attributes were not improved due to S application, but the average response over phosphorus might have resulted in increasing seed yield (Tomar *et al.*, 1997).

Application of 50 kg P_2O_5/ ha significantly increased the chlorophyll content of leaf and phosphorus and sulphur contents of seed while decreased the leaf sap pH. Oil, protein, oleic and linoleic composition remain unchanged under various levels of P (Table 2). This finding is akin to the report of Patel *et al.* (1993). Increased P and S content of seed could be ascribed to higher rates of their application (Trivedi *et al.*, 1995).

Sulphur fertilization significantly increased the leaf chlorophyll content and decreased the leaf sap pH, whereas seed composition of oil, protein, fatty acid, nitrogen, phosphorus and sulphur remained unaffected. Khanpara

TABLE 2

Effect of phosphorus and sulphur nutrition on chemical composition of mustard.

Treatment	Leaf composition		Seed composition (%)						
	chloroph-yll (mg/g)	Sap pH	Oil	Protein	Oleic acid	Linoleic acid	Nitrogen	Phosph-orus	Sulphur
Phosphorus (kg P_2O_5/ha)									
0	0.80	5.92	19.7	38.2	8.37	13.88	3.15	0.689	1.149
25	0.84	5.79	20.1	38.8	8.41	14.00	3.21	0.715	1.186
50	0.95	5.75	19.9	38.9	8.41	13.94	3.18	0.735	1.214
S.Em. ±	0.01	0.02	0.1	0.2	0.06	0.07	0.02	0.003	0.005
C.D. (P = 0.05)	0.04	0.05	NS	NS	NS	NS	NS	0.009	0.015
Sulphur (kg S/ha)									
0	0.78	5.94	19.8	38.3	8.46	13.91	3.17	0.713	1.174
25	0.84	5.91	19.9	38.7	8.35	14.02	3.19	0.707	1.180
50	0.87	5.79	19.9	38.9	8.35	14.00	3.18	0.711	1.183
100	0.95	5.64	19.9	38.6	8.42	13.84	3.19	0.720	1.196
S. Em. ±	0.02	0.02	0.2	0.3	0.07	0.05	0.02	0.003	0.006
C.D.	0.05	0.05	NS	NS	NS	NS	NS	NS	NS

et al. (1993) also reported that sulphur makes adequate availability of iron at the sites of phorphyrins biosynthesis, which results in greater synthesis of chlorophyll. Decreased leaf sap pH with sulphur application enables the plant to grow better on alkaline soils.

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Stability Analysis for Seed Yield and Developmental Charaters in Linseed (*Linum usitatissimum* L.)*

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The genotype x environment interaction influencing any developmental trait has a great impact on breeding programme aiming at further genetic improvement for earliness, plant stature and plant growth in crop plants. In view of this an investigation in linseed was planned to study the G x E interaction for flowering, maturity, plant height and seed yield. The experimental material comprising 10 parents and their 45 F_1S was sown in Randomized Block Design with three replications following 25 x 10 cm spacing in a single row plot of 2.5 m length in three environments viz. irrigated and non irrigated at Udaipur (Rajasthan) and irrigated at Anand (Gujarat) during October 1994. Stability analysis for each of the characters under study was carried out following the procedure Eberhart and Russell (1966).

The pooled analysis variance for seed yield and developmental characters is presented in Table 1. The variance due to genotypes was highly significant indicating that genotypic differences were exhisted for these characters. The environment as well as linear component due to environment were significant for all the attributes indicating that the environments over which genotypes were tested differed from each other. The non-linear component (Pooled deviation) was also significant for the characters under study, which suggested that there was considerable genetic diversity in the material studied. These findings are in agreement with those of Singh and Shrivastava (1989), Dubey *et al.* (1990) and Dhakar (1994).

The estimates of stability parameters revealed that out of 55 genotypes 26, 25, 21 and 19 showed low mean values with around unit regression coefficient and nonsignificant pooled deviation for days to flowering (early),

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TABLE 1

Mean squares of stability for days to flower, days to maturity, plant height and seed yield.

Source	*d.f.*	*Days to flower*	*Days to maturity*	*Plant height*	*Seed yield/ plant*
Genotypes (G)	54	122.68**	64.96**	46.04**	4.95**
Environment (E)	2	1186.76**	3900.72**	3505.26**	33.11**
G x E	108	4.62**	8.98**	14.30**	2.18**
E (G x E)	110	26.11	79.74	77.77	2.75
Environment (Linear)	1	2373.34**	7801.47**	7010.60**	66.21**
G x E (Linear)	54	6.16**	10.73	16.05	2.11
Pooled deviation	55	3.03**	7.11**	12.32**	2.22**
Pooled error	324	2.89	3.62	3.44	0.54
Pooled error for testing pooled deviation	-	0.96	1.21	1.15	0.18

*, ** Significant at P = 0.05 and P = 0.01, respectively.

days to maturity (early), plant height (short stature) and seed yield, respectively. The parent LCK 8605 and AKL 79 were classifield as stable for days to maturity and plant height, of which parent AKL 79 was also stable for seed yield, this parent could extensively be utilized in crossing programme for developing stable varieties with early maturity, short plant stature and higher seed yield.

The hybrids viz., LCK 88062 x LW 28-9, LW 28-9 x RLC 29, LCK 8605 x RLC 35, LCK 8605 x Triveni, AKL 79 x Triveni and RLC 35 x Triveni showing stableness for early flowering, early maturity and good plant type could be exploited to isolate segregants with earliness, dwarf plant type and high seed yield. Out of these, hybrid RLC 35 x Triveni is of immense value as it also exhibited stableness for seed yield.

Out of 45 F_1 S, 17 depicted higher mean values with around unity regression coefficient and non significant pooled deviation for seed yield (Table 2 and Figure 1). Of which, hybrid LCK 88511 x Triveni followed by LC 1048 x Chambal and LCK 88062 x AKL 79 recorded maximum mean values. The hybrid LCK 88062 x ALK 79 was also found stable for all the yield contributing components and is expected to throw good segregants as the parent AKL 79 is stable for early maturity, good plant type as well as seed yield and its components. Through pedigree selection better segregants may be advanced for crop improvement.

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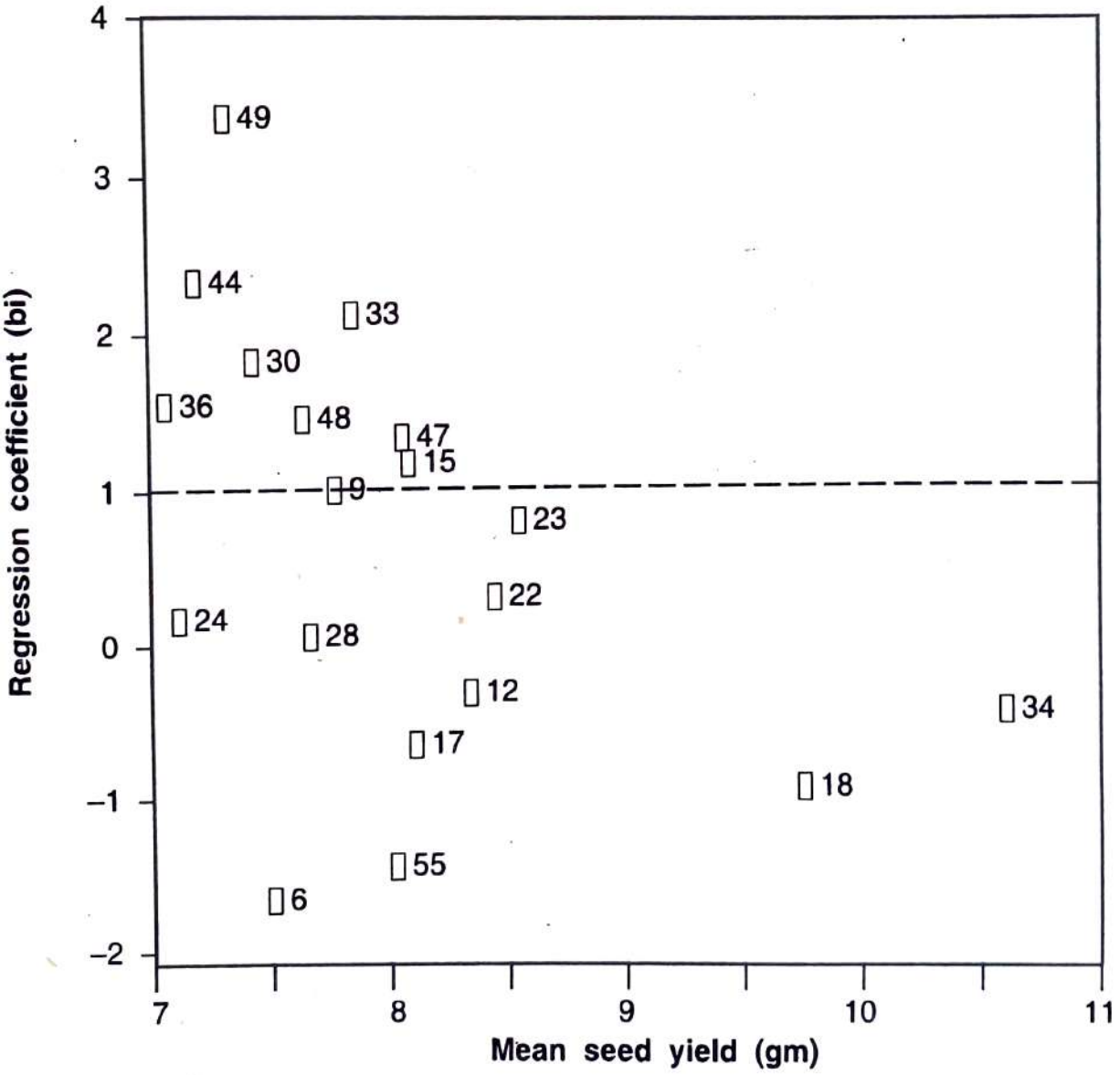
TABLE 2

Performance of genotypes for phenotypic stability of seed yield.

Parents/Cross			*μi*	*bi*	*S²di*
1. LC 1048			4.81	1.63	1.01
2. LCK 88062			4.80	2.20	0.42
3. LCK 88511			5.12	0.04	1.66
4. LW 28-9			4.22	-1.18	0.43
5. LCK 8605			4.06	1.91	3.91*
6. AKL 79			7.55	-1.62	0.02
7. RLC 29			6.58	1.52	2.04*
8. RLC 35			5.94	0.86	0.61
9. Chambal			7.57	1.02	-0.01
10. Triveni			6.77	-0.08	0.83
11. LC 1048	x	LCK 88062	7.16	1.04	2.31*
12.	x	LCK 88511	8.08	-0.40	0.58
13.	x	LW 28-9	6.96	-0.35	10.95**
14.	x	LCK 8605	7.04	0.68	1.13
15.	x	AKL 79	7.89	1.19	-0.09
16.	x	RLC 29	7.82	1.00	2.30*
17.	x	RLC 35	7.89	-0.74	0.40
18.	x	Chambal	9.64	-1.06	1.60
19.	x	Triveni	7.02	1.02	-0.13
20. LCK 88062	x	LCK 88511	6.59	0.37	-0.09
21.	x	LW 28-9	6.27	1.69	1.12
22.	x	LCK 8605	8.15	0.13	0.78
23.	x	AKL 79	8.43	0.85	-0.10
24.	x	RLC 29	7.08	0.11	-0.04
25.	x	RLC 35	8.25	2.66	9.08**
26	x	Chambal	8.96	4.34	5.64**
27.	x	Triveni	7.52	0.26	3.10*
28. LCK 88511	x	LW 28-9	7.50	1.14	4.66**
29.	x	LCK 8605	7.64	0.00	-0.04
30.	x	AKL 79	7.45	1.83	-0.18
31.	x	RLC 29	9.09	-2.05	4.56**
32.	x	RLC 35	7.87	0.77	3.10*
33.	x	Chambal	7.91	2.05	1.18
34.	x	Triveni	10.72	-0.61	1.41
35. LW 28-9	x	LCK 8605	6.02	1.42	0.42
36.	x	AKL 79	7.07	1.52	-0.02
37.	x	RLC 29	6.65	1.84	6.37**
38.	x	RLC 35	6.65	0.90	3.08*
39.	x	Chambal	5.54	0.91	0.98
40.	x	Triveni	5.63	2.92	1.16
41. LCK 8605	x	AKL 79	6.05	2.10	2.26*
42.	x	RLC 29	6.00	0.29	1.21
43.	x	RLC 35	5.23	1.01	0.15
44.	x	Chambal	7.23	2.37	1.38
45.	x	Triveni	7.20	-0.17	8.31**

Parents/Cross			*μi*	*bi*	*S²di*
46. AKL 79	x	RLC 29	5.77	1.58	-0.02
47.	x	RLC 35	7.86	1.26	1.07
48.	x	Chambal	7.85	3.22	12.23**
49.	x	Triveni	6.15	2.48	0.12
50. RLC 29	x	RLC 35	7.60	0.65	5.70**
51.	x	Chambal	7.66	1.45	-0.08
52.	x	Triveni	6.37	2.04	2.13*
53. RLC 35	x	Chambal	6.85	3.14	0.38
54	x	Triveni	7.34	3.34	0.33
55. Chambal	x	Triveni	8.17	-1.49	1.59
P.M. (X)			7.04		
SE of bi			--	1.3582	

Graphical presentation of genotypes for seed yield stability



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