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Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

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RESEARCH NOTE

Agronomic Requirement of New *Hirsutum* Hybrids in Relation to Their Plant Densities and Fertilizer Levels

V.M. Solanke[1], S.T. Wankhede[2], A.B. Turkhede, R.N. Katkar[3] and S.D.Malvi[4]

ABSTRACT

An experiment to study the effect of Agronomic requirement of new hirsutum hybrids in relation to their plant densities and fertilizer levels was conducted during 1995-96 to 1997-98, under rainfed conditions at Cotton Research Unit, Dr, PDKV, Akola (M.S.) Three plant densities and three hybrids as main plot treatments and three fertility levels as sub plot treatments were tested in split plot design with three replications. The results revealed that the American Cotton hybrid with higher plant population (27,777 Plants ha^{-1}) sown at closer spacing of 60 x 60 cm recorded significantly higher seed cotton yield (862 kg ha^{-1}) than reduced plant population of 18518 plants ha^{-1} sown at wider spacing of 60 x 90 cm (793 kg ha^{-1}) and 12345 plants ha^{-1} at 90 x 90 cm (648 kg ha^{-1}) Cotton hybrid AHH-468 and CAHH-8 produced significantly more seed cotton yield than CAHH-468. The increase of 167 kg ha^{-1} and 197 kg ha^{-1} seed cotton yield was registered with the first and second increment of fertilizer levels respectively over 25 : 12.5 : 12.5 kg NPK ha^{-1} level. Hybrid CAHH-8 produced maximum seed cotton under 60 x 60 cm spacing with 50:25:25 kg NPK ha^{-1}.

Among the agronomical factors that are responsible for the yield of cotton manipulation of plant spacing between and within rows behaviour pattern of cotton hybrids and fertilizer levels play an important role in boosting the crop yield under rainfed condition, as it markedly influenced the growth, development and finally the seed cotton. Keeping these point in view the present study was undertaken.

MATERIAL AND METHODS

A field experiment to study the agronomic requirement of new hirsutum hybrids in relation to their plant densities and fertilizer levels under rainfed condition was conducted during *kharif* 1995-96 to 1997-98 at Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. (M.S.) with three plant densties (27,777, 18518 and 12345 plants ha^{-1}) and three hybrids (AHH- 468, CAHH- 468 and CAHH-8) as main treatments and three fertilizer levels as sub plot treatments in a split plot design with three replications. The soil was medium deep black with pH 7.6 and contain 230.2, 21.2 and 570.2 kg ha^{-1}, available nitrogen, phosphorus and potassium respectively. The experiment was sown on 4th, 11th and 8th July during 1995-96, 1996-97 and 1997-98, respectively. A half dose of N, full dose of P_2O_5 and K_2O kg ha^{-1} as per treatments was applied at the time of sowing and remaining half dose of N was top dressed at square stage. All the other cultural practices were followed as per the recommendations. The crop received 543.2, 703.8 and 818.0 mm rainfall in 31, 39 and 44 rainy days during first, second and third year, respectively.

RESULTS AND DISCUSSION

Effect of spacing :

Seed cotton yield was significantly increased with increase in plant population from 12345 to 27777 plants ha^{-1}. American cotton hybrid sown with higher plant population (27,777 plant ha^{-1} at 60 x 60 cm spacing) recorded significantly higher seed cotton yield 8.7 and 33.0 per cent over 18518 and 12345 plants ha^{-1} densities respectively. Gomase and Patil (1985) and Bhalerao *et al.* (1989) reported higher plant densities ha^{-1} recorded more seed cotton yield.

Hybrids :

Amongst the hybrids tested, cotton hybrid AHH-468 recorded significantly higher seed cotton yield over CAHH-468, however, it was at per with CAHH-8.

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Fertility levels :

Application of fertilizer had a significant influence in increasing seed cotton yield (Table 1) Fertilizer dose of 75 : 37.5 : 37.5 kg NPK ha^{-1} recorded maximum seed cotton yield which was at par with the fertilizer dose of 50:25:25 kg NPK ha^{-1} and significantly more over 25 : 12.5 : 12.5 kg NPK ha^{-1}.

The higher two fertilizer levels gave 25.9 and 30.5% increased seed cotton yield over a low level of fertilizer (25:12.5:12.5 kg NPK ha^{-1}) respectively.

Interaction effect :

Seed cotton yield of CAHH-8 was maximum at higher density (27,777 plant ha^{-1}) and it was reduced significantly with decrease in plant population. Seed cotton yield of AHH-468 cotton hybrid was similar at its 27,777 and 18,518 plants ha^{-1} and significantly less at 12,345 plant population ha^{-1}. CAHH-468 gave significantly more yield at higher level of plant population ha^{-1} than lower level (Table 2).

Table 1 : Seed cotton yield as influenced by different treatments

Treatments	Seed cotton yield (kg ha^{-1})			
	1995-96	1996-97	1997-98	Pooled mean
I) Main treatment				
a) Plant densities ha^{-1}				
D1-27777	1021	974	590	862
D2- 18518	924	915	537	793
D3- 12345	819	718	405	648
S.Em $\pm$	33.7	18.8	17.9	15.3
C D.at 5%	99.4	54.4	53.9	60.3
C.V %	18.7	11.2	18.3	-
b) Hybrids				
V1- AHH-468	1000	956	568	842
V2- CAHH-468	861	739	435	678
V3- CAHH-8	903	913	529	782
S.Em $\pm$	33.7	18.8	17.9	20.7
C.D.at 5%	99.4	56.4	53.9	81.5
C.V.%	18.7	11.2	18.3	-
II. Sub treatement				
(NPK, kg ha^{-1})				646
F1-25:12.5:12.5	760	748	430	
F2-50:25:25	983	915	541	813
F3-75:37 5:37.5	1021	948	561	843
S.Em $\pm$	27.4	28.4	16.6	20.3
CD.at 5%	78.5	81.3	47.4	79.9
CV %	15.4	16.9	16.9	-

Table 2 : Seed cotton yield (kg ha^{-1}) as influenced by plant densities x hybrids interaction.

Plant densities hybrids^{-1}	AHH-468	CAHH-468	CAHH-8
D_1 27777	915	715	956
D_2 18518	901	696	781
D_3 12345	711	624	608
S.Em $\pm$	28.3	-	-
C.D. at 5%	84.9	-	-

Economics :

Economic analysis presented in Table 3 indicated that response to per rupee investment on fertilizer to first increase was Rs.6.44 and for second increment was only Rs.0.34.

Growth and yield parameters :

The growth and yield parameters were at higher levels with higher No. of plants ha^{-1} except plant height. Bolls $plant^{-1}$ and yield $plant^{-1}$ were maximum in AHH-468. On an average these growth and yield attributed showed increased trend with increase in fertilizer levels (Table 4).

Thus, it may be concluded that cotton plant population of 27,777 ha^{-1} sown at a distance of 60 x 60 cm was observed to be adequate to new cotton

Table 3. Economic analysis of the fertilizer levels in respect to cotton hybrids

Particulars	Fertility levels (kg ha^{-1})		
	25 : 12.5 : 12.5	50 : 25 : 25	75 : 37.5 :37.5
Response of seed cotton yield to inputs	646	813	843
Additional over 25:12.5 :12.5	-	167	197
Additional over 50:25:25	-	-	30
Cost of fertilizer (Rs ha^{-1})	410	820	1230
Additional over 25:12.5 :12.5	-	410	820
Additional over 50:25:25	-	-	410
Value of seed cotton (Rs ha^{-1})	11802	14854	15402
Gross returns (Rs ha^{-1})	11392	14034	14172
Additional over 25:12.5 :12.5	-	2642	2780
Additional over 50 : 25 : 25	-	-	138
Response in (Rs/Rs) investment			
Over 25: 12.5 : 12.5	-	6.44	3.39
Over 50 : 25: 25	-	-	0.34

Table 4 : Ancillary information (av. of three years)

Treatments	Bolls $plant^{-1}$	Yield $plant^{-1}$ (g)	Dry matter $plant^{-1}$(g)	Plant height (cm)	Sympodial branches $plant^{-1}$
I. Main treatment					
a) Plant densities ha^{-1}					
D_1-27777	11.5	36.8	114.2	82.2	18.1
D_2-18518	15.5	49.3	130.4	80.5	18.8
D_3-12345	18.5	60.5	156.2	81.1	19.5
b) Hybrids					
V_1-AHH - 468	17.5	51.8	161.0	82.5	18.8
V_2-CAHH-468	14.1	46.0	125.5	85.4	19.5
V_3-CAHH-8	13.9	48.6	115.9	75.9	18.4
II. Sub -treatment					
Fertilizer levels					
(NPK kg ha^{-1})					
F_1-25:12:5:12.5	12.9	41.4	114.6	76.6	18.4
F_2-50:25:25	15.8	51.5	138.7	82.5	19.1
F_3- 75: 37.5:37.5	16.7	53.5	147.4	84.7	19.2

hybrid CAHH-8 for getting maximum yield. A distance of 60 x 90 cm (18518 plant ha^{-1}) was suitable for cotton hybrids viz. AHH-468 and CAHH-468. A fertilizer dose of 50:25:25 NPK kg ha^{-1} was found to be optimum for these cotton hybrids under rainfed condition.

LITERATURE CITED

Bhalerao, P.D.,R.V.Nalamwar, S.G, Kharche and R.M.Deshpande, 1989. Effect of plant density and herbicides on weed infestation, growth and yield of seed cotton. PKV Res. J.13(1) : 69-72.

Gomase, B.P.and B.M.Patil, 1985, Agronomic requirement of pre-released and newly released cotton hybrids in respect of their plant densities and response to nitrogen. PKV Res. J.9 (1) : 45-49.

Ravankar, H.N.,V.S.Thakre and V.A.Deshmukh 1994.Response of newly evolved cotton hybrids to various Agronomic Practices. PKV Res. J. 19(1) : 14-17.

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Heterosis Studies on Fibre Quality Characters in Intraspecific Crosses of *Gossypium hirsutum* L.

P.W. Khorgade[1], I.V. Satange[2], B.A. Sakhare[3] and Beena Pillai[4]

ABSTRACT

In American cotton (*Gossypium hirsutum* L.) heterosis was studied for five quality characters. The magnitude of heterosis in desirable direction was highest for lint index followed by micronaire value, fibre strength, 2.5% span length and ginning percentage. Highest significant positive heterotic effect over mid-parent, standard variety (PKV Rajat) and standard hybrid (PKV Hy 2) was observed for lint index in the hybrid PH 93 x LRA 5166 (27.36, 10.70 and 22.37 %). Based on considerable beneficial heterotic response, the superior hybrids were identified for each character.

Cotton is one of the most important commercial fibre crop of India. Now a days heterosis has been considered as a key to boost up the per unit yield and to bring desired quality improvement in the crops. In India, the work on exploitation of hybrid vigour for seed cotton yield and its components was initiated by many workers (Mirza, 1986 and Siddiqui and Patil, 1994). However, the work on fibre quality characters is very meagre. The present investigation describes the extent of heterosis for some important fibre quality characters in intraspecific crosses of *Gossypium hirsutum* L.

MATERIAL AND METHODS

The experimental material comprised of seven diverse genotypes of American cotton (*Gossypium hirsutum* L.) viz., Abadhita, LRK 516, GB 20, PH 93, DHY 286, PKV Rajat and LRA 5166. These were crossed in all possible combinations excluding reciprocals. The resulting 21 hybrids alongwith their 7 parents and two standard hybrids viz., NHH 44 and PKV Hy 2 were raised during *kharif*, 1996 in a randomized block design with three replications. Each progeny consisted of double row of 6 m length with a spacing of 60 cm between and within the rows. Observations were recorded on five fibre quality characters listed in Table 1.

The standard procedure of analysis of variance was adopted to detect genetic differences among the genotypes. Heterosis over mid-parental value (MP), standard variety, PKV Rajat (SV) and standard hybrid, PKV Hy 2 (SH) were estimated as suggested by Hays *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes for all the five fibre quality trials studied. This indicated the presence of considerable amount of variability in the experimental material. Almost identical result has been reported by Desai *et al.* (1982) in upland cotton.

Almost all the characters exhibited considerable amount of heterosis over mid-parent (MP), standard variety, PKV Rajat (SV) and standard hybrid, PKV Hy 2 (SH). However, the magnitude of heterosis varied with characters (Table 1).

The heterotic expression for ginning percentage ranged from -5.98 to 5.52, -12.53 to 0.82 and -5.76 to 8.62 % over MP, SV and SH, respectively. Hybrid GB 20 x LRA 5166 exhibited highest heterosis over MP, while hybrid PH 93 x LRA 5166 showed highest heterosis over both the standard checks. However, only 2 and 5 hybrids exhibited significant positive heterosis over MP and SH. On the other hand none of the hybrids exerted significant positive heterosis over SV for this character. The results of similar nature were also reported by Rao *et al.* (1977) and Ahmed *et al.* (1994).

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Table 1. Heterosis over mid parent (MP) Standard variety (SV) and Standard Hybrid (SH) in percentage for five quality traits.

Crosses/Chatacters	Ginning percentage			Lint index			Micronaire value			Fibre stength			2.5% Span length		
	MP	SV	SH	MP	SV	SH	MP	SV	SH	MP	SV	SH	MP	SV	SH
Abadhita x LRK 516	-5.68**	-6.71**	0.50	-9.89**	-14.59**	-5.59	-9.92*	-16.38**	-12.08**	5.60	5.23	13.11*	1.05	3.30	0.71
Abadhita x GB 20	-3.48*	-7.56**	-0.42	-5.29	-11.67**	-2.37	-8.82*	-12.12**	-7.60	-6.90	1.20	8.78	-2.98	0.00	-2.51
Abadhita x PH 93	-3.53*	-4.79**	2.58	-4.20	-6.03	3.87	-1.46	-4.25	0.67	-4.43	-7.70	-0.79	0.22	-0.73	-3.22
Abadhita x DHY 286	-2.37	-7.28**	-0.69	1.64	-7.59	2.15	0.72	-0.64	4.47	-0.33	6.65	14.63**	3.16	7.60**	4.89
Abadhita x PKV Rajat	-5.98**	-6.53**	0.67	-4.84	-5.64	4.30	0.72	-0.64	4.47	-2.19	-2.77	4.50	-1.90	-0.43	-2.93
Abadhita x LRA 5166	0.93	-2.70	4.82**	6.47	-7.19	2.58	14.17**	0.00	5.14	-1.46	3.14	5.23	0.07	3.73	1.13
LRK 516 x GB 20	-0.57*	-4.65**	2.42	12.70**	0.97	11.61	-3.85	-11.28**	-6.71	-4.94*	4.19	11.98*	7.55**	10.00**	7.24**
LRK 516 x PH 93	-2.62	-3.78*	3.66*	-0.96	6.42	3.44	-1.53	-8.51*	-3.80	1.70	-0.89	6.53	8.30**	6.44**	3.76
LRK 516 x DHY 286	-5.63**	-10.80**	-3.91*	8.05*	-5.64	4.30	-3.76	-9.15*	-4.47	4.37	12.56*	20.99**	4.63*	8.28**	5.56*
LRK 516 x PKV Rajat	-1.93	-2.42	5.13**	-1.10	-4.47	5.38	-9.02*	-14.25**	-9.84*	-2.18	-1.93	5.40	4.83*	5.58*	2.93
LRK 516 x LRA 5166	-5.32**	-8.65**	-1.55	2.68	-14.20**	-5.16	-12.34**	-27.02**	-23.26**	-1.11	3.66	11.42*	3.76	6.74**	4.06
GB 20 x PH 93	-2.33	-6.56**	0.67	0.52	-6.61	3.23	5.88	2.13	7.38	0.74	7.33	15.36**	3.32	2.45	-0.12
GB 20 x DHY 286	-4.28**	-12.53**	-5.76**	8.69*	-6.80	3.01	1.45	-0.64	4.47	-5.82	10.10*	18.34**	3.50	8.02**	5.31*
GB 20 x PKV Rajat	-1.13	-4.70**	2.66	-2.14	-7.97*	1.72	-8.70	-10.64*	-6.04	-4.55	4.34	12.15*	7.32**	9.01**	6.28**
GB 20 x LRA 5166	5.52**	-1.44	6.18	14.15**	-6.42	3.44	-1.22	-14.25**	-9.84*	3.99	16.07**	24.76**	0.83	4.59	1.97
PH 93 x DHY 286	-0.66	-6.30**	0.94	5.33	-4.47	5.59	-1.44	-2.76	2.24	-2.75**	1.94	6.57	1.50	1.84	-0.71
PH 93 x PKV Rajat	-3.61**	-4.27**	3.69	-5.48	6.61	3.23	-3.02	-4.25	0.67	5.57	2.62	10.30	6.01**	3.43	0.83
PH 93 x LRA 5166	4.67**	0.82	8.62**	27.36**	10.70**	22.37**	-2.83	-14.89**	-10.51*	4.04	3.51	11.25*	4.16*	3.86	1.25
DHY 286 x PKV Rajat	-3.41*	-8.23**	-1.14	4.24	-4.20	5.81	-2.13	-2.13	2.91	-5.27	1.94	9.57	-0.21	2.57	0.00
DHY 286 x LRA 5166	-3.11*	-10.83**	-5.49*	10.24*	-12.06**	-2.80	5.18	-6.38	-1.56	1.19**	11.15*	19.47**	-0.89	3.99	1.38
DHY Rajat x LRA 5166	-0.51	-3.47*	3.99*	5.53	-7.20	2.58	-1.99	-12.76**	-8.27	-5.12	-2.98	4.27	1.68	3.86	1.25
SE (m) ±	-0.52	0.59	0.59	0.17	0.20	0.20	0.16	0.19	0.19	0.82	0.95	0.95	0.46	0.54	0.54

*, ** Significant at 1per cent and 5 per cent level, respectively

Out of 21 hybrids, 6 hybrids exerted significant positive heterosis over MP, while one hybrid exhibited significant positive heterosis over SV and SH for lint index. The highest heterosis over MP was recorded in PH 93 x LRA 5166 (27.36%) followed by GB 20 x LRA 5166 (14.15%) and LRK 516 x GB 20 (12.70%). The highest heterosis over SV and SH was recorded in PH 93 x LRA 5166 (10.70 and 22.37%). This hybrid also had significant positive heterosis over MP and SH for ginning percentage. This indicated that heterosis breeding would be useful for obtaining high lint yield. Similar findings were also noticed by Mirza (1986), Gupta and Singh (1987) and Siddiqui and Patil (1994).

Micronaire value is an important criterion in judging lint quality of long staple cotton. The increase in micronaire value is indicative of coarseness and is not desirable beyond the limit set for different staple categories. Among the hybrid LRK 516 x LRA 5166 exhibited highest significant negative heterosis over MP, SV and SH (-12.34 , -27.02 and -23.26) followed by Abadhita x LRK 516. Thus, these hybrids are identified as best hybrids on the basis of their fineness. Out of 21 hybrids 4, 11 and 5 hybrids showed significantly negative superiority over MP, SV and SH, respectively. These results are in conformity with those reported by Gunaseelan and Krishnaswami (1990) and Ahmed *et al.* (1994).

The fibre strength of each genotypes was determined by an instrument "Stelometer". Larger the strength index, stronger would be the fibre strength. Heterosis for fibre strength ranged from -6.90 to 5.60, -7.70 to 16.07 and -0.79 to 24.76 % over MP, SV and SH, respectively. Hybrid Abadhita x LRK 516 showed highest heterosis over MP (5.60%), while hybrid GB 20 x LRA 5166 exhibited highest heterosis over both the standard checks. The other promising hybrids were LRK 516 x DHY 286, DHY 286 x LRA 5166 and GB 20 x DHY 286 on the basis of their significant positive heterosis over SV and SH. The high amount of heterotic response for this quality trait in cotton was also reported by Ahmed *et al.* (1994).

In cotton, 2.5% span length is a new concept of measurement of fibre length parameter to be recorded by Digital Fibrograph. In the present study, the hybrid LRK 516 x PH 93 exhibited highest significant positive heterosis over MP (8.30%) followed by LRK 516 x GB 20 (7.55%) and GB 20 x PKV Rajat (7.32%). The highest significant positive heterosis over SV and SH was recorded in LRK 516 x GB 20 (10.00 and 7.24%) followed by GB 20 x PKV Rajat and LRK 516 x DHY 286. Out of 24 hybrids 7, 8 and 5 hybrids exhibited significantly positive superiority over MP, SV and SH, respectively. On the other hand none of the hybrids showed significant negetive heterosis for this character. Desai *et al.* (1982) and Gunaseelan and Krishnaswami (1990) also reported varying magnitudes of heterosis for 2.5% span length.

It may thus be concluded that the following crosses could be considered for exploiting hybrid vigour, PH 93 x LRA 5166 and GB 20 x LRA 5166 for ginning percentage and lint index; LRK 516 x LRA 5166 and Abadhita x LRK 516 for micronaire value; GB 20 x LRA 5166 and LRK 516 x DHY 286 for fibre strength and LRK 516 x GB 20 and GB 20 x PKV Rajat for 2.5% span length. In general, the hybrid PH 93 x LRA 5166 which showed considerable heterosis over MP, SV and SH in desirable direction for all the five quality characters can be considered as the best combination among the 21 hybrids evaluated.

LITERATURE CITED

Ahmed, S., A. Hussain, N. Muhammad and A. Rashid, 1994. Heterosis studies on quality traits in intraspecific crosses of *Gossypium hirsutum* L. Pak. J. Scientific and Industrial Res. 37 (4) : 153-155.

Desai, D.T., N.P. Mehta and S.B.S. Tikka, 1982. Heterosis for seed cotton yield, yield components and some fibre quality characters in upland cotton (*Gossypium hirsutum* L.) GAU Res. J. 7(2) : 79-86.

Gunaseelan, T. and R. Krishnaswami, 1990. Inheritance of fibre properties in the inter-racial crosses of *Gossypium hirsutum* L. J. Indian Soc. Cott. Improv. 15 (1) : 6-15.

Gupta, S.P. and T.H. Singh, 1987. Heterosis and inbreeding depression for seed cotton yield and fibre attributes in upland cotton (*G. hirsutum* L.) Crop Impro. 14 (1) : 14-17.

Hays, H.M., F.F. Immer and D.C. Smith, 1955. Methods of Plant Breeding, Mc. Graw-Hill Book Co. Inc., New York.

Mirza, S.H., 1986. Heterosis and heterobeltiosis for plant height, yield and its components in intraspecific diallel crosses of cotton, *G. hirsutum* L. Pakistan Cotton 30 (1) : 13-22.

Rao, G.M.R., K.G. Hiremath, J.V. Goud and B.H. Katarki, 1977. A study of heterosis in *Gossypium hirsutum* L. Mysore J. Agric. Sci. 11(2) : 134-139.

Siddiqui, M.A. and R.A. Patil, 1994. Heterosis in crosses of *hirsutum* cotton. J. Maharashtra Agric. Univ. 19(2) : 241-244.

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Heterosis for Yield and Yield Components in Sesamum (*Sesamum indicum* L.)

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ABSTRACT

A study was made in sesamum with a 5 X 5 diallel to assess the extent of heterosis over mid and better parent for yield and its related attributes. All the hybrids showed significant positive heterosis both over mid and better parent for seed yield plant^{-1}. The estimate of heterosis for seed yield plant^{-1} ranged from 25.35% to 58.19% over mid parent and 14.26% to 55.22% over better parent. The cross JS-1 X JS-3 exhibited the maximum heterosis for seed yield plant^{-1} (55.22% over better parent) followed by JS-2 x JS - 3(44.34% over better parent.) Heterosis for yield was manifestated through component heterosis and hybrid vigour of even small magnitude for individual trait may had additive or synergistic effect on seed yield.

Sesamum (*Sesamum indicum* L.) is one of the important edible oilseed crops of the warm regions of the tropics and sub-tropics. Though India stands first in both total sesamum production and acreage in the world but the average productivity of this crop is far below compare to many other countries. Development of high yielding hybrid may, therefore, be useful to overcome the present yield barrier of the crop. Considering the easy emasculation and availability of abundant pollen and large number of seeds/ capsule, hand pollination and exploitation of heterosis is a feasible proposition , in sesamum (Subbalakshmi, 1996). The present study was therefore, undertaken to study the extent of heterosis in sesamum for seed yield and its attributes.

MATERIAL AND METHODS

The experiment was conducted at the Instructional cum Research Farm of Assam Agricultural University, Jorhat during *kharif* 1993 and summer 1994. The experimental material comprised of five parental lines of sesame and their 10 F_1s obtained by all possible direct cross combinations among the parents. The F_1s along with the parents were grown in radomized block design with three replications. Recommended package of practices were followed to raised the crop. Observations were recorded for nine quantitative traits, viz., days to 50% flowering, days to maturity, plant height, number of branches plant^{-1}, number of seeds capsules^{-1}, 1000-seed weight and seed yield plant^{-1}. Mean values of ten randomly selected plants of each entry in each replication were recorded to estimate the percentage of heterosis.

RESULTS AND DISCUSSION

The percentage of heterosis for yield and yield components are presented in Table 1. The cross JS-4 x Local exhibited significant heterosis (over better parent) for days to 50% flowering. Three crosses viz., JS-2 x Local , JS-3 x Local and JS-1 x Local showed significant positive heterosis (over better parent) for days to maturity. JS-3 x JS-4 and JS-4 x Local exhibited significant negative heterosis (over better parent) for plant height, indicating significant

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Table 1. Percentage of heterosis over mid and better parent (MP & BP) for seed yield and its related attributes in sesame.

Crosses		Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of capsules plant^{-1}	Capsule length (cm)	Number of seed capsule^{-1}	1000 seed weight (g)	Seed yield plant^{-1} (g)
JS-1 x JS-2	MP	-1.81	1.84	1.96	10.30	27.17**	-0.50	3.75	2.01	49.74**
	BP	-2.68	1.33	0.77	5.35	20.35**	-0.66	2.58	1.33	40.60**
JS-1 x JS-3	MP	-2.25	1.18	1.64	30.43**	38.64**	-0.17	5.89	0.50	58.19**
	BP	-3.65	1.01	0.91	22.22**	37.00	-0.67	4.59	0.33	55.22**
JS-1 x JS-4	MP	2.31	1.88	-0.04	33.97**	19.44**	-0.17	7.20*	0.33	41.21**
	BP	-0.88	0.33	-0.49	12.45	11.63	-0.33	6.98	0.33	30.20**
JS-1 x Local	MP	1.36	4.83**	14.79**	3.90	19.78**	1.19	11.83**	3.72*	51.57**
	BP	0.00	2.35*	9.22**	-17.94*	5.09	-0.67	0.42	2.33	18.08
JS-2 x JS-3	MP	-0.47	0.34	-0.26	14.03*	15.18*	2.01*	14.13**	5.86**	50.96**
	BP	-0.93	0.00	-0.73	11.76	11.24	1.33	11.47**	4.98**	44.34**
JS-2x JS-4	MP	3.25	1.36	6.30**	-10.19	9.38	1.33	9.69**	6.71**	45.59**
	BP	3.25	-0.67	4.60**	-21.62**	7.93	1.00	8.23*	6.00*	42.78**
JS-2 x Local	MP	4.11*	5.32**	16.48**	13.75	9.55	1.36	11.74**	5.78**	48.46**
	BP	3.63	2.33*	9.60**	-6.91	1.08	0.66	-0.66	5.07**	21.41**
JS-3 x JS-4	MP	3.74	1.37	-6.84**	16.03*	1.95	1.34	7.25*	3.83*	25.35**
	BP	1.84	-0.33	-7.93**	3.06	-2.79	1.00	6.15	3.65	17.65**
JS-3 x Local	MP	2.75	5.00**	10.20**	-5.52	5.38	2.73**	17.52**	6.58**	44.71**
	BP	2.75	2.36*	4.13**	-21.44*	-3.98	1.35	6.71	4.98**	14.31*
JS-4 x Local	MP	9.35**	2.61*	0.86	14.89	-2.95	3.40**	16.28**	9.12**	37.57**
	BP	7.35**	1.74	-3.62**	6.51	-9.34	1.67	4.61	7.67**	14.26*

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

reduction in plant height in these two crosses. However , the crosses viz., JS-2 x Local and JS-1 x Local exhibited significant positive heterosis (over better parent) for plant height. Significant positive heterosis (over better parent) for number of branches plant^{-1} was recorded in the cross JS-1 x JS-3 while, significant negative heterosis were recorded in three crosses viz., JS-2 x JS-4, JS-3 x Local and JS-1 x Local indicating reduction in number of branches in these crosses. Significant positive heterosis (over better parent) were exhibited by JS-1 x JS-2 and JS-1 x JS-3 for number of capsules plant^{-1}. Not a single cross exhibited significant heterosis over better parent for capsule length, however, three crosses viz., JS-4 x Local, JS-3 x Local and JS-2 x JS-3 exhibited significant heterosis over mid parent. Two crosses viz., JS-2 x JS-3 and JS-2 x JS-4, exhibited significant positive heterosis (over better parent) for number seeds capsule^{-1}. Six crosses viz., JS-4 x Local, JS-2 x JS-4, JS--2 x Local, JS-2 x JS-3, JS-3 x Local and JS-3 x JS-4 exhibited significant positive heterosis over better parent for 1000 seed weight.

All the crosses exhibited significant positive heterosis for seed yield plant^{-1}. Out of which, maximum heterosis was observed in the cross JS-1 x JS-3 (58.19% and 55.22% over mid and better parent respectively). It was following by JS-2 x JS-3 (50.96% and 44.34% over mid and better parent respectively.) Reddy and Haripriya (1990) also recorded a maximum heterosis of 71.00% and 50.00% over mid and better parent for seed yield in sesame. In the present study, none of the crosses showed significant heterosis over better parent for capsule length. Moreover, in the cross, JS-1 x JS-4, none of the yield attributes exhibited significant heterosis over better parent. It was also observed that no single cross exhibited significant heterosis for all the traits studied. These revealed that heterosis for yield was manifested through component heterosis and hybrid vigour of even small magnitude (non-significant effect) for individual yield components may have additive or syergistic effect on seed yield. Similar remarks were also made by Sasikumar and Sardana (1990) in sesame. Evidently, manifestation of heterosis for yield and yield components may be due to non-additive gene effects in the parents.

The present study revealed manifestation of considerable amount of heterosis for seed yield in sesame. It indicates larger scope for heterosis breeding in this crop considering feasibility of hand emasculation for commercial exploitation of heterosis.

LITERATURE CITED

Reddy, C.D.R. and S.Haripriya, 1990. Genetic architecture, combining ability and heterosis for certain physiological parameters in sesame (*Sesamum indicum* L.) Indian J. Pl. Physiol. 33(1) : 94-96.

Sasikumar, B. and S.Sardana, 1990. Heterosis for yield and yield components in sesame. Indian J. Genet. 50 (1) : 45-49.

Subbalakshimi, B. 1996. Heterosis in sesamum. Madras Agric. J. 83 (6) : 345-348.

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Study on in Vivo Pollen Germination in Interspecific Crosses of Sesame

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ABSTRACT

Studies on pollen germination and tube growth *in vivo* in direct, reciprocal and backcrosses of *Sesamum indicum* (2n = 26) involving wild species *S. alatum* (2n = 26), *S. laciniatum* (2n=32) was conducted. Pollen germination percentage ranged from 21.47 to 80.54 and it was maximum in the backcross (*S. indicum x S. laciniatum*) x *S. indicum*. Pollen tube growth was observed after 1,4,8 and 24 hours after pollination. It was longer in the backcross (38.05 mm) 24 hours after pollination. Percentage pollen tube growth in the style after 24 hours of pollination ranged from 15.46 to 52.34 and it was maximum in the cross (*S. indicum x S. laciniatum*) x *S. indicum*. There was difference between direct and reciprocal crosses of *S. indicum* and *S. alatum*. Spectrum of recombination was poor in the cross S.alatum x S. indicum. To find out the presence of zygotic elimination mechanism, this study was undertaken. Sesame, an important oilseed crop has wild species with desirable traits like resistant to pests, diseases and hardiness. For the improvement of cultivated sesame, interspecific crosses were attempted to transfer useful genes from wild species. But in some cases incompatability was encountered which resulted in shrivelled seeds containing aborted embryos. The present study was conducted, to reduce the mechanism of incompatability in interspecific crosses of sesame.

MATERIAL AND METHODS

The experimental material comprised of *S. alatum* x *S. indicum* and its backcrosses (*S. indicum* x *S. laciniatum*)x *S.indicum*, (*S.alatum* x *S.indicum*) x *S.indicum* with distinct morphological traits. For effecting crosses, flower buds to bloom on the next day were selected and emasculated on the previous day evening. Next day morning, pollen collected from the desired male parents were dusted on the emasculated flower and labelled appropriately. Pollinated pistils were treated according to modified method of Sitch (1990). After 1, 4, 8 and 24 hrs. of pollination, pollen germination and growth was observed using flourescent microscope.

RESULTS AND DISCUSSION

The pollen germination percentage in crosses of sesame were differing from each other (Table 1). *S. alatum* x *S. indicum* showed lower mean pollen germination percentage while higher percentage was noticed in (*S.indicum* x *S.laciniatum*) x *S.indicum*. Variations in pollen germination among crosses of different indica rice varieties were reported earlier (Selvanathan and Khanna, 1989). Highest percentage of pollen tubes in style 24 hours after pollination was observed in the cross (*S. indicum* x *S. laciniatum*) x

Table 1. Percentage of in vivo germination of crosses

Crosses	Mean (per cent)
S. alatum x *S.indicum*	21.47
S. indicum x *S.alatum*	43.89
(*S.alatum* x *S.indicum*) x *S.indicum*	65.98
(*S.indicum* x *S.laciniatum*) x *S.indicum*	80.54

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Table 2. Percentage of pollen tubes reaching the style 24 hours after pollination

Crosses	Mean (Percentage)
S. alatum x *S.indicum*	15.46
S. indicum x *S.alatum*	36.93
(S.alatum x *S.indicum)* x *S.indicum*	38.81
(S.indicum x *S.laciniatum)* x *S.indicum*	52.34

Table 3. Length of pollen tube after different hours of pollination

Crosses	Lengthof	pollen	Tube (mm)	
	1	4	8	24 hrs
S. alatum x *S.indicum*	1.34	10.52	14.51	28.60
S. indicum x *S.alatum*	1.16	14.60	16.94	19.31
(*S.alatum* x *S.indicum*) x *S.indicum*	1.01	23:40	24.73	29.14
(*S.indicum* x *S.laciniatum*) x *S.indicum*	1.03	31:35	36.37	38.05

S.indicum, where as the combination *S.alatum* x *S. indicum* registered the lowest percentage (Table 2).

One hour after pollination, the cross *S.alatum* x *S. indicum* exhibited highest length of tube growth (Table 3) while (*S.indicum* x *S.laciniatum*) x *S.indicum* showed slow action. This backcross showed longer tube growth after 24 hours of pollination. Time requirement for entry of pollen tube into the ovule was variable depending upon the distance between the pollen on the stigma and ovule (Weatherwax, 1919). Differences in the chromosomal constitution of the pollen grains might bring about differential growth rates of pollen tubes (Blakeslee, 1928). The difference observed in the present study also might be due to the variation in the chromosome number of the parents involved in this study.

LITERATURE CITED

Blakeslee, A.F., 1928. Genetics of Patum. Y. Induct Amstamm, Lehre (supplement) . pp 117-130

Selvanathan, M and V.K., Khanna, 1989. Pollen development and hybridization between indica varieties in rice. Intl. Rice Res. News Lett. 14 : 7-8.

Sitch, L.A., 1990. Incompatability barriers operating in crosses of *Oryza sativa* with related species and genera. In : Gustafsson, J.P.(ed) Gene manipulation in plant improvement ii Phenum press, New York, pp 77-93

Weatherwax, P., 1919. Gametogenesis and formation in *Zea mays* as the basis of xenia and heridity in the endospern. Bull. Torry Bot Club, 46: 73-90.

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Combining Ability Studies in Sesame (*Sesamum indicum* L.)

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ABSTRACT

In 12 x 12 diallel analysis, the mean squares due to gca and sca were significant for all the traits studied. However, the relative estimates due to sca were higher in magnitude that the corresponding estimates due to gca for all the traits except days to 50 per cent flowering indicating the role of non-additive gene action in this material. The parents N-128, Phule Til-1 were identified as good combiners for as much as 6 and 7 traits including seed yield per plant. The cross Phule Til - 1 X IC-21705 was found to be promising for isolation of superior segregates.

The breeding strategy for any crop improvement programme involves the direct selection or hybridization followed by selection. The success of hybridization programme is largely determined by the proper choice of parents and early identification of the potential crosses that are most likely to give the highest proportion of superior segregates in later generations. The combining ability studies provide a useful took in this direction.

Therefore, the present study was undertaken to estimate the general and specific combining ability effects for the selection of potential parents and crosses.

MATERIAL AND METHODS

In the present investigation, 12 genotypes selected on the basis of maturity, high yield and oil potential, crossed in diallel fashion excluding reciprocals to obtain 66 crosses. These twelve genotypes and their 66 crosses were grown in a randomised complete block design with three replications during *kharif* season of 1989 at the farm of Department of Agril. Botany, Punjabrao Krishi Vidyapeeth, Akola. Each treatment consisted of a single row of 24 plants spaced 15 cm within the row and 30 cm between the rows. Normar package of practices were followed to raise the healthy crop. The data were recorded on five randomly selected competitive plants per genotype in each replication for 10 trains viz., days to 50% flowering, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule, capsule length 1000- seed weight, seed yield per plant, oil content and harvest index. The combining ability analysis was carried out following the methodology of Griffing's (1956) Mode I method 2.

RESULTS AND DISCUSSION

The Parent Phule Til - 1 (1.62 g plant^{-1}) and the cross phule Till-1 X IC-41930 (3.21g plant^{-1}) exhibited the highest mean seed yield (Table 4). The combining ability analysis revealed that mean squares due to general and specific combining ability were significant for all the traints under study (Table 1). However, the relative estimates of components of variartion due to specific combining ability (1/66 Σs_{ij}^2) were higher in magnitude than the corresponding estimates due to general combining ability (1/11Σg_i^2) for all the traits except days to 50 per cent flowering indicating the predominance of non-additive gene action in this material. Sprague and Tatum (1942) suggested that in a highly selected set of parents, variances due to specific combining were greater in magnitude as compard to general combining ability. Similar result have been reported by Shrivas and Singh (1981), Anandkumar and Rangaswamy (1987), Khorgade *et al.* (1988), Goyal and Sudhirkumar (1991), and Manivannan (1997). However, relative importance of gca when compared to sca indicated that the ratio was closer to unity for all the traits suggesting the importance of additive portion in predicting the performance in this material.

The high gca effect provides an guideline for selection of parents in hybridization programme. The gca effects of parents are presented in Table 2. In the present study, the parent IC-21705 was best

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Table 1. Analysis of variance for combining ability

Source of Variation	d.f.	Mean squares									
		Days to 50% flowering	Plant height (cm)	Number of branches plant^{-1}	Number of of capsule plant^{-1}	Number of seed capsule^{-1}	Capsule length (cm)	1000 seed weight (g)	Seed yield plant^{-1} (g)	Oil content (%)	Harvest index (%)
1	2	3	4	5	6	7	8	9	10	11	12
GCA	11	45.044**	612.143**	1.085**	79.942**	161.385**	0.042**	0.115**	0.799**	3.425**	17.862**
SCA	66	3.119**	94.407**	0.252**	24.488**	28.989**	0.014**	0.046**	0.330**	2.246**	5.850**
Error	154	1.751	44.652	0.054	1.608	2.597	0.005	0.023	0.054	1.367	1.489
Components of variation											
$1/1\Sigma gi^2$		3.092	40.535	0.074	5.595	11.342	0.003	0.007	0.053	0.147	1.170
$1/66\Sigma sij^2$		1.368	49.755	0.198	22.880	26.392	0.009	0.023	0.276	0.879	4.361
GCA Vs. SCA=2 MS_{GCS} / 2 MS_{GCA} + MS_{SCA}		0.97	0.93	0.90	0.87	0.92	0.86	0.83	0.83	0.75	0.86

* $P \leq 0.05$, ** $P \leq 0.01$

Table 2. General combination ability effects of parents for different traits

Sr. No.	Parents	Days to 50% flowering	Plant height (cm)	Number of branches plant^{-1}	Number of of capsule plant^{-1}	Number of seed capsule^{-1}	Capsule length (cm)	1000-seed weight (g)	Seed yield plant^{-1} (g)	Oil content (%)	Harvest index (%)
1	2	3	4	5	6	7	8	9	10	11	12
1.	N-128	3.814**	12.825**	0.648**	2.141**	3.270**	0.055**	0.058	0.240**	0.374	-2.200**
2..	Phule Til-1	-0.234	8.747**	0.272**	2.232**	3.465**	0.054**	0.221**	0.288**	0.091	0.499
3.	ES-216	-1.496**	0.257	-0.256**	-0.440	3.012**	0.056**	0.016	0.059	0.584	0.712*
4.	IC-21705	-2.854**	2.310	0.268**	4.293**	4.041**	0.032	-0.093*	0.268**	0.360	1.672**
5.	JLT-5	-1.592**	-1.852	0.048	2.122**	0.380	-0.005	-0.065	0.080	-0.419	0.497
6.	IC-41930	1.193**	6.976**	-0.077**	-0.920**	-1.127**	-0.022	0.082	-0.064**	-0.839**	-0.600**
7.	EC-118569	0.551	-8.210**	-0.233**	-2.739**	-5.092**	-0.044**	-0.067	-0.378**	-0.194	-1.271**
8.	EC-109693	0.838*	-5.876**	-0.289**	-2.002**	-6.368**	-0.007	0.025	-0.365**	-0.626*	-1.037*
9.	IC-043118	-0.877**	-5.728**	-0.147*	0.031	-0.110	0.015	-0.104**	-0.042	-0.189	0.617**
10.	IC-14120	-1.353**	-6.280**	-0.170**	0.008	0.784	0.018	-0.007	0.004	0.194	1.120**
11.	TMV-3	0.362	-0.305	-0.095	-4.179**	-2.340**	-0.085**	-0.023	-0.332**	-0.209	-0.607
12.	IC-42959-2	1.646**	-2.862	-0.123*	-0.548	-2.168**	-0.113**	-0.044	0.115	-0.805**	0.597
SE (gi) +		0.339	1.710	0.059	0.324	0.412	0.018	0.039	0.059	0.299	0.312
SE (gi - gi) +		0.500	2.526	0.088	0.479	0.609	0.027	0.057	0.088	0.442	0.461

* $P \leq 0.05$, ** $P \leq 0.01$

general combiner for days to 50 per cent flowering, number of capsules per plant, number of seeds per capsule and harvest index. The parent Phule Til - 1 was best general combiner for 1000- seed weight and seed yield per plant. The parent N-128 was best general combiner for plant height and number of branches per plant. The parents ES-216 & IC-41930 were the best general combiners for improving capsul length and oil content respectively. These parents may produce the progenies of high mean performance for these traits. The parent Phule Til - 1 was good combiner for 7 traits viz., plant height, number of branches per plant, number of capsules per plant, number of seed per capsule, capsule length, 1000-seed weight and seed yield per plant. Similarly, the parent N-128 was also good combiner for 6 traits viz., plant height, number of branches per plant, number of capsules per plant, number of seeds per capsul length, and seed yield per plant. High general combining ability effects are related to additive genetic effects or additive x additive interaction effects which represent the fixable genetic components of variation. In view of this, these parents possess the favourable genes for yield and its contributing traits which can be utilised insesamum breeding.

Specific combining ability effects represent dominance and epistatic components of variation which contribute tangibly in the identification of promising cross combinations for their exploitation of heterosis at commercial level. The crosses showing highest estimates of sca effects for different traits are presented in Table 3. The cross Phule Til -1 x IC-043118 was the best cross combination for number of capsules per plant and oil content. For number of seeds per capsule and seed yield per plant, the cross Phule Til - 1 x IC-41930 was the best specific cross combination. The cross EC-109693 x IC 14120 showed highest sca effects for days to 50 per cent flowering in desired direction while for plant height the cross N-128 x EC - 118569 recorded highest positive significant sca effect. The crosses IC-21705 x IC-42959-2, N-128 x IC-41930, IC-043118 x IC14120 and ES-216 X TMV-3 expressed the highest positive significant sca effects for number of branches per plant, capsule length, 1000-seed weight and harvest index respectively.

In the present study, most of the cross combinations with high and significant sca effects also showed very high heterotic effects. The cross phule Til - 1 X IC-41930 exhibited high mean, high heterosis, high useful heterosis and high sca effect for seed yield per plant (Table 4). This cross appears to be worthy for exploitation of heterosis at commercial level in sesamum. Similarly, the cross Phule Til-1 X IC - 21705 also exhibited high mean seed yield, high useful heterosis and non-significant sca effect and the parents, phule Til-1 and IC-21705, involved in this cross were also good combiners for 7 and 6 traits respectively including seed yield (Table 4). Therefore, this cross may serve as a better source population to get superior recombinant lines. Biparental cross approach in this cross (Phule Til - 1 X IC-21705) should be advocated to exploit both

Table 3. The crosses showing highest estimates of specific combination ability effects for different traits

Sr. No.	Traits	Crosses	SCA effects	S.E. (Sij) +
1	2	3	4	
1.	Day to 50% flowering	EC-109693 X IC-14120	-4.298**	1.233
2..	Plant height (cm)	N-128 x EC-118569	21.239**	6.226
3.	Number of branches Plant^{-1}	IC-21705 X IC-42959-2	1.046**	0.217
4.	Number of capsules per plant^{-1}	Phule Til -1 X IC - 043118	10.158**	1.182
5.	Number of seeds capsule^{-1}	Phule Til-1 X IC 41930	10.056**	1.502
6.	Capsule length (cm)	N-128 X IC 41930	0.296**	0.066
7.	1000 seed weight (g)	IC-043118 X IC 14120	0.480**	0.141
8.	Seed yield plant^{-1} (g)	Phule Til-1 X IC 41930	0.986**	0.217
9.	Oil content (%)	Phule Til -1 X IC-043118	2.986**	1.089
10.	Harvest index (%)	ES-216 X TMV-3	5.265**	1.137

* $P \leq 0.05$; ** $P \leq 0.01$

Table 4. Estimates of means, useful heterosis, gca effects and sca effects of some of the promising parents and crosses for seed yield plant^{-1}

Sr. No.	Parents/Crosses	Mean (g plant^{-1})	Useful heterosis	GCA effects	SCA effects
1.	Phule Til-1	1.62	-	-	-
2.	IC-42959-2	1.61	-	-	-
3.	ES-216	1.48	-	-	-
4.	Phule Til-1 X IC-41930	3.21	98.15**	H X L	0.986**
5.	Phule Til -1 X IC-043118	3.10	91.36**	H X L	0.982**
6.	N-128 X IC -14120	3.09	90.74**	H X L	0.973**
7.	Phule Til-1 X IC-21705	2.74	69.14**	H x H	N.S.

N.S. = Non significant, H = Height gca effect and L = Low gca effect of the parents involved in that particular cross.

additive and non -additive genetic variances revealed by the parental material selected in the present study.

LITERATURE CITED

Anandkumar, C.R.and S.R.S. Rangaswamy, 1987. Combining ability for yield in sesame. J. Oilseeds Res. 4(2) : 233-241.

Goyal S.N. and Sudhir Kumar, 1991. Combining ability for yield components and oil content in sesame. Indian J. Genet. 51 (3) : 311-14.

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

Khorgade, P.W.; M.M.Patil M.N. Narkhede, 1988 . Line X Tester analysis for combining ability in sesame. J. Maharashtra Agric. Univ. 13 (1) : 67-70.

Manivannan N., 1997. Combining ability in sesame (*Sesamum indicum* L.) J.Oilseeds Res. 14 (2) : 165-167.

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

Sprague, G.F. and L.A. Tatum, 1942. General Vs. specific combining ability in single cross of corn. J. Amer. Soc. of Agron. 34 : 923-932.

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Genotypes x Environment Interaction in Pigeonpea* (*Cajanus cajan* (L) Millsp.)

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ABSTRACT

Fifteen genotypes including hybrids, varieties and mass selected populations grwon in 22 environments and were analysed for stability for grain yield and other yield components. G x E interactions were observed to be significant for all characters. Non-linear components of G x E interaction were important for all yield contributing components. The hybrids have shown better performance as compared to the varieties and mass selected populations in respect of grain yield per plot, number of pods and seed weight per plent. Among hybrids AKPH-6140, AKPH-2033 and AKPH-8031, and variety C-11 were better but the the stability parameters expressed predominance of unpredictability. AKPH-8022 and AK-9115 were considered to be the stable genotypes for grain yield and majority of yield contributing traits.

Pigeonpea is one of the major grain legume having wider adaptability and cultivated in tropical and subtropical environmental. It is highly sensitive to the changing environments that exist in different agro climatic regions. Therefore, there is a need to identify and/or evolve varieties with stable performance over different environments. Many promising populations were developed from the segregating generations of the selected crosses at Dr. PDKV, Akola (Wanjari, 1996). Some pigeonpea hybrids developed at Akola are performing well in the country (Verma and Sidhu, 1995). The present investigation was under taken with the objectives to ascertain stability of the hybrids, mass selected populations and varieties and to identify superior genotypes of pigeonpea with specific adaptabilities.

MATERIAL AND METHODS

Fifteen genotypes including five each hybrids, varieties and mass selected populations were grown in randomized block design with three replications at two locations viz., Akola and Nagpur during three consecutive seasons. i.e. *rabi* 91-92, *kharif* 92-93 and *rabi* 92-93. Experiments were simulated at each location by changing the sowing time and fertilization. Thus there were such eleven dates of sowing with two fertilizer levels forming 22 experiments. Twenty two experiments so conducted were treated as 22 environments. Uniform irrigation, plant protection and cultural operations were followed. The data from each of these 22 environments were subjected to analysis of variance for estimating G x E interactions. Five representative plants were selected randomly from each plot for observation on different characters except grain yield which has been recorded on plot basis. The stability analysis was carried out after satisfying the requirements of homogeneity of error by Bartlet's test. Stability parameters were worked out as per model suggested by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

It is revealed from the pooled analysis of variance (Table 1) that the variances due to genotypes were highly significant for the characters viz., number of pods per plant, seed weight per plant, 100-seed weight and grain yield per plot indicating that the genotypes under present study had significant variability. The variances due to environments were also highly significant for all the characters. It implies that genotypes were evaluated under sufficiently diverse environmental conditions.

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Table 1. Pooled analysis of variance (mean squares) for stability for yield and its components in pigeonpea.

Source	d.f.	Number of pods plant^{-1}	Seed weight plant^{-1}	100 seed weight	Grain yield plot^{-1}
Genotypes (G)	14	5.42^{-03**}	9.26^{-02**}	19.24**	0.27**
Genotypes x Environment	294	1.14^{-03*}	1.73^{-02*}	0.93**	1.95^{-02**}
Env. + (Geno. + Env.) E + (G x E)	315	3.57^{-03}	5.37^{-02}	3.00	9.12^{-02}
Environment linear	1	0.78	11.88	671.79	22.98
Genotypes x Env. (Linear)	14	16.2^{-04*}	20.58-$^{-03}$	0.93	20.25
Pooled deviation (non-linear)	300	10.5^{-04**}	16.02^{-03*}	0.87**	18.15^{-03**}
Pooled error	616	8.11^{-04}	1.45^{-02}	0.66	1.11^{-02}

* Significant at 5% and ** Significant at 1% level

The genotypes x environment interactions were found to be significant for all the characters. There would be an individuality of each genotypes to interact with the environments. Balkrishan and Natarajarathnam (1989), Mehra and Pahuja (1980); Singh *et al.* (1988), Wanjari *et al.*, (1988), have reported significant genotype x environment interactions in pigeonpea for grain yield and various yield contributing characters.

Non-linear component of G x E interaction was important for number of pods per plant, seed weight per plant, 100-seed weight and grain yield per plot (Table 1).

Number of pods per plant are considered to be one of the important yield contributing character in pigeonpea. AKPH-6140 and AKPH-2033 had significantly higher number of pods and seed weight per plant. However, they were unpredictable in terms of stability. The genotypes AKPH-8022, C-11 and AK-9116 were considered to be stable (bi=1) with significantly higher number of pods whereas a hybrid AKPH-8031 was only a stable genotype for seed weight per plant. As regard the 100-seed weight, the hybrids AKPH-6140 and AKPH-2033 possessing significantly better seed size and AKPH-8022 with average seed size were having average stability (Table 2). The varieties BDN 1 and Hyderabad 185 had bi>1 with higher mean values suggesting that these bold seeded genotypes may have better seed size under favourable environments but are likely to be affected very much due to abnormal environments. AKPH 8031 possessed average seed size and had above average stability which indicates that its seed size is less amenable to environmental fluctuations which can be used as a source material for further breeding programme.

Grain yield per unit area is the most important economic character and is sum total of all the components acting directly or indirectly in a community of many individual plants. Keeping in view the said discussion one would a priori state that under the diverse environment included in the present study no genotype can perform equally well under all environments. Both regression coefficient and deviation from regression were significant for five genotypes namely AKPH-8031, AKPH-6140, AKPH-3020, AKPH-2033 and C-11. Thus G x E interaction can not be predicted from estimates of regression. They are likely to deviate from their predicted performance. These findings are in agreement with the results reported by Singth *et al.* (1988). Among the genotypes with predictable G x E components (non-significant S^2di) No. 148, Hyderabad-185, AK-9114, AK-9115 and AK 9117 had better stability with average yield at par with

Table 2 . Estimates of stability parameters for different characters in pigeonpea

Sr. No.	Genotypes	Number of pods/Plant			Seed weight/plant (g)			100-seed weight(g)			Grain yield/plot (kg)		
		X	bi	S²di	X	bi	S²di	X	bi	S²di	X	bi	S²di
Hybrids													
1	AKPH-8022	49.94	0.92**	7.50-05	8.58	0.98**	3.51-03*	9.89	1.10**	0.09	0.50	0.87**	8.70-04
2	AKPH-8031	49.96	0.79**	-1.00-05	8.97	0.96**	-3.50-04	9.80	0.81**	-0.11	0.48	1.03**	3 . 6 1 -
03*													
3	AKPH-6140	63.36	1.37**	3.60-04*	6.95	0.78**	4.60-04	8.74	0.66-04	0.35	0.91**	7.47-03**	
4	AKPH-3020	63.65	1.24**	5.00-04**	10.62	1.13**	4.31-03*	10.22	0.99**	0.07	0.61	1.12**	0.01
Varieties													
6	BDN-1	44.53	0.98**	7.00-05	8.14	1.03*	1.82-03*	10.45	1.17**	0.04	0.37	1.01**	-3.50-05
7	BDN-2	43.91	0.92**	2.50-05	8.32	1.22**	-1.5503						
8	C-11	58.35	1.11**	7.50-05	8.14	1.03*	1.82-03*	10.45	1.17**	0.04	0.37	1.01**	-3.50-05
9	No. 148	44.96	0.77**	-6.00-05	8.43	0.87**	-2.0810.29	0.92**	0.22**	0.41	1.04**	-1.13-03	
10	Hyd-185	45.56	1.16**	-9.00-05	8.17	0.91**	-2.36-03	10.33	1.19**	-0.03	0.40	1.02**	3.75-04
Mass selected populations													
11	AK-8811	45.52	0.83**	0.00	7.25	0.64**	-2.69-03	8.74	0.96**	0.18*	0.36	0.72**	1.26-03
12	AK-9114	46.37	0.89**	8.00-05	8.15	0.98**	1.37-03	9.84	1.13**	0.20**	0.41	1.05**	-9.60-04
13	AK-9115	46.39	0.95**	-1.50-05	8.20	1.04**	4.50-04	9.51	1.01**	0.03	0.45	0.97**	-1.20-03
14	AK-9116	50.33	1.07**	-9.00-05	8.35	1.10**	-7.05-04	9.42	0.98**	0.12	0.37	0.95**	4.80-04
15	AK-9117	49.39	1.15**	3.00-05	7.97	0.97**	-1.21-03	9.72	1.02**	-5.70	0.40	0.94**	-2.00-04
General mean		49.35	-	-	8.67	-	-	9.83	-	-	0.45	-	-
S.E. (m)		0.004	0.14	-	0.02	0.14	-	0.12	0.14	-	0.02	0.11	
C.D. at 5%		0.01	-	0.06	-	-	0.33	-	-	0.06	-	-	

general mean (Table 2). They are supposed to show average response to environmental fluctuations and therefore possessed more adaptive value.

It could be concluded that the hybrids have shown better performance as compared to the varieties and mass selected populations in respect of grain yield per plot, number of pods and seed weight per plent. In respect of productivity the hybrids AKPH-6140, AKPH-2033 and AKPH-8031 were better and a variety , C-11 were topping but the stability parameters expressed predominance of unpredictability. Only one hybrid AKPH-8022 which qualified for predictable performance and could be identified as better stable for productivity among the hybrids. Among the mass selected populations AK-9115 is a stable genotype for grain yield and majority of yield contributing traits. The genotypes AKPH-6140, AKPH-2033, AKPH-8022, AKPH-8031, C-11 and AK-9115 which showed stability for many of the yield component traits are identified as ideal genotypes for future breeding programme as one of the parent or component of base population.

LITERATURE CITED

Balkrishnan, K. and N. Natarajaratnam, 1989. Genotype environment interaction for yield components in pigeonpea (*Cajanus cajan* (L) Millsp). Madras Agric. J. 76 (7) : 365-370.

Eberhart, S.A. and W.A. Russell , 1966. Stability parameters for comparing varieties. Crop Sci. 6: 36-40.

Mehra, R.B. and A.N. Pahuja, 1980. Adaptability studies on red gram (*Cajanus cajan* (L) Millsp) in India. Tropical grain legume bulletin (17-18) : 18-21

Singh, R. H.S. Yadav and P. Singh, 1988. Phenotypic stability of grain yield in arhar (*Cajanus cajan* L) Agric. Sci. Digest 8(3) : 146-148.

Verma, M.M. and P.S. Sidhu, 1995. Pigeonpea hybrids, Historical Development. Present status and future perspective in Indian Context. pp. 121-137. "Hybrid Research and Development" (Ed) M.M. Rai and S. Mouria. Indian Society of Seed Technology, IARI, New Delhi.

Wanjari, K.B., A.N. Patil, G.r. Fulzele and P.B. Ghawghawe, 1988. A note on stability analysis in pigeonpea (*Cajanus cajan* L.). Ann. Plant Physiol. 2 (1) : 113-114.

Wanjari, K.B. , 1996. Conservation breeding : A successful approach in pigeonpea. In : 2nd International Crop Science Congresss, 12-24 November 1996, ICAR, New Delhi. pp. 240.

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Decomposition of Different Organic Residues in Soil

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ABSTRACT

The incubation study with one percent organic residues of twelve sources mixed with soil resulted in wide variation in the rate of decomposition, C:N ratio and microbial population at different intervals. CO_2 evolution was maximum during first 15 days and it decreased there after. The rate of decomposition was highest for groundnut husk as compared to other residues. After incubation for 30 days, lowest C:N ratio was observed in grass complex. Fungal, bacterial and actinomycetes population were increased at 30 days of incubation.

Decomposition of organic residues of either plant or animal origin is essentially a microbiological process. The decomposition brings about various changes and affects the physical, chemical and biological properties of soil. The decomposed organic material leads to the formation of humic substance, which appreciably influence the soil fertility (Alexander, 1961). However, due to variations in the nature of organic materials, particularly the C:N ratio, the decomposition rate of these materials and consequent chemical and biological changes in the soil differ considerably (Gaur *et al.* 1971).

With this background, the present investigation was undertaken to assess the rate of decomposition of certain locally available organic residues (materials) as well as their influence on some microbiological changes.

MATERIAL AND METHODS

Surface soil sample (0-15 cm) in bulk was brought from Central Research Station Farm, Dr. PDKV, Akola. The soil was air dried and passed through 2 mm sieve. The soil clay texture had pH 7.8, EC 0.3 dSm^{-1}, $CaCO_3$ 6.2%, organic carbon 0.49%, field capacity 35.8%, available N, P_2O_5 and K_2O were 135.2, 10.5 and 314 kg ha^{-1} respectively.

Incubation study was done in triplicate. The treatments consisted of (T_1) cotton stalk; (T_2) safflower straw; (T_3) sorghum stubble; (T_4) soybean stover; (T_5) wheat straw; (T_6) sugarcane trash; (T_7) groundnut husk; (T_8) sunflower straw; (T_9) green gram stover; (T_{10}) parthenium with seed; (T_{11}) grass complex with seed; (T_{12}) xanthinium with seed and (T_{13}) control.

The org anic residues of different origins were ground to powder and thoroughly mixed with soil @ 1 per cent of the weight of soil. The 100 g soil sample treated with organic residue were placed in a closed stoppered conical flask (100 ml). The flasks were incubated at 25°C maintaining soil moisture 50% of field capacity. The CO_2 liberated is absorbs in a known volume of std. NaOH solution in a test-tube hung inside the flask and CO_2 evolved in 15 and 30 days of incubation was estimated by titrating it with HCl in the presence of $BaCl_2$. Total N and organic carbon were determined as per standard method described by Jackson (1967). Microbial population was determined by dilution plate technique (Dhingra and Sinclair, 1993).

RESULTS AND DISCUSSION

Rate of decomposition

The rate of decomposition of organic materials in the form of CO_2 evolution is presented in Table 1. In general, the release of CO_2 from the soil treated with organic residue was more as compared to control. The rate of CO_2 evolution was maximum within first 15 days, indicating that as soon as optimum conditions of moisture and temperature were provided the microbial activity shoots up without any log period and it diminished in the next 15 days. These results are in conformity with those of Sarmah and Bordoli, 1994. The initial peak may be due to rapid decomposition of readily water soluble constituents of the added organic materials (Somani and Saxena, 1977). The highest CO_2 was evolved from groundnut husk followed by soybean straw, grass complex and green gram stover. The lowest rate of CO_2 evolution was noticed for parthenium weed, which might be due to low carbon content in the material.

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Table 1. CO2 evolution and rate of decomposition of various materials

Treatment	CO_2 evolved (mg 100 g^{-1} soil)			Rate of decomposition (mg CO_2 - C d^{-1} 100 g g^{-1} soil)		
	Within 15 days	Within 30 days	Cumulative within 30 days	Within 15 days	Within 30 days	For 30 days
T_1	119.9	69.3	189.2	2.18	1.26	1.72
T_2	100.1	57.2	157.3	1.82	1.03	1.43
T_3	115.5	67.1	182.7	2.10	1.22	1.66
T_4	150.7	91.3	242.0	2.74	1.66	2.23
T_5	108.9	64.1	173.0	1.98	1.66	1.57
T_6	124.3	77.0	201.3	2.26	1.40	1.83
T_7	156.2	95.7	251.9	2.84	1.74	2.28
T_8	104.5	66.0	170.5	1.90	1.20	1.55
T_9	130.9	82.5	213.4	2.38	1.50	1.93
T_{10}	90.1	48.4	138.6	1.64	0.87	1.25
T_{11}	136.4	89.1	225.5	2.46	1.62	2.05
T_{12}	126.5	80.3	206.8	2.29	1.46	1.87
T_{13}	24.2	16.5	40.8	0.44	0.3	0.36
SE (±)	2.48	2.59	4.01	0.044	0.046	0.035
CD at 5%	7.35	7.69	11.91	0.132	0.138	0.103

Table 2. Organic carbon, total nitrogen and C:N ratio of residues as influended by decomposition

Treatment	Initial			At 30 days		
	Org. C (%)	Total N (%)	C:N Ratio	Org. C (%)	Total N (%)	C:N Ratio
T1	64.74	1.10	58.6	20.34	1.08	18.7
T2	33.19	0.70	47.1	16.02	0.67	23.7
T3	40.85	0.97	42.0	17.73	0.95	18.6
T4	47.76	1.22	39.2	19.20	1.19	16.0
T5	35.45	0.65	54.9	14.01	0.64	21.6
T6	45.12	0.49	92.0	22.25	1.32	46.0
T7	56.02	1.34	41.7	22.75	1.32	17.1
T8	47.29	0.95	49.7	18.14	0.91	19.8
T9	55.29	1.82	30.3	32.20	1.81	17.7
T10	34.34	0.80	42.7	12.21	0.77	15.6
T11	39.18	1.14	34.3	15.20	1.12	13.4
T12	19.30	0.48	40.0	10.05	0.47	21.2
T13	0.85	0.04	19.4	0.45	0.04	10.4
SE m +	2.09	0.025	1.9	2.23	2.65	2.1
CD (5%)	6.23	7.65	5.6	6.63	7.86	6.3

Table 3. Mean microbial population before and after decomposition of straw

Treatment	Before decomposition			After decomposition (30 days)		
	Fungi	Bacteria	Actinomycete	Fungi	Bacteria	Actinomycete
T_1	6.33	9.66	8.33	8.00	16.33	15.33
T_2	7.66	12.66	11.00	9.33	19.33	17.66
T_3	8.00	13.33	12.33	10.33	20.66	19.33
T_4	10.33	14.66	13.66	12.00	23.33	21.33
T_5	6.66	10.33	9.00	8.66	18.33	16.00
T_6	6.00	9.33	7.33	7.66	16.00	14.66
T_7	9.66	14.33	12.66	11.33	22.33	20.66
T_8	7.00	12.00	10.66	9.00	18.66	16.33
T_9	10.66	15.00	14.00	12.66	24.66	22.00
T_{10}	4.33	6.33	5.33	5.66	9.66	9.33
T_{11}	5.33	8.00	7.00	7.33	11.33	10.00
T_{12}	4.66	6.66	5.66	6.33	10.33	9.66
T_{13}	2.66	5.33	4.00	4.00	8.66	7.33
SE m $\pm$	0.98	1.51	1.53	1.12	1.09	1.19
CD at 5%	2.90	4.49	4.55	3.33	3.25	3.54

C:N ratio

The C:N ratio of the organic residues were determined initially and after 30 days of incubation with soil (Table 2). Initial C:N ratio was widest in sugarcane trash followed by cotton stalks and wheat straw, whereas it was narroest in green gram straw followed by grass complex and soybean straw. After 30 days of incubation the lowest C:N ratio was observed in grass complex may be due to more succulent and easily decomposable.

Microbial population

Fungal, bacterial and actinomycetes population were enumerated before and after decomposition (Table 3). Maximum population was recorded at 30 days of incubation. Bacteria were predominant over fungi and actinomycetes during the course of study, which is in line with the findings of Gaur *et al.*, 1971. Highest microbial activity was observed in the soil ammended with greengram followed by soybean stover and groundnut husk. This might be due to the narrow C:N ratio in these crops, whereas the lowest activity was recorded by the addition of parthenium and xanthinium weeds. Cereals and other oil seed crop residues also increased the fungal, bacterial and actinomycetes population over control.

LITERATURE CITED

Alexander, M., 1961. Introduction to soil microbiology. John Wiley and sons. Inc., New York.

Dhingra, O.D. and J.B. Sinclair, 1993. Basic plant pathology methods. CBS Publishers, Delhi.

Gaur, A.C. K.V. Sadasivam, O.P. Vimal and R.S. Mathur, 1971. A study on the decomposition of organic matter in an alluvial soil. CO_2 evolution, microbial and chemical transformation. Pl. Soil. 35 : 17-28.

Jackson, M.L., 1967. Soil chemical analysis. Prentice Hall India Pvt. Ltd., New Delhi.

Sarmah, A.C. and P.K. Bordoli, 1994. Decomposition of organic matter in soil in relation to mineralization of carbon and nutrient availability. J. Indian Soc. Soil Sci. 42 (2) : 199-203.

Somani, L.L. and S.N. Saxena, 1977. A study on the composition of some organic matter sources in the medium black soil of Udaipur : Humus builts up and nutrient availability. Univ. Udaipur Res. J. 15 : 30-42.

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Field Evaluation of Biopesticides and Neem Seed Extract Against Pod Borer *Heliothis armigera* on Pigeonpea

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ABSTRACT

The results revealed that the treatment *B.t.*K. (Dipel 8L, *Bacillus thuringiensis* Berliner Var. Kurstaki, 176 x 10^2 spores ml^{-1}) 750 ml ha^{-1} was the most effective followed by *B.t.*K. 750 ml ha^{-1} alternated with endosulfan 0.07% and endosulfan 0.07% alone in minimizing per cent larval population. However endosulfan 0.07% alone was found to be the most efficacious treatment in minimizing per cent pod damage giving increased yield followed by *B.t.*K. 750 ml ha^{-1} (*Heliothis armigera* nuclear polyhedrosis virus) alternated with endosulfan 0.07%, HaNPV - 250 LE ha^{-1} alternated with neem seed extract 5% and HaNPV - 250LE ha^{-1} alone. The treatment need seed extract 5% (NSE) alone was not effective.

Pod borer *H. armigera* causes colossal losses in the yield of pigeonpea to the tune of 60-90% (Anonymous, 1994). Despite the fact that chemicals proved their potential to avert the insect pests on pigeonpea (Mhase *et al.* 1987 and Patil *et al.* 1990). The everincreasing concern for environment, residue problems in eatables and the reaction of the insect pests to pesticides, requirement of pesticide free commodity in the open market cautioned to look for an alternative technologies for pest control which are not only effective but are ecofriendly in nature.

Amongst several entomopathogens tested against this pest, the Nuclear Polyhedrosis virus (NPV) (Dhamdhere *et al.* 1986 and Natrajan *et al.* 1991) and an entomobacterial preparation *Bascillus thuringiensis* has been found to be promising one (Broza, 1986). First economic use of *Heliothis* virus was made by Coaker (1958) on cotton crop in Uganda. In India, incidence of NPV on laboratory culture of *H. armigera* was first recorded by Patel *et al.* (1968) from Gujrat. A need has emerged to search out new methods to curb this pest which envisaged to undertake these studies.

MATERIAL AND METHODS

Field evaluation were conducted at Entomology section, College of Agriculture, Nagpur during *Kharif* 1994-97. Nine treatments including control (Table 1) were compared on pigeonpea variety C-11, sown in randomized block design with three replications in a plot measuring 3 x 2.10 m. Row to row and plant to plant spacing were 60 and 30 cm respectively. Neem seed extract was prepared by grinding the seed into fine power, 5 gm of this powder was held in a cloth bag soaked in water for almost 12 hr. and on the next day squeezed in 100 ml of water. The 5% extract thus obtained was used for spraying by mixing it with 0.1% teepol (Doharey and Singh, 1989).

Observations on larval population were recorded on randomly selected five plants per plot. Pretreatment observations were recorded 24 hr. prior to spray and post treatment observations were recorded at 7 and 14th DAA. The observations were also recorded on per cent pod damage and yield at harvest. In all three applications of treatment sprays were undertaken at an interval of 15 days commencing from the initiation of 50% flowering.

RESULTS AND DISCUSSION

The data (Table 1) at 14th days after application indicated that the treatment *B.t.*K. alone 750 ml ha^{-1} prove to be the most effective recording 49.48% reduction in larval population followed by *B.t.*K. 750 ml ha^{-1} alternated with endosulfan 0.07% (49.01%) and endosulfan 0.07% alone (45.02%), and these treatments were at par with each other. Broza (1986) reported the promising effect of *B.t.*K. alone in

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Table 1. Effect of different treatments against *H. armigera* on pigeonpea (Variety - C-11) during 1994-97.

Treatments	Pooled average % reduction in larval population at 14 th DAA		Pooled average% pod damage at harvest		Pooled average yield (q ha^{-1})	ICAR
HaNPV - 250 LE ha^{-1}	35.79	(37.62)	23.32	(28.74)	8.21	1:2.28
B.t.K. - 750 ml ha^{-1}	49.48	(46.19)	24.27	(29.02)	8.01	1:0.54
NSE 5%	23.76	(28.78)	39.58	(38.88)	5.51	1:2.95
HaNPV - 250 LE ha^{-1} alternated with endosulfan 0.07%	33.97	(36.70)	21.38	(27.32)	8.35	1:2.90
HaNPV- 250 LE ha^{-1} alternated with NSE 5%	31.02	(33.07)	23.06	(28.55)	8.48	1:3.17
B.t.K. - 750 ml ha^{-1} alternated with NSE 5%	49.01	(46.23)	21.57	(27.15)	9.18	1:1.58
Endosulfan 0.07%	45.02	(41.47)	16.23	(23.57)	10.54	1:7.13
Control (untreated)	9.73	(16.22)	52.75	(46.66)	3.84	–
SE (m) ±	3.40		2.01		0.74	–
CD at 5%	10.20		6.04		2.21	–

Figures in parentheses are angular transformed values.
DAA - Days after application.

minimizing larval population and found at par to chemical insecticide against *H. armigera*. Bijjur *et al.* (1994) reported endosulfan alone as the most effective treatment in minimizing larval population of *H. armigera* on sunflower and pigeonpea. However Kulkarni *et al.* (1988) reported the combined effect of *B.t.*K. with endosulfan against this pest.

The pooled data on average pod damage revealed that all he treatments were found significantly superior over NSE 5% and control. The treatment endosulfan 0.07% alone with minimum pod damage (16.23%), proved to be the most effective and at par with the treatments HaNPV-250 LE ha^{-1} alternated with endosulfan 0.07% (21.38%) and *B.t.*K. 750 ml ha^{-1} alternated with endosulfan 0.07% (21.57%). However the treatments, HaNPV - 250 LE ha^{-1} alternated with endosulfan 0.07% (21.38%), *B.t.*K. 750 ml ha^{-1} alternated with endosulfan 0.07% (21.57%), HaNPV - 250 LE ha^{-1} alternted with NSE 5% (23.06%), HaNPV - 250LE ha^{-1} alone (23.32%), *B.t.*K. 750 ml ha^{-1} alone (24.27%) and *B.t.*K. 750 ml ha^{-1} alternated with NSE 5%(26.74%) were found to be statistically at par in respect of per cent pod damage. Earlier Patil *et al.* (1990) reported endosulfan alone as the most efficacious treatment with lowest per cent pod damage.

The maximum yield (10.54 q ha^{-1}) was obtained in the treatment of endosulfan 0.07% alone followed by *B.t.*K. 750 ml ha^{-1} alternated with endosulfan. 0.07% (9.18 q ha^{-1}), HaNPV - 250 ml ha^{-1} alternated with neem seed extract 5% (8.48 q ha^{-1}) and HaNPV-250 ml ha^{-1} alternated with endosulfan 0.07% (8.35 q ha^{-1}). Talathi *et al.*(1983) also reported the maximum yield of pigeonpea from endosulfan treated plots and these results are corroborative with our findings. In the present studies, the treatment neem seed extract 5% alone was not effective in minimizing larval population or per cent reduction in pod damage. This possibly may be due to the prolonged reproductive phase of pigeonpea could have diluted the effect of neem seed extract which is known to have short residual toxicity. These findings are consistent with those of Sachan *et al.* (1993). Panchabhavi *et al.* (1994) also reported the effectiveness of neem seed extract in sequential spray when applied in alternation with insecticides against pod borer on pigeonpea.

Considering the Incremental Cost Benefit Ratio (ICBR) the treatment endosulfan 0.07% was found to be the most cost effective giving ICBR of 1:7.13. The results are in agreement with the earlier findings of Borkar and Narkhede (1995). It was followed by HaNPV - 250 LE ha^{-1} alternated with neem seed extract 5% (ICBR 1:3.17), neem seed extract 5% alone (ICBR 1:2.95) and HaNPV - 250 LE ha^{-1} alternated with endosulfan 0.07% (ICBR 1:2.90).

LITERATURE CITED

Anonymous, 1994. International crop research Institute for semi-arid Tropics (1979). Annual Report 1973-74, ICRISAT, Hyderabad (India) : 87

Borkar, S.L. and S.S. Narkhede, 1995. Efficacy of insecticides and number of applications for the control of pod borer complex on pigeonpea. J. Appl. Zool. Res. 6 (2) : 113-116

Broza, M., 1986. Seasonal change in population of *Heliothis armigera* in cotton field in Israel and its control with a *B. thuringiensis* preparation. J. Appl. Ent. 102 (4) : 363-370

Coaker, T.H., 1958. Experiments with a virus disease of cotton bolloworm *H. armigera* (Hbn.)Ann. Biol. 46 : 536-541.

Dhamdhere, S.G. and V.M. Khaire, 1986. Field evaluation of different doses of NPV on *Heliothis armigera* (Hbn) Curr. Res. Report, M.P.K.V., Rahuri, Maharashtra (India), 2(2) : 221-226.

Doharey, K.L. and R.R. Singh, 1989. Evaluation of neem (*A. indica* A. Juss) seed kernel extract against chaffer beetle. Indian J. Ent. 51 (2) : 217-220.

Kulkarni, V.V. and S.V.. Amonkar, 1988. Microbial control of *H. armigera* : Part II - Relative toxicity of spores and crystals of *B. thuringiensis* Var. Kurstaki to *Heliothis armigera* and their toxicity in field of control. Indian J. Expt. Biol. 26 : 708-711.

Mhase, N.L., M.V. Kadam and D.S.. Ajari, 1987. Chemical control of pod borer complex on pigeonpea. Curr. Res. Report, M.P.K.V., Rahuri, Maharashtra (India), 3 (1) : 32-38

Natrajan, N., P.V. Subbrao and S. Gopal, 1991. Management of the Gram pod borer *Heliothis armigera* (Hbn.) with polyhedrosis virus and insecticides in pigeonpea. Madras agric. J. 74(1) : 122-124.

Panchbhavi, K.S., Y.K. Kotika, R.S. Krishna Giradi and S. Yelshetty, 1994. A note on the efficacy of sequential spray of neem (*A. indica* A. Juss) seed extract and insecticides for the control of pod borer (*Heliothis armigera* Hubner infesting redgram (*Cajanus cajan* (L) Millsp.) Karnataka J. Agric. Sciences. 7 (3) : 353-357.

Patel, R.G., R. Singh and P.B. Patel, 1968. Nuclear polyhedrosis virus of gram pod borer *Heliothis armigera* (Hbn) J. Econ. Ent. 61 : 191-193.

Patil, C.S., V.M. Khaire and U.N. Mote, 1990. Comparative performance of different insecticides against the pod borer complex on short duration pigeonpea. J. Maharashtra agric. Unit. 15(3) : 337-339.

Sachan, J.N and Gururaj Katti, 1993. Neem in *Helicoverpa* (*Heliothis*) *armigera* management in pulse ecosystem. World Neem Conference -Vol. I, Bangalore (India), 24-28 Feb., 1993 : 459-467

Sanjay Bijjur, K.A. Kulkarni and S.Lingappa, 1994. Utilization of NPV in *Heliothis armigera* (Hubner). Management in sunflower and pigeonpea ecosystem. Indian J. Ent. 56 (3) : 241-245.

Talathi, G.M., V. Upadhyay and P.A. Baloni, 1983. Incidence and control of pod borrer on tur in Gujrat. Pesticides 17 (5) : 21-22.

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Econo - Feasibility of Sugar Production From Sweet Sorghum

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ABSTRACT

Sugar is being important in Iran. Sugar-beet and sugar-cane need high farm inputs besides specific environmental conditions and irrigation facilities.

Due to salty soils, production of sugar from sugar crops has become uneconomic and hence sugar from sweet sorghum as an alternative to sugar beet and sugar cane was considered. Economic analysis revealed that cost of sweet sorghum would not be different from sugar beet. Sweet sorghum can be the best substitute for sugar production in near future.

Sugar is used as an energy source in human diet as well in food industries. Present population in Iran is 57 million and estimated growth rate is 3.2 per cent. In 1991, production of sugar from sugarbeet reached 0.597 million tonnes and 0.139 million tonnes from sugarcane. At the same time the importation of sugar was approximately 0.45 million tonnes. The principal regions of production of sugarbeet are the provinces of Khorasan and Isfahan, while those of sugarcane are located in the south of country at Haft, Tapeh and Karon. There exists 36 sugarbeet based sugar factories in the country while only 2 from sugarcane. The present policy of government is to maintain the existing production and processing of sugarbeet but to expand considerably sugarcane that involve an expansion of 84,000 ha in the southern region near Awas with 7 additional sugar factories, each one having capacity of around 100,000 tonnes annum^{-1} sugar (Blas, 1992).

Both the sugar crops need high farm inputs besids specific environmental conditions. However, due to salty soils, the production has become uneconomic, since water requirement is high and water charges are 3 per cent of the value of average crop yield per hectare, (Almodares and Soltani, 1991).

Sweet sorghum is another possible sugar producing species which as yet has not been exploited in Iran. Promotion of sugar production from sweet sorghum started in 1989 as a FAO project. Work on sweet sorghum agronomy and breeding was carried out and good amount of information in now available (Almodares and Soltani, 1991, Almodares *et al.* 1994). Work on sugar processing from sweet sorghum was started with the exploration of possibilities for manufacturing sugar at Isfahan.

MATERIAL AND METHODS

Experimental activity was carried out on two aspects namely the composition of stalk's juice from sweet sorghum grown in Isfahan and clarification of juice. Achievements obtained indicated the usefulness of the project to promote sugar production through processing of sweet sorghum (Kulkarni *et al.*, 1995). FAO project phase II started in 1992 to advice government on sweet sorghum handling and processing for sugar production and to introduce sweet sorghum processing technology adopted to the particular conditons in the country. The objects of this study were (1) to assemble existing information and estimates, 'bestguess' budgets for sweet sorghum production and for processing in to sugar categorized into tradable and non-tradable and (2) estimate financial profitability for farmers and for processor given existing recommended technologies. The collection and analysis of the basic data and information involved discussion and interviews with the representative of Ministry of Agriculture, Ministry of Commerce, Sugar factories, University of Isfahan, college of Agriculture of the Universities of Isfahan and Tehran besides farm level experimental stations and related project visits.

RESULTS AND DISCUSSION

Government of Iran's recent economic reforms

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have touched most elements of macro-economic policies, aiming for the most part to reduce various prices distortions and financial imbalances of the war years. The multiple exchange rates were reduced to three from seven, these now being the official rate (70 Rials per US $). Competitive rates (66 Rials per US $) and Floating rate (1450 Rials per US $).

Sweet sorghum could produce 50 metric tonnes (MT) of crushable stalks, 3 MT of grains and 17 MT of leaves and stem tops hectare^{-1}. Sweet sorghum cultivation requires less farm inputs (seed, fertilizers, pesticides, irrigation) and labour sugarbeet and in addition to stalks, grains and leaves in case of sweet sorghum are obtained (Almodares and Soltani, 1991, Almodares *et al.* 1994).

However, on the yield side, the sugar content of the sweet sorghum reaches only around 11% while sugar content of sugarbeet average 16% in the province of Isfahan (Almodares *et al*, 1994). For comparison with sugarbeet, yield of 40 MT ha^{-1} of sweet sorghum has been taken in to consideration. Average yield of sugarbeet in province is 36 MT ha^{-1}.

Financial budgets, yields and inputs for sweet sorghum and sugarbeet in province of Isfahan are given in Table 1 and 2. It appears that cost of the inputs (excluding labour) for sweet sorghum and sugarbeet is about same i.e. 2,50,00 Rials ha^{-1} . It is because of higher cost of transportation of sweet sorghum to the factory. However, the cost of labour is much higher in the case of sugarbeet (300,000 to 400,000 Rials ha^{-1}) than in case os sweet sorghum (135,000 Rials ha^{-1}). These data have been obtained from the representative samples of 54 sugarbeet farms covering 254 ha and from the report of Almodares and Soltani (1991) for sweet sorghum.

In the entire economic analysis, the official exchange rate has been taken at competitive rate i.e. 1450 Rials/US $. From the Policy Analysis Matrix (PAM) for both the sugar crops (Table 3), it is seen

Table 1. Sweet sorghum financial budget, yields and inputs (in Rial, '000 $^{-1}$ ha)

Revenue[1]	1484	Units	Quantity
Inputs			
Ploughing	22.0		
Dishing	8.0		
Leveling	16.0		
Seeding	2.0	Kg	10
Fertilizer	9.6	Kg	Urea 200, Phosphate 300
Pesticides	8.0	l	8
Irrigation water	24.0	m^3	8000
Transport to factory	175.0		
Sub Total Inputs	246.6		
Income (before labour costs)	1237.4		
Labour (hired)			
Seeding	8.0	hr	4
Fertilizer	2.8	Hr	3.5
Irrigation	40.0	md	8
Weeding	10.0	md	2
Harvesting	24.0	hr	4
Loading with hanks	50.0	md	10
Sub-Total Labour	134.8		
Income (after labour costs)	1102.6		

1) Selling price of sweet sorghum taken as first hypothesis equal to selling price of beet (only decrease of 2840 Rl. per 1% reduction of sugar content = sweet sorghum 11%, sugarbeet 16%) however it could be much less since it requires 7.7 tonns of beet for 1 ton sugar and 14.3 tonnes of sweet sorghum for 1 ton sugar.

Sales :	40 t x 29 100 =	1 164 000	stems
	2t x 160 000 =	320 000	grain
		1 484 000	Rl.

Table 2. Sugarbeet financial budget (average province of Isfahan 1991) (in Rial, '000' ha^{-1})

Revenue [1]	1559	Units	Quantity
Inputs			
Ploughing	15.0		
Dishing	7.7		
Levelling	11.8		
Seeding	9.3	Kg.	21.8
Manure	5.3		
Fertilizer	19.4	Kg.	801.6
Pesticides	8.3	1	7.1
Irrigation water	78.2		
Transport on the site	95.4		
Sub Total Inputs	250.4		
Income (before labour costs)	1308.6		
Labour			
Seeding, land preparation	11.5		4
Manure	1.9		3.5
Fertilizer	7.3		12
Irrigation	32.4		32
Pesticides	5.7		4
Weeding	106.0		4
Harvesting	41.7		30
Handling in trucks	92.0		
Sub-Total Labour	298.5		
Income (after labour costs)	1001.0		

1) Yield : 36 t ha^{-1}.
Factory gate price 43 300 Rl. ton^{-1} at 16% sugar content including subsidies.

Table 3 A : Policy analysis matrix (PAM) for sugarbeet and sweet sorghum (in Rials)*

Total Revenue		Tradable Inputs		Domestic Resources[1]		Profits[2]	
SS	SB	SS	SB	SS	SB	SS	SB
Financial Prices							
1548800	1484000	27700	17600	521000	363800	1009900	1102600
Economic Prices							
856800	786500	415500	264000	401800	309900	39500	212660
Transfers							
702000	697440	-387800	-246400	119400	53900	970400	889940

Where : SB = Subarbeet; SS = Sweet sorghum

1. Fertilizers and chemicals conversion factor is 15
2. Other inputs : conversion factor for labour is 0.6

*. Factory gate price for SB 43300 Rials MT $^{-1}$ inclusive of subsides.

*. Computation of Econ. import parity price of SS same as SB for ex Factory cost except value of byproducts set at 20000 Rials MT^{-1} instead of 10000 Rials MT^{-1} that is 224000 Rials MT^{-1}

*. Transfer from farm to factory costs 4000 Rials MT^{-1}

*. Equivalent border price for SS (econ. Farmgate price) = 11664 Rials MT^{-1}

*. Selling price of 2840 Rials per 1% sugar content (SS contains 11% and SB 16% sugar)

Table 3 B : Co-efficient for sugarbeet and sweet sorghum (in Rials)

	Sugarbeet	Sugarcane
Nominal Protection Co-efficient (NPC)	$\frac{1558800}{856800} = 1.8$	$\frac{1484000}{786560} = 1.9$
	(+ ve protection output)	(+ve protection output)
Effective Rate of Protection (ERP)	$\frac{(1558.5 - 27.7)}{(856.8 - 415.5)} = 3.5$	$\frac{(1484000 - 17600)}{(786860 - 264000)} = 2.8$
Domestic Resource Costs (DRC)	$\frac{401800}{(856800 - 415500)} = 0.9*$	$\frac{309900}{(786560 - 264000)} = 0.6*$

* Indicates economic profitability

that Domestic Resource Cost (DRC) between sugar beet (0.9) and sweet sorghum (0.6) provides a comparative advantage of producing sweet sorghum at the farm level under the retained assumptions for the calculations. According to sugar technologists the cost of recommended processing of sweet sorghum would not be significantly different of the sugarbeet processing. However, for confirmation a pilot plant studies are necessary. Secondly, if the unit cost of processing sweet sorghum is not greater than the cost of processing sugarbeet for refined sugar, then the former has a comparative advantage over sugarbeet.

Under the present circumstances of uncertainty with regards to costs and yields of sugarcane production in Iran, detailed analysis has not been achieved but general relationship used by the Ministry of Agriculture as Beet cost X 2 = cane cost. Moreover, cane plantation in Khurasan will involve heavy fixed costs of drainage besides high farm inputs.

LITERATURE CITED

Almodares, A. and A. Soltani, 1991. Sweet sorghum half mechanized, Publication in Persian language. Isfahan Univ. Publ.

Almodares, A., A. Sepahi, H. Dalilotojjary and R. Ghyami, 1994. Effect of phenological stages and carbohydrates contents of Sweet Sorghum cultivars. Ann. Pl. Physiol. 8(1) : 42-48.

Blas, J., 1992. 'Promotion of sugar production from Sweet Sorghum', A Econo Consultants Report (Proj # TCP\IRA\2252A) submitted to FAO (unpublished)

Kulkarni, D.P., A.Almodares and R.B. Somani, 1995. Sweet sorghum an alternative sugar crop in Iran. Ann. Pl. Physiol. 9(2) : 90-94.

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Genetic Analysis of Shoot Fly Resistance in Sorghum*

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ABSTRACT

Genetic architecture of shoot fly resistance was assessed in sorghum hybrid groups of cytoplasmic male sterile lines and their parents under different levels of shoot fly infestation. The inheritance was studied for oviposition and deadheart formation. The study indicated that the resistant parental groups and their corresponding hybrids supported low oviposition when compared to susceptible groups. The susceptibility (as measured by high deadheart %) in female parent was over dominant in the hybrid. Resistance was required in both the parents to have shoot fly resistant hybrids. The female parents ought to be resistant.

The sorghum shoot fly, *Atherigona soccata* Rondani is a cosmopolitan pest of sorghum. Jotwani *et al.* (1971), Sharma *et al.* (1977) and Singh and Jotwani (1980) demonstrated ovipositional non-preference to be major mechanism of shoot fly resistance. Ovipositional non-preference and deadheart formation are related phenomena in the sense that less egg laying results in less deadhearts (Sharma *et al.*, 1977). This relationship holds well in parental varieties as well as in their F_1 generations. Limited information is available on the nature of gene action for these traits, especially where separate sets of parents are used to develop hybrids. Hence, an understanding of the genetics of resistance in relation to varying levels of shoot fly infestation and an assessment of the utility of different paternal lines in developing resistant hybrids and exploiting heterosis for grain yield under post rainy season are of paramount importance.

MATERIAL AND METHODS

The investigation was carried out at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT,) Patancheru, Andhra Pradesh, in four sowings during rainy and postrainy seasons of 1995-96. A line x tester experiment using a total of 12 cytoplasmic male sterile lines and 12 diverse restorers in nine sets was undertaken for this investigation. The resulted nine groups of hybrids obtained by crossing three groups of cms lines [Rainy season-bred resistant cms lines - SPSFR 94001A, SPSFR 94003A, SPSFR 94002A and SPSFR 94031 A (RBR cms), Postrainy season-bred resistant cms lines-SPSFPR 94001A, SPSFPR 94002A SPSFPR 94005A and SPSFPR 94007A (PRBR cms), and rainy season-bred susceptible cms lines- ICSA 20, ICSA 89001, ICSA 89004 and ICSA 90002 (SB cms)] and three groups of restorer lines [Resistant bred restorers- ICSV 712, ICSV 88088, ICSV 89015 and ICSV 89030 (RBR), susceptible high yielding restores-ICSR 89076, ICSR 90002, ICSR 90005 and ICSR 90014 (SBR) and postrainy season-adapted landraces- ICSR 93031, ICSR 93011, ICSR 93009 and ICSR 93010 (PRLR)] along with their parents and checks (resistant- ICSV-705B, ICSV-708B, PS-19349B, IS-18551 and M-35-1; susceptible- 296B, CSH-9 and ICSV-112) were examined to elicit information on the type(s) of crosses needed to obtain shoot fly resistant hybrids in different seasons.

The resulting 144 F_1 sorghum hybrids along with parents and checks were evaluated in randomized complete block design (RCBD) with three replication under two environment both in the rainy and postrainy seasons. Different levels of infestation were created by adjusting the sowing dates and by enhancing the shoot fly population through the use of infestor rows. Natural environment-I in the rainy season (E1K) and in the postrainy season (EIR) was created just by allowing the shoot fly

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population to develop naturally to represent farmers field. Whereas artificial environment-II in the rainy season (EIIK) and in the postrainy season (EIIR) was created by enhancing shoot fly population by sowing CSH-1 (a susceptible hybrid) in four rows, 21 days prior to the planting of the test material. Moist fishmeal packets of 500g each were placed within the infestor rows to attract shoot flies (Starks, 1970). Sowings were taken four to six weeks later than the normal planting period to have sufficient shoot fly pressure. Each entry was planted in 2-row plots of 2 m x 0.75 m (i.e., 2 rows of 2-m length, ridges 75 cm apart). Plots were thinned 10 days after emergence (hereafter referred as DAE) to spacing of 5 cm between plants within rows. All cultural practices such as interculture, irrigation (only in postrainy season) weeding etc., were carried out to maintain a weedfree crop in all the trials in rainy and post rainy seasons. The plant protection measures during rainy and postrainy seasons were avoided until the shoot fly infestation period was complete. The crop in all the four environments was protected against stem borer by spraying endosulfan (700g a.i. ha^{-1} twice at an interval of 10 days at 35 DAE and 45 DAE. During the grain filling stage both the trials were protected against head bugs by spraying carbary (1kg a.i. ha^{-1}) twice at an interval of six days.

Observation on shoot fly eggs $plant^{-1}$ and deadhearts $plot^{-1}$ were recorded in both rainy and postrainy seasons. Shoot fly egg were counted at weekly intervals up to three weeks after sowing on ten randomly selected seedlings. The average number of eggs $plant^{-1}$ was calculated. Deadhearts were counted at weekly intervals starting from second week, up to four weeks after sowing and were calculated as per cent of total plants. The data for each character were analysed as per randomized complete block design ANOVA suggested by Panse and Sukhatme (1978). The treatment sum of squares in the ANOVA was further partitioned to examine the particular contrasts among the genotypes.

RESULTS AND DISCUSSION

In general, number of eggs $plant^{-1}$ were more in rainy season than in postrainy season (Fig.1). This may be due to low pest load in the postrainy season than in the rainy season. Both bred (RBR cms, PRBR cms and RBR) and the farmer selected (PRLR) resistant parental line groups showed least egg count irrespective of the season when compared with the susceptible parent groups (SBR cms and SBR). Least egg count appeared to be recessive over high count (Table 1), with the result, hybrids involving both the resistant parents (RBR cms PRBR cms, RBR, and PRLR) only showed least count while all other combinations (SB cms x RBR, RBR cms x SBR, PRBR cms x SBR, SB cms x SBR, SB cms x PRLR) supported high egg count irrespective of season / temperature (Table 1 ; Fig.1). In other words, high egg count pattern followed nonglossy pattern across all seasons (Jayanthi, 1997).

Deadheart per cent ranged from 51.91 to 88.62 among all groups of hybrids, parental lines and controls (Table 2; Fig.2). Of all the parental lines and control groups, rainy season-bred resistant cms lines (RBR cms) had least deadheart (51.91%) and performed well in all the four environments, followed by resistant checks (58.74). Interestingly both postrainy season-adapted lines (PRBR cms and PRLR) had lower deadheart % only in postrainy season (and in rainy season they were inferior to the rainy season-bred resistant cms lines (RBR cms) (Fig.2).

Among hybrids, RBR cms x PRLR recorded least deadheart per cent (67.84) followed by PRBR cms x PRLR group (69.55). The highest deadheart per cent was recorded in SB cms x SBR group (86.88). Comparatively a low deadheart per cent was recorded in all the hybrid groups involving resistant female and male lines. Use of susceptible lines either as female or male increased the level of deadhearts and the deadheart per cent in these hybrids were comparable with that of susceptible x susceptible crosses (SB cms x SBR). This suggested that resistance to shoot fly as measured by deadheart damage was recessive and both the parents have to be resistant in order to have resistant hybrids. Further, the deadheart per cent was high in those hybrids where susceptible line groups were used as female parents than as pollen parent in combination with resistant parent groups.

Deadheart per cent was low in hybrid groups having rainy season resistant line as female and resistant / landraces as pollen parent in both rainy and postrainy seasons. However, the crosses

Table 1. Gene action for ovipositional non-preference in various sorghum hybrid groups.

Cross	Egg count Plant^{-1a}						
	EIR/ EIIR[b]	P_1[b]	P_2[b]	Mid parent value	Hybrid[b]	Mid parent Vs Hybrid	Gene action for least egg count
RBR cms x RBR	EIR	0.29	0.69	0..49	0.99	0.50**	Recessive
	EIIR	0.96	0.83	0.90	1.30	0.40**	Recessive
PRBR cms x RBR	EIR	0.53	0.69	0.61	0.85	0.24**	Recessive
	EIIR	1.01	0.83	0.92	1.50	0.58**	Recessive
SB cms x RBR	EIR	1.90	0.69	1.30	2.15	0.85**	Recessive
	EIIR	1.60	0.83	1.21	1.75	0.54**	Recessive
RBR cms x SBR	EIR	0.29	2.37	1.33	2.18	0.85**	Recessive
	EIIR	0.96	1.98	1.47	1.57	0.10	Recessive
PRBR cms x SBR	EIR	0.53	2.37	1.45	1.49	0.04	Recessive
	EIIR	1.01	1.98	1.50	1.53	0.03	Recessive
SB cms x SBR	EIR	1.90	2.37	2.14	2.28	0.14	Recessive
	EIIR	1.60	1.98	1.79	1.83	0.04	Recessive
RBR cms x RBR	EIR	0.29	0.51	0.40	0.90	0.50**	Recessive
	EIIR	0.96	1.43	1.20	1.30	0.10	Recessive
PRBR cms x PRLR	EIR	0.53	0.51	0.52	0.76	0.24**	Recessive
	EIIR	1.01	1.43	1.22	1.21	0.01	Intermediate
SB cms x PRLR	EIR	1.90	0.51	1.21	1.98	0.77**	Recessive
	EIIR	1.60	1.43	1.52	1.74	0.22**	Recessive

[a]Based on 4 P_1 parents; 4 P_2 parents and 16 F_1 hybrids
[b]EIR= Postrainy natural environment; EIIR = Postrainy artificial environment; P_1=Parent 1; P_2 = Parent 2, ** Significant at 1 per cent

involving postrainy season-bred resistant lines (PRBR cms) as female parents had high level of resistance only in postrainy season. On the other hand, use of landraces (PRLR) as pollen parent with susceptible female parent did not increase the level of resistance level in the hybrid either in rainy or postrainy season. But use of landraces as pollen parent with rainy / post rainy season bred resistant lines as females had high deadheart per cent in rainy season and markedly low deadheart per cent in postrainy season.

In crosses involving either RBR cms or PRBR cms as one of the parental lines the susceptibility was intermediate / partially dominant / dominant, even though the male parent was susceptible bred restorer group (SBR) (Table 2). Interestingly, the crosses involving the susceptible bred cms females (SB cms) showed dominant / over dominant for susceptibility even though the male parent was resistant bred lines. Thus, it clearly

Table 2. Gene action for susceptibility (deadheart %) in various hybrid groups

Cross	EIR/ EIIR[b]	P_1[b]	P_2[b]	Deadhearts %[a] Mid parent value	Hybrid[b]	Mid parent Vs Hybrid	Gene action for susceptibility
RBR cms x SBR	EIR	16.40	72.17	44.30	59.91	15.61**	Partially Dominamt
	EIIR	37.96	81.03	59.49	78.31	18.82**	Dominamt
PRBR cms x RBR	EIR	16.4	88.79	22.60	51.26	28.66**	Dominamt/Over Dominamt
	EIIR	37.95	51.79	44.87	62.70	17.83**	Dominamt/Over Dominamt
PBR cms x PRLR	EIR	16.40	27.81	22.11	36.98	14.87**	Dominamt/Over Dominamt
	EIIR	37.85	52.89	45.42	65.44	20.02**	Dominamt/Over Dominamt
PRBR cms x SBR	EIR	38.09	72.17	55.13	52.93	2.20**	Intermediate
	EIIR	50.26	81.03	65.65	69.41	3.76**	Partially Dominamt
PRBR cms x RBR	EIR	38.09	28.79	33.34	43.35	10.01**	Dominamt/Over Dominamt
	EIIR	50.26	51.79	51.03	63.21	12.18**	Dominamt/Over Dominamt
PRBR cms x PRLR	EIR	38.09	27.81	32.95	37.88	4.93**	Dominamt
	EIIR	50.26	52.89	51.58	67.25	15.67**	Dominamt/Over Dominamt
SB cms x RBR	EIR	64.75	28.79	46.77	61.44	14.67**	Dominamt
	EIIR	76.40	51.79	64.10	86.10	22.00**	Dominamt/Over Dominamt
SB cms x PRLR	EIR	64.75	27.81	46.28	65.40	19.12**	Dominamt
	EIIR	76.40	52.89	64.65	84.72	20.07**	Dominamt/Over Dominamt
SB cms x SBR	EIR	64.75	72.17	68.46	71.18	2.72**	Dominamt
	EIIR	76.40	81.03	78.72	85.31	6.59**	Dominamt/Over Dominamt

[a]Based on 4 P_1 parents; 4 P_2 parents and 16 F_1 hybrids
[b]EIR = Postrainy natural environment; EIIR = Postrainy artificial environment; P_1 = Parent 1; P_2 = Parent2
** Significant at 1 per cent

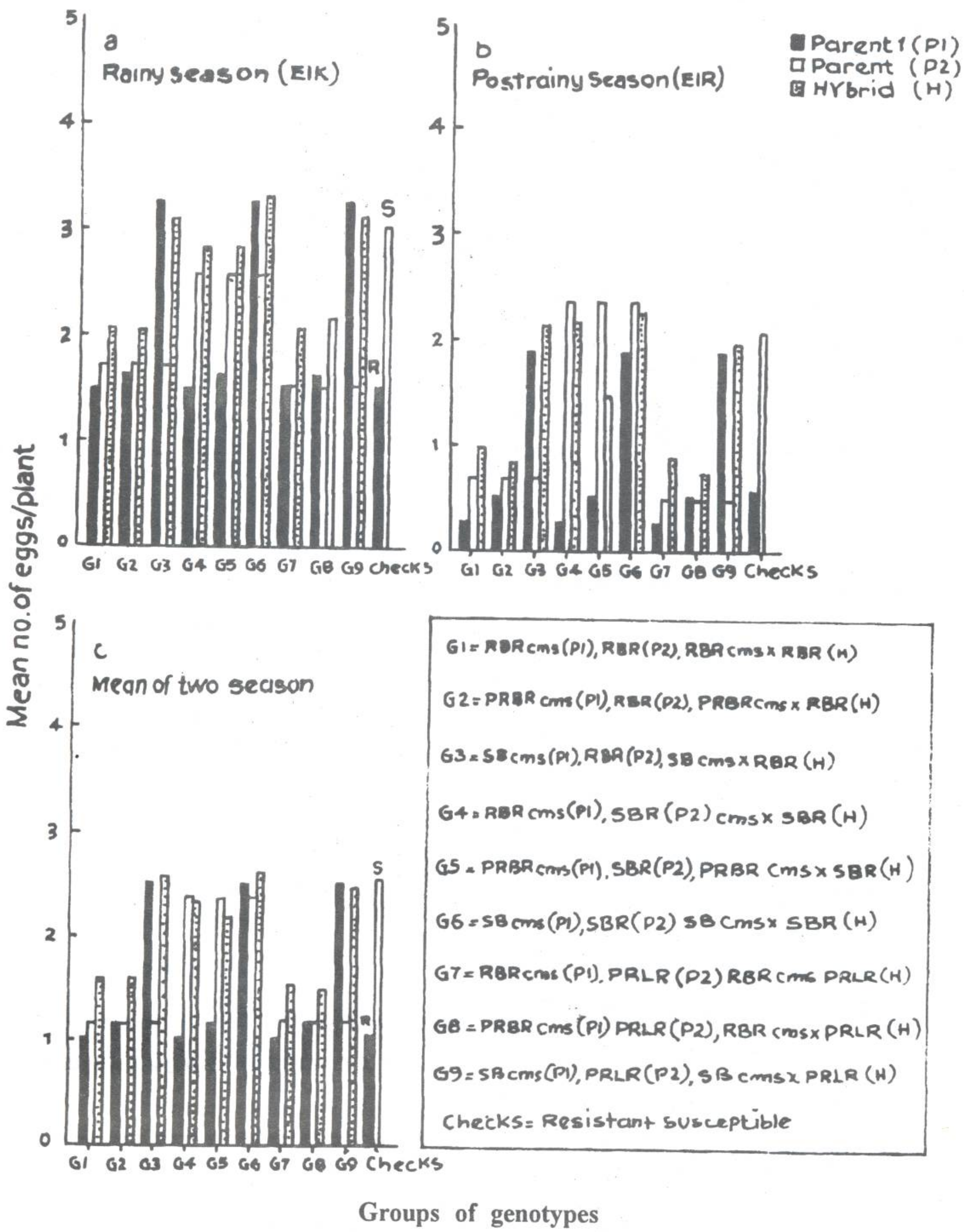
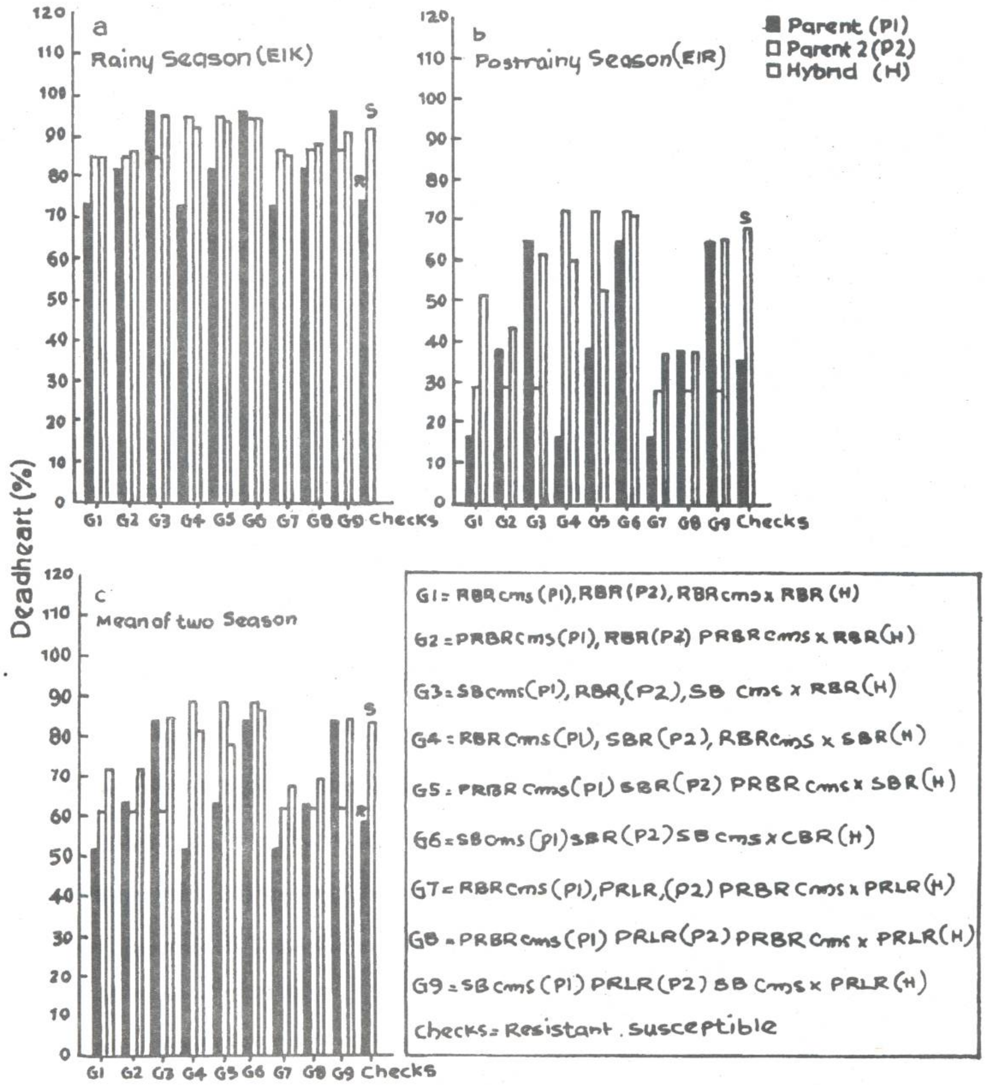


Fig. 1. Mean number of eggs/plant in parents and their hybrid groups (a) Rainy season (EIK) (b) Postrainy season (EIR) (c) Mean of two seasons.



Groups of genotypes

Fig. 2. **Mean deadheart (%) of parents and their hybrid groups (a) Rainy season (EIK) (b) Post rainy season (EIR) (c) Mean fo two seasons.**

indicated that to have resistant hybrids both male and female parents should be resistant and that the susceptibility is influenced by the female parent. These findings were supported by Balakotaiah *et al.* (1975). Rana *et al* (1975 & 1981), Sharma *et al.* (1977), Borikar and Chopde (1981), Biradar and Borikar (1985), Nimbalkar and Bapat (1987) and Singh and Verma (1988).

Thus the susceptibility in female parents was overdominant in the hybrid. To have shoot fly resistant hybrids both parents should be improved for their resistant ability and the female parents ought to be resistant. The observed specificity in the resistance as measured by deadhearts might be due to the observed differences in the expression of various train. Further, it may also be due to the biotype specificity, and the present studies can not rule out the role of biotype specificity. However, further controlled studies are required to differentiate the causes for the observed specificity in the resistance / susceptibility.

LITERATURE CITED

Balakotaiah, K.,B.S. Rana, D.P. Tripathi, and N.G.P. Rao, 1975. Genetic analysis of some exotic and Indian crosses in Sorghum X. Inheritance of resistance to sorghum shoot fly. Indian J. Genet. 35: 344 -347.

Biradar, S.G.and S.T. Borikar, 1985. Genetic analysis of shoot fly resistance in relation to growth stages in sorghum. J. P1. Breed. 95(2): 173-178

Borikar, S.T.and P.R. Chopde 1981. Inheritance of shoot fly resistance in sorghum. J. Maharashtra Agric Univ 6:47-48.

Jayanthi, P.D.K., 1997. Genetics of shoot fly resistance in sorghum hybrids of cytoplasmic male sterile lines. Ph.D thesis, Andhra Pradesh Agricultural University, Hyderabad.

Jotwani, M.G., G.C. Sharma, B.G. Srivastava and K.K. Marwaha, 1971. Ovipositional response of shoot fly (*Atherigona soccata* Rond). On some of promising resistant lines of sorghum. Investigations on insect pests of sorghum and millets (1965-1970) Final technical report (ED.Pradhan S) Division of Entomology, Indian Agricultural Research Institute, New Delhi. pp. 119-122.

Nimbalkar, V.S.and D.R. Bapat 1987. Genetic analysis of shoot fly resistance under high level of shoot fly infestation in sorghum. J. Maharashtra Agric Univ 12:331-334.

Panse, V.G.and P.V. Sukhatme, 1978. Statistical methods for agricultural workers. ICAR, New Delhi.

Rana, B.S., M.G.Jotwani, and N.G.P. Rao, 1981. Inheritance of host plant resistance to the sorghum shoot fly. Insect Sci. Applic. 2 (1/2) : 105-109.

Rana. B.S., D.P. Tripathi, K.Balakotaiah, R. Damodar and N.G.P. Rao, 1975. Genetic analysis of some exotic x Indian crosses in sorghum selection for shoot fly resistance. Indian J. Genet. 35:350-355.

Sharma, G.C., M.G. Jotwani, B.S.Rana and N.G.P. Rao, 1977. Resistance to the sorghum shoot fly, *Altherigona Soccata (Rondani)* and its genetic analysis, J. Ent. Res. 1:1-12.

Singh, S.P. and M.G. Jothwani, 1980. Mechanisms of resistance in sorghum to shoot fly I Ovipositional non-preference. Indian J. Ent. 42:240-247.

Singh, S.P., and A.N. Verma, 1988. Inheritance or resistance to shoot fly, *'Atherigona soccata* (Rondani) in forage sorghum. J. Insect Sci. 1 (1) : 49-52.

Starks, K.J., 1970. Increasing infestation of the sorghum shoot fly in experimental plots. J. Econ Entomol 63: 1715-1716.

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New Additions to the Flora of Yavatmal District (M.S.)

S. P. Rothe

ABSTRACT

The paper enumerates 29 species from Yavatmal district which are addition to the Flora of Yavatmal district (1995). Most of them belong to the weed flora of the district.

The district Yavatmal is situated in the eastern part of Maharashtra between north latitudes 19° 28' and 20 48' and longitudes 77° 19' and 79 07'. It occupies an area of about 13517.21 sq.km.

The forest area of this district is divided into two divisions. East Yavatmal and West Yavatmal. The east Yavatmal division is subdivided into ten ranges and West into seven ranges. The soil of the district can be classified as red soils, brownish sandy soils and black cotton soils. The vegetation has been considerably modified by the combined influence of all the site factors like climatic, edaphic and biotic factors including availability of species, their characteristics, dispersal chance etc.

Wilt (1908) listed the plants found in the Berar forest circle of the Central Provinces. The list contain 333 species of which 159 are from Yavatmal; recently S. Karthikeyan and Anantkumar reported a total of 577 species 1 subspecies and 1 variety comprising 365 genera and 98 families.

An analysis shows a total of 606 species, 376 genera and 102 families in Yavatmal district.

MATERIAL AND METHODS

Extensive and intensive collection of angiospermic species were made by visiting various places in last two years throughout the district in different seasons, all the specimens collected were numbered and properly processed. These are deposited in Botany Department of Shri Shivaji College, Akola. Following is a list together with diagnostic description, distribution in the area and phenological notes etc.

Family : Cleomaceae

Cleome cheilidonii L.f.Suppl. 300. 1781 : Hook f.T. Anders in Hook. F.F1. Brit.

India 1; 170.1872.

Erect glaucous annual herb 30-100 cm tall; leaves digitate. 3-9 foliate. Lexflets elliptic-obovate, mucronate at apex. Flowers in terminal corymbose racemes, Pink to rosy red. Siliqua, erect, cylindrical beaked. Seeds black.

Occasional in ditches, shallow ponds.

Floristic analysis

Divisions	No. of Families		No. of Genera		No. of Species		Sub species	Variety
	Previously reportd	Recent report	Previously reported	Recent report	Previously reported	Recent report	previous	
Dicotyledons	79	02	271	9	418	25	1	1
Monocotyledons	19	02	94	2	159	04		
TOTAL	98	04	365	11	577	29	1	1

Department of Botany, Shri Shivaji Arts, Science and Commerce College, Akola

Fls and Frts - July to January.

Pusad, Rothe, 211.

Family : Polygonaceae

Polygala erioptera Dc., Prodr. 1: 326, 1824; Bennett in Hook F.F1. Brit. India 1: 203. 1872; Chandrabose & Nair in Proc. Ind. Acad. Sci (Plant Sci.) 90;121.1981.

Erect stout, appressed hairy, annual herb, 10-30 cm tall. Leaves linear to elliptic, oblong. Flowers in short, axillary racemes, Pedicel short, pubescent sepals, with membranous cilliate margins. Petals pink to rosy red, slightly exceeding the wings. Capsules oblong elliptic.

Occasional on rocky soil of open grass lands.

Fls and Frts - July to February.

Darwha. Rothe - 218.

Family : Vitaceae.

Cissus setosa Roxb. Flind. 1: 410. 1820, Gamble F1. Pres Madras. 1:68 (B S I reprint.) 1957 *Vitis Setosa* Wall. Ex Wt & Arn. Prodr. 1:127. 1834; Lawson in Hook. F.F1. Brit. Ind. 1: 654.1875.

Succulent, herbaceous climber, stem and Leaves covered with scattered glandular bristles. Leaves sessile, Leaflets shortly stalked, elliptic or obovate - oblong 3-9 x 2-5 cm obtuse, irregularly toothed, glandular, hispid beneath. Flowers small in cymes, creamy white. Berries ovoid or globose.

Rare on rocky slopes in hill forests.

Fls and Frts - August to November.

Umarkhed, Rothe 221.

Family : Fabaceae

Tephrosia pentaphylla (Roxb) G.Don in Sweet, Hort. Brit. Ed. 3: 170.1839, Gamble, F1.Pres; Madras 1 : 225 (BSI reprint, 1957). *Galega pentaphylla* Lamb. F1. Ind. 3 : 384. 1832. *Tephrosia senticosa* Wt. Icon. F. 370. 1840, non (L) Pres. 1808 ; Baker in Hook. F.F1. Brit. India 2:112.1876

Erect much branched, under shrub 20-40 cm tall, branches divaricate, slender, terete, Leaves pinnate 2-3 cm long, glabrous above, densly white hairy beneath. Flowers axillary pink; pods oblong 2.5 - 4 cm long.

Rare on waste land around fields.

Fls and Frts - September to November

Painganga river, Rothe - 239.

Family : Caesalpiniaceae

Cassia obtusifolia L. Sp. Pl.377, 1753; Cooke. F1.Pres.

Bombay 1: 447 (BSI reprint) 1958, C. tora sonsu Baker in Hook f. F1. Brit. India 2: 263. 1878. Pro. Parte. Non L. 1753.

Erect under Shrub, 40 - 50 cm tall. Leaves 6 - 10 cm long; rachis grooved, pubescent, with gland between the lowest pair of leaf lets, stipules linear, subulate leaflets in 3 pairs Opposite obovate oblong. Flowers subsessile yellow pods linear, obtusely 4 - gonous.

Common on waste land along roadsides

Fls and Frts - September to January.

Darwha, Rothe 231.

Family : Mimosaceae

Neptunia triguetra (Willd) Benth, in Hook J. Bot. 4:355. 1842, Baker in Hook f. F1. Brit. India 2 : 286. 1878.

Prostrate glabrous, perennial herb. Leaves pinnate. Leaflets 4 - 15 pairs, sessile, oblong. Flowers in globase heads, yellow; Pods oblong, glabrous, beaked, black.

Frequent along river bank, on black soil.

Fls and Frts - September to December

Painganga river, Rothe - 247.

Family : Asteraceae

Gnaphalium leuto- album L. Sp. 851. 1753. Hook f. Brit. Ind. 3: 288. 1881.

Erect herb 10-25 cm tall; usually brachning from the base; covered all over with cottony pubescence. Leaves sessile oblong linear lanceolate 3-6 x 0.4 - 0.5 cm. Heads golden yellow, 7-8 mm across in terminal corymbose cymes. Achenes ellipsoid 0.5 mm long pale brown; Pappus hairy; white.

Occasional on wet soil; along river bank.

Fls and Frts - January to March.

Painganga river, Rothe 281.

Grangea maderaspatna (L.) Poir in Encyel. Suppl. 2 : 825.1811. Hook. f. Fl. Brit. Ind. 3:247.1881. *Artemissia maderas patna* L. Sp. Pl. 841.1753.

Suberect densly pubescent annual herb; Branches spreading, Leaves pinnatifid obovate - oblong 3-8 x 2-2.3 cms finely serrate, Heads globose, yellow 1-1.2 cm across, Solitory or in pairs on leaf opposed peduncles. Achenes flattened, 2 mm long; glandular.

Occasional along stream banks

Fls and Frts - November to March

Pusad, Rothe 261.

Family : Asclepiadaceae

Calotropis procera (Ait.) R. Br. In Ait. Hort. Kew ed.2, 2:78; Hook f.F1. Brit. Ind. 4:18, 1883; Santapau & Irani, Univ. Bombay Bot. Mem. 4:19. 1962., Naik, F1 Osmanabad 204. 1979. *Asclepias procera* Ait - Hot. Kew 1:305. 1789.

Erect Shrub, 1-2 m tall. Leaves opposite, Sessile or subsessile; broadly ovate, obovate or ovate oblong, cordate and auricled at base acute. Flowers in lateral umbellate cymes, white or pale purple with dark purple tips. Corona longer than staminal tube. Follicles boat shaped, cottony pubescent.

Common on waste land.

Fls and Frts - January to June

Pusad, Rothe 209.

Leptadenia reticulata (Retz.) Wt. & Arn. Contr. 47. 1834; Hook f. F1. Brit. Ind. 4:63, Santapau & Irani Univ. Bombay Bot. Mem. 4:60.1962. *Cynanchum reticulatum* Retz. 4:63 obs 2; 15.187.

Extensively large much branched shrub. Leaves opposite glaucous green ovate to ovate lanceolate rounded at base, grey tomentose especially beneath when youn. Flowers in umbellate cymes; dull white, Follicles broadly lanceolate.

Rare along hedges and river banks.

Fls and Frts - September to January.

Painganga river, Rothe 279.

Telosma cordata (Burm.f.) Merr. In Philip. J.Sci. 19:372.1921. Raizada & Saxena, F.Mussorie 440. 1978. Asclepias cordate Burm Pallid (Roxb) Wt & arn. In Wt. contr. 42. 1834 Hook f. F1. Brit. Ind. 4:38.1883. *Telosma pallida* (Roxb) Craib in Kew 4 : 83. 1962.

Twining under shrub, branches lenticellate, pubescent near the node otherwise glabrous, Leaves opposite, membranous, broadly ovate subcordate or rounded at base. Flowers in dense lateral cymes; white. Follicles fusiform, woody; shortly acuminate 7.5-10 x 2-2.5 cm long.

Occasional along river banks.

Fls and Frts - June to January

Yavatmal, Rothe 275.

❖ Family : Boraginaceae

Cordia sinensis Lamk. Encyl. 1:423.1792; Warfa in Nord. J.Bot. 9:649. 1990. *Cornus gharaf* forsk, F1. Aeg. Arab. 94.1775. nomen. *Cordia rothii* Roem & schuil Syst. 4:798. 1819; Clarke in Hook. f.F1. Brit. Ind 4:138.1883; *C. gharaf* (Forsk) Ehrenb & Asch. In Sitz, Ges, Naturf. Fr. Berlin 1879.

Medium sized tree, bark grey, furrowed, young part pubescent. Leaves oblanceolate or elliptic oblong, entire obtuse or rounded at apex rough above Flowers in lax terminal or axillary cymes; White. Drupes ovoid 0.7-1.5 cms; orange yellow.

Rare in hill Forest

Fls and Frts - March to June

Darwha, Rothe 229.

Family : Cuscutaceae

Cuscuta hyalina Roth Nov. P1. Sp. 100.1821; Clarke in Hook f. F1. Brit. Ind. 4:226.1883.

Leafless parasite, stem slender, glabrous. Flowers white in axillary racemes. Fruits globose, 2 mm in diam, dry papery, pale white, Seeds ovate, longitudinally lined rugose.

Occasional parasite an Amaranthus sps and Medicago sativus.

Fls and Frts - July to November

Yavatmal, Rothe 208.

Family : Solanaceae

Datura ferox L. Amoen. Acad. 3:403. 1756; Haegt. In Austr. J.Bot. 24 : 427. 1976; Bhandari, Ind. Des. 268. 1978. Zate in Marathwada Univ. J.Sci. 20 (3); 1. F.1.1981.

Stout appressed pubescent, branched annual herb. 0.5 - 1 -5 m tall. Leaves broadly ovate oblique at base, coarsely lobed, acute or acuminate, minutely lobed. Pubescent. Flower solitory - pale white. Capsules ovoid - ellipsoid, erect, spiny ; seeds, flat brown.

Occasionally found on waste lands.

Native of China; now fast naturalising

Fls and Frts - September to December

Pusad, Rothe 203.

Withania somnifera (L) Dunal, in DC. Prodr. 12 (1) : 453. 1852.

Clarke in Hook. f. F1. Brit. Ind. 4: 239. 1883. Physalis somnifera L. Sp. P1. 1: 182.1753.

Erect undershrub 60 - 150 cm tall, branches terete, densly clothed with stellate hoary tomentum. Leaves ovate ellipsoid, cuneate at base, entire, obtuse, pubescent. Flowers in sessile or subsessile fascicles, greenish yellow. Berries red, globose, 5-6 mm in diam. Enclosed in persistent calyx, Seeds subreniform.

Occasional along road sides, on waste land.

Fls and Frts - September to December,

Umarkhed, Rothe 249.

Family : Scrophulariaceae

Striga asiatica (L) O.Ktze. Rev. Gen. P1; 1: 466; 1891. Chatt & Bharo; in Bull. Bot. Soc. Bengal. 9(2); 1955. *Buchnera asiatica* L. Sp. P1. 630, 1753. *Striga lutea* Lour. F1 Cochinch. 22, 1790; Hook. f. F1. Brit. Ind. 4.229, 1884.

Parasite on roots of grasses; Stem 7 - 20 cm, erect strigose with prickly hairs. Leaves sessile. 1.2 - 3 cm long linear, rough with prickles. Flowers yellow in lax spikes. Capsules 5 mm long, oblong, ellipsoid.

Occasional on gravelly soil of grasslands.

Fls and Frts - June to January.

Kharbi - Rothe 224.

Striga densiflora (Benth.) Benth. in Hook, comp. Bot. Mag. 1:363. 1836; Hook f. F1. Brit. Ind. 4:299. 1884. *Buchnera densiflora* Benth. Scroph. Ind. 41. 1835.

Erect, Scabrid, Sparingly, branched annual herb 20 - 30 cm tall. Leaves linear lanceolate, 2- 4 cm long. Flowers white; axillary solitory or in terminal spikes. Capsules oblong, 3 - 4 mm long. Seeds ovoid, black.

Common parasite on roots of grasses

Fls and Frts - August to November.

Wari, Rothe 204.

Striga gesnerioides (Willd) Vatke. Oester. Bot. Zeit. 11. 1875. Chatt & Bhar in Bhar in Bull. Bot. L.Soc. Bengal 9 (2) : 151. 1955. *Buchnera gesnerioides* Willd. Sp. P1. 3: 338. 1800. *B. orobanchoides* (Endl.) Benth in Camp. Bot Mag. 1 : 361. T. 19; 1836. Hook f. F1. Brit. Ind. 4: 229; 188.

Small erect herb 10 -20 cm tall, Parasite on roots. Stem terete, branched; shining dark purple. Leaves scale like. Flowers sessile white or pink in dense terminal spike. Capsules oblong ellipsoid 6 mm. Long.

Common parasite on roots.

Fls and Frts - September to Novermber

Khargi, Rothe 222.

Veronica anagallis - aqualtica L Sp. P1. 12, 1753. *V. anagallis* L. loc. Cit; Hook. f. F1. Brit. Ind. 4: 293, 1884.

Erect glabrous herb 20 - 40 cm tall. Leaves sessile, Opposite or the upper alternate, semiamplexicaule; 2 - 4 x 1.5 - 2 cms' oblong - lanceolate. Flowers bluish white in axillary and terminal recemes, capsules compressed, orbicular, 3 mm in diam.'

Occasional along streams and in rocky river beds.

Fls and Frts - June to August.

Pandharkawada, Rothe 264.

Family : Orobanchaceae

Orobanche cernua Loefl. Var: *nepalensis* Dc. Prodr. 71:33. 1847. Santapau & Wagh in Bull. Bot. Sur. India, 5:107, 1963. *O. cernua* L. var. (*desertorum*) Ritter. Boek. Mono. Orob, in Biblioth. Bot. Heft. 19: 145. F. 33 (1), 1890. *O nicotianae* Wight. 111.2 : 179, t. 158, 1850; Hook. f. F1. Brit. Ind. 4 326, 1884.

Root parasite 20 - 45 cm tall. Leaves scaly, few scattered lanceolate acute pubescent or obovate, brown, seeds ovoid, black.

Parasite on Brinjal, tomato roots.

Fls and Frts - January to March.

Yavatmal, Rothe 287.

Family : Amaranthaceae

Alternanthera pungens M.B & K Nov. Gen. Sp. 2: 206, 1818; Santapau & Shah in journ. Bombay Nat. Hist. Soc. 58; 551. 1961; Naik, F1. Osmanabad 287. 1979; Naik & Pokle in J. Ind. Bot. Soc. 64: 297. 1985. A. repens (L.) Link, Enum. P1. Hort. Berol. 1 : 154. 1821. Et. In Stead. No, men. Ed. 2,1:65. 1840 non Gmelin 1791.

Prostrate much branched annual herb 15 - 45 cm long. Leaves opposite, broadly obovate to orbicular 1-3 x 8-2.7 cm. obtuse. Flowers in short axillary pungent spikes; 6-10 mm long. Utricles compressed, orbicular, 1 mm in diam. narrowly winged.

Native of central America, naturalised on wasteland.

Fls and Frts - June to December.

Wari, Rothe 294.

Amaranthus polygonoides L. F1. Jamaica Pugill. 2:27 1759; Amoen. Acad 5; 389; 1760; Naik in Journ. Bombay. Nat. Hist. Soc 64(1) : 134 - 135, 1967.

Herb 15-40 cm tall. Leaves lanceolate to rhomboid narrow at base, tapering into 0.5-2 cm long petiole; acute with a small mucro at apex. Flowers pale green, clustered in leaf axils. Utricles faintly rugulose.

Occasional on waste land along road sides and on old wall.

Fls and Frts - August of October.

Yavatmal - Rothe - 296.

Amaranthus viridis L. Sp. P1. ed. 2: 1405. 1763; quoad. Descr. Et. Herb. L.excl. ref. Bauhin et. Topurntort. Merr. Amer. Jounrn . Bot. 23: 611, 1936. Hook. F. F1. Brit. Ind. 4:720. 1885. A. gracillus Desf. Tabl. Bot 43, 1804.

Erect branched annual herb, 30-60 cm tall. Leaves ovate 4-6 x 3.5 cm, entire. Flowers in axillary clusters and in terminal 8-15 cm long spike or panicles. Utricles globose with short beak much rugose.

Occasional on waste land

Fls and Frts - Auguest to December

Yavatmal, Rothe 227.

Family : Lamiaceae

Plectranthus mollis (Ait.) spreng. Syst. 2:690. 1825; Santapau in Rec. Bot. Surv. Ind. 16 (1); 216, ed. 3, 1967. *Ocimum molle* Ait. Hort. Kew. 2: 322, 1789. *Plectranthus incanus* Link, Enum. Hort. Bero. 1:2:120; 1822. Hook f. F1. Brit. Ind.

Erect herb 30 - 60 cm tall, leaves ovate 5-10 x 4-9 cms. acute, crenate, flowers pale bule or lialace in few florered cymes arranged in axillary and terminal racemes. Nutlets subglobose, pale brown and dotted with purple.

Common on waste land

Fls and Frts - August to November

Painganaga river bed, Rothe 244.

Family : Aristolochiaceae

Aristolochia bracterolata Lamk. Encycl. 258. 1783. Santapau. Bull . Bot. Surv. Ind. 5 (2); 105.1953 *A.bracerate* Retz. Obs. 5;29. 1788; Hook f. F1 Brit. Ind 5:76 1886.

Procumbent or Twining glaucous herb, woody at base. 5-35 cm long. Leaves linear- oblong or obovate- oblong. 3 -13 x 1.2-5 cm acuminate. Flowers palegreen in few flowered axillary racemes; Capsules 3-4 cm long. globose oblong; opening from below upwards, 6 valved.

Occasional in hill forest; near villages.

Fls and Frts - October to January.

Pusad, Rothe 274.

Family : Najadaceae

Najas graminea Del. Descr. Ezypte. Hist. Nat. II 282, tab 50. f. 3, 1813; Hook f. F1. Birt. Ind. 6: 569; 1893.

An aquatic graceful herb, 20 - 60 cm long. Leaves narrowly linera 2-2.5 cm long with minute, oblique spinules on the margins; sheath long auricled. Flowers of both sexes naked, axillary.

Common in ponds & ditches.

Fls and Frts - Setember to October.

Darwha, Rothe 262.

Family : Potamogetonaceae

Potamogeton crispus L. Sp. P1. 126. 1753; Hook. f. F1. Brit. Ind. 6: 566.1893.

Submerged aquatic herb. Leaves oblong 2.5 - 4.5 x 5-6 cm, dentate and undulate on margins, acute at apex. Flowers yellow, 2-3 mm across in terminal Spikes, Fruits ovoid, 2 mm long; beaked.

Rare in stagnant water
Fls and Frts - September to December
Pandharkawda, Rothe 253.

Potamogeton nodosus Poir in Encycl. Meth. Bot. Suppl. & : 535. 1819; Dandy in J. Linn. Soc. 50; 531.1937. Subramanyam Aq. Angio. 95. 1962. P. indicus Roxb. F1 India 1: 471. 1820; non Roth. Ex Roen & Schult. 1818; Hook f. F1. Brit. Ind. 6: 565. 1893.

Aquatic herb rooted in mud under water; Leaves linear, submerged ones sessile, the floating ones petiolate, elliptic oblong, 8-20 x 3.5 - 4 cm acute or rounded at base, glabrous. Flowers flesh coloured in axillary spikes, fruits ovoid.

Rare in shallow water
Fls and Frts - June to August
Pandharkawada, Rothe 236.

Potamogeton pectinatus L. Sp. P1. 127, 1753; Hook. f. F1. Brit. Ind. 6:567. 1893; Subramanyan' Aq. Angio. 95. 1962.

Submerged aquatic herb. Leaves filiform, 4-10 cm long. Flowers greenish white in long pedunculate Spikes. Drupe lets 4, ovoid, 2.5 x 1.5 mm; shortly beaked one seeded, Seeded ovoid, pale yellow.

Rare shallow water

fls and Frts - February to June

Pandharkawada, Rothe 248.

LITERATURE CITED

Cook. T., 1901- 1908. The Flora of the Presidencey of Bombay Vol. I.II & III reprinted ed.1958. B.S.I. Calcutta.

Gamble, J.S. and C.E.C. Fischer, 1915-1936. Flora of the Presidency of Madras Part I-II London. Reprinted edition, 1957, B.S.I. Calcutta.

Hooker, J.D., 1880. The Flora of British India, Reeve & Co. London.

Naik V.N. and Associates, 1998. Flora of Marathwada; Amrut Prakashan, Aurangabad.

S. Kartikayen and Anant Kumar, 1995. Flora of Yavatmal district; Maharashtra, B.S.I.; Calcutta.

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Evaluation of Some IPM Modules Against *Helicoverpa armigera* Hb. on Pipeonpea

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ABSTRACT

Some IPM modules were field evaluated against *Helicoverpa armigera* on pigeonpea for three years during 1995-96, 96-97 and 97-98 at three locations in central Vidharbha zone of NARP Yavatmal in central India. Pooled analysed results revealed that HANPV 250 LE/ha was effective and at par with endosulfan 0.07 %, HMPV 250 LE/ha + endosulfan 0.035 %, NSE 5% + endosulfan 0.035 %, in reducing pod damage caused by *Helicoverpa* larvae and increased grain yield with cost economics. Cow dung 5% alone was not only ineffective but also reduced the efficacy of NSE and endosulfan when used in combinations.

Helicoverpa armigera a major pod borer of pigeonpea contributes major share in causing losses by pod borers (Awasti and Bhatnagar , 1983). Central Vidharbha Zone in Central India has recently witnessed almost failure of pigeonpea crop during 1997-98 due to *Helicoverpa*. Although, various insecticides have been recommended (Anonymous, 1998) *Helicoverpa* continues to be a problem, inviting alternative IPM approach. Cow dung, neem products, HNPV are reported effective against *Helicoverpa* on Pigeonpea (Rao and Rao, 1993, Latif *et at*. 1996, Sadawarte and Sarode 1997). Therefore some IPM modules were evaluated against this pest of pigeonpea.

MATERIAL AND METHODS

Some IPM modules, with ten treatments (Table 1), replicated thrice in RBD were field evaluated against *Helicoverpa armigera* on pigeonpea at Yavatmal during 1995-96, 1996-97 and 1997-98. Treatments were imposed twice at an interval of 15 days starting from recommended ETL i.e. 5% pod damage, achieved more or less at similiar period. Five observational plants were randomly selected from each plot. Total pods and pods damaged by larvae were counted to work out per cent damage. Yield data were also recorded. Data were subjected to statistical analysis year and location wise. Interpretation of results is based on the basis of pooled analysis of three years. Incremental cost benefit ratio (ICBR) also workout for cost economics.

RESULTS AND DISCUSSION

Damage :

Minimum pod damage by *Helicoverpa* larvae (Table 1) was registered by the treatment (T-9) HNPV 250 LE ha^{-1} at par with (T-8) endosulfan 0.07 %, (T-3) HNPV 250 LE ha^{-1} + endosulfan 0.035 %, (T-7) NSE 5% + endosulfan 0.035%, (T-2) NSE 5% + cowdung 5% alone. Treatment (T-4) NSE 5 % alone. Treatment (T-1) NSE 5 % + cowdung 5 % was least effective. Treatments (T-5) cowdung 5 % alone and (T-6) endosulfan 0.0345 % (1/2 dose) were ineffective.

Grain Yield :

Maximum grain yield was harvested from the treatment (T-3) HNPV 250 LE/ha + endosulfan 0.0345 %, at par with (T-8) endosulfan 0.07 %, (T-9) HNPV 5 % + endosulfan 0.035 % and (T-6) endosulfan 0.035 % alone. Treatment (T-1) NSE 5% + cow dung 5% was least effective. Treatments (T-4) NSE 5% and (T-5) cowdung 5% alone have not shown any yield increase over control. Cowdung alone 5% was not only ineffective, but also showed antagonistic effect when used in conbination with NSE and endosulfan by reducing their efficacy.

Sanchan and Lal (1993) reported that endosulfan followed by NSE were effective against *Helicoverpa armigera* on pigeonpea. Khan and Narayanappa (1993) and Makar *et al*. (1994) reported endosulfan 0.07% was effective against *Helicoverpa* on

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Table 1. Per cent damage by *Helicoverpa armigera* and yield of chickpea at different locations (Pooled data of 95-96, and 97-98)

S.N.	Treatments	Pod damage by Helicovepa				Grain yield of pigeonpea (q ha^{-1})				ICBR
		Yavatmal	Nagpur	Tharsa	Pooled	Yavatmal	Nagpur	Tharsa	Pooled	
1.	NSE 5% + Cow dung 5%	42.70 (40.76)	31.53 (5.31)	21.14 (24.63)	37.79 (23.79)	9.70	10.64	27.63	15.99	1:8.76
2.	NSE 5% + Cowdung 5% + endosulfan 0.035%	34.46 (35.74)	26.73 (4.19)	19.69 (23.23)	26.96 (21.05)	10.71	8.79	28.29	15.93	1:6.45
3.	HNPV 250 LE ha^{-1} + endosulfan 0.035%	33.65 (35.37)	25.49 (4.19)	15.74 (19.87)	24.96 (19.81)	12.11	10.98	34.97	19.35	1:7.80
4.	NSE 5%	39.90 (39.26)	23.46 (4.47)	21.20 (24.70)	28.18 (22.81)	10.12	10.96	23.45	14.85	1:6.28
5.	Cowdung 5%	50.73 (45.49)	29.81 (5.15)	21.50 (24.84)	34.01 (25.16)	7.56	8.89	25.81	14.08	1:7.66
6.	Endosulfan 0.035%	51.51 (48.83)	23.63 (4.64)	19.31 (22.70)	31.48 (34.39)	7.34	9.30	32.84	16.49	1:9.52
7.	NSE 5% + Endosulfan 0.035%	35.67 (36.63)	19.59 (4.29)	18.08 (21.80)	24.44 (20.90)	9.87	9.43	32.21	17.17	1:9.52
8.	Endosulfan 0.07%	32.01 (34.30)	27.00 (4.99)	14.95 (18.48)	24.65 (19.25)	11.78	11.30	32.72	18.60	1:14.85
T_9	HNPV 250 LE ha^{-1}	32.24 (34.44)	23.98 (4.64)	13.51 (17.53)	23.24 (18.87)	10.41	11.21	30.26	17.29	1:6.33
T_{10}	Control	55.15 (47.99)	39.54 (6.04)	26.59 (29.82)	40.42 (27.95)	7.01	7.05	23.92	12.66	-
	SE m (±)	1.40	0.24	2.55	1.47	0.97	1.58	2.52	1.16	
	CD at 5%	4.18	0.72	N.S.	4.36	2.88	N.S.	7.50	3.31	
	CV %	6.16	8.53	15.85	11.37	17.47	10.46	14.87	17.58	

(----) V x ; (------)* net return over control Rs. ha^{-1} (Price @ Rs. 1363 q ha^{-1}).

pigeonpea, with increase in yield. Endosulfan 0.07%, HNPV 250 LE ha^{-1} and NSE 5% are recommended for adoption (Anonymous, 1998). Sadawarte and Sarode (1997) reported NSE 5% + 1/2 dose of endosulfan (0.035%) was most effective against pod borers of pigeonpea, but cowdung + NSE + 1/2 dose of insecticide reported least effective and cowdung alone to be ineffective.

As regards reduction in pod damage and increase in grain yield, treatment (T-9) HNPV 250 LE ha^{-1} was most effective and at par with (T-8) endosulfan 0.07%, (T-3) HNPV 250 LE ha^{-1} + endosulfan 0.035% and (T-7) NSE 5% + endosulfan 0.035%.

ICBR

Among the four effective treatments, maximum ICBR was obtained from treatment (T-8) endosulfan 0.07% (1:14.85), followed by (T-7) NSE 5% + endosulfan 0.035% (1:9.52), (T-3) HNPV 250 LE ha^{-1} + endosulfan 0.035 (1:7.80) and (T-9) HNPV 250 ha^{-1} (1:6.33). Beside these four treatments, higher ICBR was obtained from (T-6) endosulfan 0.035% (1:14.01), but it was ineffective in reducing the damage and increasing the yield.

However, among four effective treatments observed in these investigations, HNPV 250 ha^{-1} and endosulfan 0.07% has already been recommended for adoption in the state. Therefore, HNPV 250 ha^{-1} + endosulfan 0.035% or NSE 5% + endosulfan 0.035

% with two sprays at an interval of 15 days starting from ETL were proposed for recommendation for the management of *Helicoverpa armigera* on pigeonpea. These are subsequently approved for recommendation.

LITERATURE CITED

Anonymous, 1998. Plant Protection Recommendations. Commissioner of Agriculture, Maharashtra State, Pune. : 47-48.

Awasthi, J.K. and A. Bhatnagar, 1983. A note on damage caused bypod borer complex in pigeonpea. Bull. Ent. 24 (1) : 37-40.

Khan, H.K., and E. Narayanappa, 1993. Management of tur pod borers in red gram production demonstraion. Pl. Prot. Bull., 45 (2-3) : 38-39.

Latif, H., C.P. Shrivastava, S. Rathi and K.N. Singh, 1996. Comparative performance of chamical insecticides, neem derivatives and microbial insecticides against insect pests of pigeonpea. Pestology, 20 (8) : 5-7.

Makar, P.V., M.M. Sanap and R.B. Deshmukh, 1994. Optimum spray schedule for pigeonpea pod borers. Indian J. Pulses Res., 7 (2) : 144-147.

Rao, K.T. and N.V. Rao, 1993. Repellin,a plant origine insecticide for controlling pod borer, *Helicoverpa armigera* of pigeonpea. Proc. National symposium on Botanical Pesticides in IPM, Rajahmundry. 232-235.

Sachan, J.N. and S.S. Lal, 1993. Role of botanical in *Helicoverpa armigera* management in pulses. Proc. National Symposium on Botanicla Pesticides in IPM, Rajahmundry : 261-269.

Sadavarte, A.K. and S.V. Sarode, 1997. Efficacy of neem seed extract, cowdung and cow urine alone and in combinations against pod borer complex of pigeonpea.J. Soil and Crops 6 (2) : 146-150.

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Performamce of some IPM Modules Against *Helicoverpa armigera* Hb. on Chickpea

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ABSTRACT

Field efficacy of NSE, cowdung, urine (5.0%), and endosulfan 0.03% in different IPM modules was evluated against *Helicoverpa armigera* Hb. on chickpea at three locations under N.A.R.P., central Vidarbha zone, in central India, during 1995-96, 96-97 and 97-98.Pooled results of pest control, yield, net return and ICBR revealed that NSE 5 % + endosulfan 0.035% and NSE 5.0% alone with two applications at 15 days interval starting from 5.0% flowering, were the most effective and economic treatments in the management of *Helicoverpa armigera* on chickpea. Cow-dung and urine were ineffective. However, cow-dung was antagonistic to NSE.

Chickpea is a major pulse crop growing in *rabi* season as rainfed or irrigated in Central India. *Helicoverpa armigera* is the only pest of concern causing heavy losses of chickpea. As mush as 80.0% yield losses (Ujagir and Khare, 1987) and 60.0 to 87.5% avoidable losses (Singh *et al.* 1989) are reported. Inspite of recommendation of some insecticides, HNPV and NSE (Anonymous, 1998), it continues to be a problem. Organic farming invites the natural resources in the pest management programme. Several workers have reported neem seed extract to be effective against *Helicoverpa armigera* on chickpea (Gohokar *et al.* 1987 and Sachan and Lal, 1993). Cattle urine as natural resources are reported effective in the insect control (Peries, 1985 and Rankin, 1985). However, need based application of insecticide is inevitable in IPM approach. Therefore, some IPM modules, with cowdung, urine, NSE and half dose of endosulfan, were evaluated against *H. armigera* on chickpea.

MATERIAL AND MATHODS

Field trials were conducted to evaluate some IPM modules, including cowdung, urine NSE (5.0%) and endosulfan 0.035%, against *Helicoverpa armigera* Hb. on chickpea. Trials were conducted with 8 treatments, replicated thrice in RBD at Yavatmal, Nagpur and Tharsa under NARP central Vidarbha Zone in Central India, during 1995-96, 1996-97 and 97-98. Each treatment was imposed twice, first at 50% flowering and second 15 days later. Five plants per plot were randomly selected for observations. Total number of pods and the pods damaged by *Helicoverpa* larvae were counted at harvest to obtain per cent damage. yield data were also recorded. These data were pooled analysed for mean results with ICBR (Table 1).

RESULTS AND DISCUSSION

Damage

Pooled data presented in Table 1 revealed that, except cowdung 5% and urine 5%, all other treatments were significantly effective over control, in reducing pod damage by *Helicoverpa* larvae. Among the treatments, NSE 5.0% + endosulfan 0.035 was most effective and at par with NSE 5.0% alone, endosulfan 0.035% alone, NSE 5.0% + cowdung 5.0% and NSE 5.0% + cowdung 5.0 + urine 5.0 % in their order. Cowdung 5.0% and urine 5.0% were ineffective.

Yield

Maximum grain yield was obtained from the treatment of NSE 5.0% + endosulfan 0.035 % at par with NSE 5.0% alone, endosulfan 0.035 alone, and NSE 5.0%, cowdung 5.0% + urine 5.0%. However NSE 5.0% + cowdung 5.0%, cowdung 5.0% alone and urine 5.0% alone showed non-significant difference. The data on insect control and yield revealed that NSE 5.0% + endosulfan 0.035% was

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Table 1. Per cent damage by *Helicoverpa armigera* and yield of chickpea at different locations (Pooled data of 95-96, and 97-98)

S.N.	Treatments	Pod damage at harvest (%)				Grain yield (q ha^{-1})				Return	ICBR
		Yavatmal	Nagpur	Tharsa	Pooled	Yavatmal	Nagpur	Tharsa	Pooled	Rs. ha^{-1} (net return over control Rs.)	
1.	NSE 5% + Cow dung 5%	12.67 (3.42)	20.87 (4.53)	21.64 (4.02)	18.39 (4.02)	4.35	4.51	11.92	6.93	9432 (1363)	1:2.29
2.	NSE 5% + CD 5% + urine 5%	13.53 (3.57)	21.73 (4.65)	19.40 (3.88)	18.22 (4.03)	4.27	4.82	12.53	7.20	9832 (1734)	1:2.71
3.	NSE 5% + endosulfan 0.035%	8.62 (2.90)	15.49 (3.45)	16.01 (3.53)	13.37 (3.45)	4.94	5.42	14.85	8.40	11449 (3380)	1:5.00
4.	NSE 5%	12.43 (3.44)	17.57 (4.16)	18.34 (3.74)	16.11 (3.78)	4.37	5.74	13.21	7.77	10590 (2521)	1:4.63
5.	Cowdung 5%	16.64 (3.96)	33.14 (5.62)	23.58 (4.25)	24.12 (4.61)	3.20	5.14	11.67	6.67	9091 (1022)	1:3.48
6.	Urine 5%	17.48 (4.05)	34.51 (5.72)	22.68 (4.19)	24.89 (4.65)	3.25	5.69	11.41	6.78	9241 (1172)	1:3.99
7.	Endosulfan 0.035%	19.12 (4.19)	16.35 (4.05)	16.30 (3.55)	17.25 (3.93)	3.51	5.92	13.40	7.61	10372 (2303)	1:6.45
8.	Untreated control	19.71 (4.31)	42.18 (6.45)	25.03 (4.51)	28.97 (5.09)	3.03	4.26	10.48	5.92	8069 (---)	-
	SE m (±)	0.19	0.32	0.11	0.24	0.23	0.44	0.56	0.40	-	-
	CD at 5%	0.59	0.98	0.34	0.72	0.71	NS	1.71	1.22	-	-
	CV %	9.05	11.43	4.87	9.84	10.49	10.49	7.85	9.78	-	-

(-----) V x ; (------)* net return over control Rs. ha^{-1} (Price @ Rs. 1363 q ha^{-1}).

most effective followed by NSE 5.0% alone, indicating that need of low doses of insecticides for effective pest managment. The very purpose of testing the efficacy of cowdung and urine indicated to be ineffective in the management of *Helicoverpa armigera* on chickpea. On the otherhand cowdung 5% spray showed antagonistic effect when used with NSE 5%.

Dubey *et al.* (1985) reported NSE 5.0% to be most effective than other botanicals tested against *H. armigera* on chickpea, giving higher yields. Siddappaji *et al.* (1986) observed NSE 5.0% to be next effective than insecticides against this pest. However, Gohokar *et al.* (1987) and Sachan and Lal (1993) reported that NSE 5.0% was equally effective with endosulfan and other insecticides against *H. armigera* on chickpea. Sadawarte and Sarode (1997) observed NSE 5.0% + half dose of insecticides to be most effective and cowdung and uring (5.0%) least effective against this pest on pigeonpea.

ICBR

Maximum ICBR was registered by endosulfan 0.035% alone (1:6.45), followed by NSE 5.0% + endosulfan 0.035% (1:5.00), NSE 5.0% (1:4.64), NSE 5% + CD 5% + urine 5% (1:2.71). However, the later treatment was least effective with minimum ICBR endosulfan 0.035% alone, though showed highest ICBR, it ws third in efficacy and yield having non-significant results for all the three years at Yavatmal. NSE 5.0% + endosulfan 0.035% and NSE 5% alone with two sprays starting from 50% flowering and 15 days later, were the effective economic and ecofriendly treatments management of *Helicoverpa armigera* Hb. on chickpea. Cowdung 5.0% and uring 5.0% were ineffective.

LITERATURE CITED

Anonymous, 1998. Plant Protection Recommendations. Commissionarate of Agriculture, Maharashtra State, Pune : 47.

Dubey, O.P., S.C. Odak and V.P. Gurgava, 1985. Evaluation of antifeeding properties of indigenous medical plants against larvae of *Helicoverpa armigera* J. Ent. Res. 15 (3) : 208-211.

Gohokar, R.T., S.M. Thakare and M.N. Borle, 1987. Chemical control of gram pod borer , *Helifcoverpa armigera* Hubner, by synthetic pyrethroids and insecticides. Pesticides 21(1) : 55-56.

Peries, L., 1985. Cattle urine as a substitute for agrochemical. Natural crop protection based on the local farm resources in the topics and subtropics. : 124 (Edt. Stoll G.) Langen, Germany : Josef Margraf.

Rankin, 1985. ABC'S of insect pests. Natural crop protection based on local farm resources in the subtropics : 125. (Edt. Stoll G.), Langen, Germany : Josef Margraf.

Sachan, J.N. and S.S. Lal, 1993. Role of botanicals in *Helicoverpa armigera* management in pulses. Proc. National Symposium on botanical pesticides in IPM, Rajahmundry: 261-269.

Sadawarte, A.K. and S.V. Sarode, 1997. Efficacy of neem seed extract, cowdung and cow urine alone and in combination against pod borer complex of pigeonpea. International chickpea and Pigeonpea News Letter 4: 36-37.

Siddappaji, C.A., A.R.V. Kumar and Gangadharaiah, 1989. Evaluation of different insecticides sprays against the chickpea *Helicoverpa armigera* (Hubner). Pesticide 20(1) : 13-16.

Singh, M.L., M.S. Mahal and Balraj Singh, 1989. Assessment of losses in yield of gram by pod borer, *Helicoverpa armigera* Hubner, J. Insect Science 2(1) : 38-43.

Ujagir R. and B.P. Khare, 1987. Optimum insecticides regime for the control of gram pod borer, *Helicoverpa armigera* Hb. in chickpea at Pantanagar, U.P. Indian J. Plant Prot. 15 (1) : 39-41.

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Research Notes

Influence of Irrigation Frequency, its Depth and Antitraspirants on Growth, Yield and Water Use Efficiency in Wheat

Under irrigated farming, wheat has occupied an important position. However, due to low productivity and deminishing water resources, it was felt necessary to restructure the irrigation scheduling for tuning with the concept of yield per unit area per unit of water used. Therefore, the present investigation was conducted at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. (M.S.) during 1997-98.

The soil experiment plot was clay having 33.4 and 15.9 per cent gravimetric moisture in 0-60 cm soil at FC and PWP respectively with B.D. of 1.27 Mg m^{-3} . The experiment was arranged in split plot design assigning nine combinations of three irrigation frequencies and three irrigation water levels to main plot and antitranspirant (kaolin) spray with control to subplots replicated thrice. Irrigation frequencies were four irrigations at CRI. jointing, flowering and milk stages (I_4), five irrigations at I_4 + tillering (I_5) and six irrigations at I_5 + dough stage (I_6). Irrigation water levels were quantity of water equal to net irrigation requirement (NIR) (Q100), 0.75 NIR (Q 75) and 0.5 NIR (Q 50). The crop (AKW-1017) was sown on 10.11.97 and raised with recommended practices in a plot size of 2.7 x 3.0 sq. m. Kaolin (6%) was sprayed at 50 DAS and control plots water sprayed. NIR was calculated from moisture content in 0-60 cm soil profile before irrigation and the required quantity of water (treatmentwise) measured with V notch was supplied. Crop was harvested on 5.3.98.

Six irrigations scheduled at I_5 + dough (I_6) produced significantly higher grain yields than four irrigations scheduled at CRI, jointing, flowering and milk (I_4) stages, but it was at per with five irrigations (I_5) i.e. I_4 + tillering. However, the difference between the irrigations scheduled at I_4 and I_5 was not significant.

The irrigation depth applications equivalent to 100% NIR produced significantly higher yields than irrigation depth of 0.5 NIR and it was at per with 0.75 NIR. The irrigation depths of 0.75 and 0.5 NIR were on par with each other. Grain and straw yields were significantly reduced due to kaolin spray.

Consumptive use of crop was increased with increase in irrigation frequency as well as its depth. The highest consumptive use was recorded with six irrigations and quantity of water equal to NIR. Kaolin spray reduced the consumptive use.

The highest water use efficiency was recorded with five irrigations and it was reduced both in I_4 and I_6 treatments. This confirm the findings of Pal *et al.* (1996). Increase in the quantity of irrigation

Table 1 : Yield, consumptive use and WUE of wheat as affected by varied treatments.

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	C.U. (mm)	WUE (kg ha cm^{-1})
Irrigation frequency				
I4	21.95	56.27	28.04	78.28
I5	24.61	52.61	28.05	87.74
I6	26.50	53.73	31.94	82.97
CD at 5%	3.79	N.S.	-	-
Q50	21.26	53.23	27.04	78.62
Q75	24.49	56.36	28.96	84.56
Q100	27.32	53.01	32.03	85.29
CD at 5%	3.79	NS	-	-
Antitranspirant Spray				
Control	29.19	61.84	31.14	93.74
Spray	19.82	46.57	27.55	70.85
CD at 5%	2.86	3.38	-	-

water enhanced the WUE at decreasing rate. Similar results were reported by Malvia *et al.* (1987). However kaolin spray has drastically reduced the WUE. Upadhaya and Mathur (1992) also recorded reduction in water use efficiency due to antitranspirant spray.

LITERATURE CITED

Malvia, DD., J.C. Patel; M.N.Vyas and K.P. Patel, 1987. Effect of soil moisture regimes and fertilizer on wheat.Indian J. Agron. 32(3) : 158-160.

Pal, S.K., J. Kaur, R. Thakur; V.N. Verma and M.K. Singh 1996. Effect of irrigation, seeding date and fertilizer on growth and yield of wheat. Indian J. Agron. 41(3) : 386-389.

Upadhaya, S.D.and C.M.Mthur, 1992. Effect of antitranspirants on the physiological characteristics of wheat. Advances in Plant Soil, 5(2) : 457-463.

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Dynamics of Potassium in Vertisol as Influenced by Integrated Fertilizer Management Under Sorghum -Wheat Sequence

The use of potassic fertilizer is seldom matched with the actual requirement of intensive cropping practice. It is belived that most of the K release takes place from the non-exchangeable K pool as and when the readily available form in the soil get depleted, thus in the absence of potash little to moderate decrease in available K has generally been observed (Lutz and Jones, 1971). With a view to understand the complexities of potassium dynamic under intensive multiple cropping system, the various forms of K in the soil have been studied under sorghum-wheat cropping sequence on a long term fertilization programme in Vertisol.

A long term field experiment was laid out during 1988-89 at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in Vertisol, raising sorghum and wheat in *kharif* and *rabi* season, respectively. The soil of the experimental site was clay with mildly alkaline in reaction (pH 7.9), low in available N(121 kg ha^{-1}) and available P (8.5 kg ha^{-1}) but medium to high in available K (356 kg ha^{-1}). The experiment was laid out in randomised block design with fourteen treatments replicated four times in 10 x 10 m^2 plots. The NPK fertilizers were applied through urea, single super phosphate and muriate of potash, respectively. The source of P in treatment T_{10} and T_{13} was sulphur free fertilizer (DAP) and that of Zinc (T_9 & T_{14}) through zinc sulphate and sulphur through gypsum (T_8 & T_{13}). Full dose of P, K, S, Zn and half dose of N was applied at the time of sowing and remaining half dose of N after 30 days of sowing of both the crops with the recommended dose of sorghum (120:60:50) and wheat (100:50:40). FYM was applied 10 t ha^{-1} (T_{11} & T_{12}) before sowing of crop. Soil sample from each treatment of the experimental site were collected from 0-30 cm depth before sowing and after harvest of sorghum-wheat crop during 1994-95. Total K was estimated from HF extract digest method (Jackson, 1967). Ammonium acetate (1N pH 7.0) extractable and boiling 1 N nitric acid K were determined by procedures adopted and described by Knudson *et al.* (1982) and Wood and De Turk (1940), respectively.

The dynamics of different fractions of potassium increase with increasing level of fertilizer dose (Table 1). The highest water soluble K was noticed with 150 % NPK (T_5) and it increased by 42.6 % over control (T_1) after harvest of wheat. The application of FYM in conjunction with 100% NPK (T_{11}) increased the exchangeable K over 100% NPK (T_4) by 5.5 per cent and 8.9 per cent after harvest of sorghum and wheat crop, respectively. This may be due to the decomposition of FYM which might have been helpful in converting non-exchangeable K to exchangeable from (Black, 1968). However, zinc and sulphur in combination with 100% NPK increased the exchangeable K due to the synergistic relation between them.

A wide variation in the available K (190-323 mg kg^{-1}) was observed in various fertilizer treatments. The maximum available K was found in 150% NPK (T_5) treatment and it increased by 70% over control (T_1) after harvesting of wheat. The highest non-exchangeable K was observed with 150% NPK (T_5) in both the crops. In the absence of potassic fertilizer the non-exchangeable K decreased over control. Similar observations were also recorded by Dhanorkar *et al.* (1994) in Vertisols. The lattice K significantly increased with increasing level of fertilizer treatment involving K with or without FYM. This may be attributed to entrapping of K between lattice of smectite clay mineral present in Vertisols. The highest total K was recorded in higher fertilizer dose (150% NPK) and it decreased in absence of potassic fertilizers. Increase in soil total K due to K fertilization was also reported by Biswas *et al.* (1977). In sulphur free treatment (T_{10}), total K decreased over sulphur containing fertilizer. Similar observations were also reported by Bharadwaj *et al.* (1994). In general, the dynamics of different fractions of potassium showed a increasing trend with increasing level of fertilizer dose. Moreover, the combination of FYM, zinc and sulphur with 100 % NPK showed further additive effect on potassium.

Table 1. Different fractions of potassium in soil as influenced by various fertilizer doses under sorghum-wheat sequence.

Treatment	Water sol. K	Exch. K	Avai. K	Non-exch.K	Latti. K	Total K
	(mg kg^{-1})				(%)	
	Before sowing of sorghum					
T_1 Control	6.6	160	167	725	1.28	1.37
T_2 50 % NPK	6.8	168	175	775	1.30	1.40
T_3 75 % NPK	7.6	176	183	875	1.44	1.65
T_4 100 % NPK	8.3	184	192	937	1.53	1.65
T_5 150 % NPK	9.5	206	215	987	1.62	1.75
T_6 100 % N	6.6	153	160	713	1.23	1.32
T_7 100 % NP	6.7	159	166	700	1.26	1.35
T_8 100 % NPK + 5 kg S	8.1	183	191	925	1.51	1.62
T_9 100 % NPK + 10 kg $ZnSO_4$ (wheat)	8.6	186	195	925	1.51	1.62
T_{10} 100 % NPK (S free)	7.7	178	186	925	1.46	1.57
T_{11} 100 % NPK + 10 t FYM	8.8	195	204	925	1.58	1.70
T_{12} 10 t FYM	6.6	166	172	787	1.30	1.40
T_{13} 100% NPK (S free + 47.5 kg S)	8.0	180	188	925	1.51	1.62
T_{14} 100 % NPK + 20 kg $ZnSO_4$ (wheat)	8.7	187	196	912	1.53	1.65
Mean	7.7	177	185	859	1.43	1.54
CD %	1.4	21	32	124	0.21	0.25
	After Harvest of Sorghum					
T_1 Control	6.1	154	160	700	1.26	1.35
T_2 50 % NPK	6.6	166	173	750	1.30	1.40
T_3 75 % NPK	7.2	172	179	825	1.42	1.52
T_4 100 % NPK	8.0	183	191	912	1.51	1.62
T_5 150 % NPK	9.0	205	214	963	1.60	1.72
T_6 100 % N	5.8	149	154	675	1.21	1.30
T_7 100 % NP	6.2	152	158	650	1.24	1.32
T_8 100 % NPK + 5 kg S	7.6	180	188	887	1.49	1.60
T_9 100 % NPK + 10 kg $ZnSO_4$ (wheat)	8.1	186	194	875	1.51	1.62
T_{10} 100 % NPK (S free)	7.2	175	182	862	1.44	1.55
T_{11} 100 % NPK + 10 t FYM	8.5	193	201	875	1.56	1.67
T_{12} 10 t FYM	6.2	156	162	750	1.25	1.35
T_{13} 100 % NPK (S free + 47.5 kg S)	7.3	180	187	875	1.49	1.60
T_{14} 100 % NPK + 20 kg $ZnSO_4$ (wheat)	8.2	187	196	875	1.51	1.62
Mean	7.3	174	181	820	1.41	1.51
CD %	1.9	28	29	187	0.19	0.19
	After Harvest of Wheat					
T_1 Control	6.8	183	190	850	1.22	1.32
T_2 50 % NPK	7.6	246	253	950	1.30	1.42
T_3 75 % NPK	8.1	268	276	1050	1.41	1.55
T_4 100 % NPK	9.2	284	293	1200	1.50	1.65
T_5 150 % NPK	9.7	313	323	1349	1.60	1.77
T_6 100 % N	7.6	236	243	825	1.16	1.27
T_7 100 % NP	8.7	252	260	837	1.19	1.30
T_8 100 % NPK + 5 kg S	9.0	283	290	1125	1.50	1.65
T_9 100 % NPK + 10 kg $ZnSO_4$ (wheat)	9.5	288	297	1125	1.50	1.65
T_{10} 100 % NPK (S free)	8.3	278	286	1200	1.42	1.57
T_{11} 100 % NPK + 10 t FYM	9.7	307	316	1112	1.55	1.70
T_{12} 10 t FYM	7.7	252	259	850	1.26	1.37
T_{13} 100 % NPK (S free + 47.5 kg S)	8.8	281	289	1125	1.50	1.65
T_{14} 100 % NPK + 20 kg $ZnSO_4$ (wheat)	9.5	291	300	1112	1.53	1.67
Mean	8.6	268	277	1050	1.40	1.54
CD %	1.6	16	37	105	0.14	0.15

LITERATURE CITED

Bharadwaj, V., S.K. Bansal, S.C. Maheshwari and P.K. Omanvar, 1994. Long term effect of continuous rotational cropping and fertilization on crop yields and soil properties III. Changes in the fractions of N,P and K of the soil J.Indian Soc. Soil. Sci. 42 (3) : 392-397.

Biswas, C.R., G.S. Sekhon and Rajenderjit Singh, 1977. Accumulation and decline of available phosphorus and potassium in a soil under multiple cropping. J. Indian Soc. Soil Sci. 25 (1) : 23-27.

Black, C.A., 1968. Soil Pl. Relationship, 2nd edition, John Wiley and sons, New York

Dhanorkar, B.A., D.K. Borkar, R.B. Puranik and R.P. Joshi, 1994. Forms of soil potassium as influenced by long term application of FYM and NPK in Vertisol. J. Potassium Res., 10(1) : 42-48.

Jackson, M.L., 1967. Soil Chemical Analysis. Printice of Indian Pvt. Ltd. New Delhi. : 128.

Knudson, D.G., A. Pelerron and P.F. Pratt, 1982. Lithium, sodium and potassium in method of soil analysis part-2. Chemical and microbiological properties. Agronomy monograph 9 : 225-238.

Lutz, J.A. and C.D. Jones, 1971. Crop yield and available P and K in soil as affected by sixteen annual application of NPK fertilizer. J. Indian Society of Soil Science 19 : 269-274.

Wood, L.K. and E.E. De Turk, 1940. The absorption of potassium in soils in non-replaceable forms. Proc. Soil Sci. Soc. Am. 5 : 152-161.

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Efficacy of Homeopathic Drug 'CINA' Against Helminthiasis of Buffalo Calves with Reference to Haemobiochemical Profile

Gastrointestinal helminthiasis is more common in young buffalo calves which is clinically manifested by constipation followed by diarrhoea, severe dehydration, toxaemia and coma (Brauah *et al.*, 1979). Besides overt clinical signs, the condition is associated with significant alterations in levels of different haematological and biochemical values.

Homeopathic remedies are cheap, safe and often effective and provide useful alternatives to conventional drugs. Several workers have tried homeopathic remedies in animal treatment with success (Sapre, 1979). In the present study an attempt has been made to find out the efficacy and to study the haemobiochemical changes associated with the condition.

Total eight buffalo calves aged 1-4 months harbouring '*Neoascaris vitulorum*' infection (EPG≥ 1500) were selected for the study. EPG (eggs per gram of faces) was determined before treatment ('O' day) and on 3rd, 5th, 7th, and 15th day post treatment by using Stoll's dilution technique (Soulsby, 1982). Each infected calf received 3 drops of 'Cina' (Tinc) 200 x orally once a day for 7 days.

Blood samples were collected before treatment ('O' day) and 15th day post treatment for estimation of haemoglobin (Hb), packed cell volume (PCV), differential leucocyte count (DLC), blood glucose (Hawk *et al.*, 1965) and total serum protein and albumin (Modified Biuret and Dumas method) of infected and non infected healthy buffalo calves.

Table 1 : Average faecal egg count in calves at different intervals with standard errors.

Intervals	Eggs per gram of faces (EPG)				
	Pre treatment	Post treatment days			
	0	3rd	5th	7th	15th
Mean	19300	21200	31650	23850	25125
SE ±	± 135.39	±110.74	±197.99	±165.86	±181.03

Table 2 . Haematological and biochemical findings in helminth infested (pre and post treatment) and non infested buffalo calves.

S.N.	Parameters	Infested calves		Non-infested calves
		Pre treatment	Post treatment	
1	Haemoglobin (gm %)	10.27± 0.42	10.13 ± 0.76	10.7 ± 0.90
2	PCV (%)	37.0* ± 2.10	34.12 ± 1.88	34.38 ± 1.47
3	Neutrophil %	17.75 ± 1.69	19.25 ±1.40	20.5 ±1.02
4	Lymphocyte %	74.5 ± 1.94	73.75 ± 1.50	74.13 ± 1.38
5	Monocyte	2.25 ± 0.45	2.38 ± 0.38	3.63 ± 0.65
6	Eosinophil %	5.5* ± 1.02	4.63ᵃ ± 0.78	1.75 ± 0.45
7	Blood glucose (mg dl^{-1})	32.52* ± 2.16	37.49ᵃ ± 3.30	47.34 ± 1.48
8	Total serum protein (gm dl^{-1})	4.67* ± 0.25	5.35 ± 0.31	6.20 ± 0.34
9	Serum albumin (gm dl^{-1})	2.64* ± 0.10	2.99 ± 0.15	3.20 ± 0.11

* - Denotes significant differences (p<0.5) between pre and post treatment values.

a - Denotes significant difference (p<0.5) between post treatment and non infested control values.

It was observed that total faecal egg count was not reduced significantly at different intervals after treatment (Table 1). It indicated that calves were still harbouring the helminths and Tincture 'Cina' could not eliminate worm load completely. These finding are closely in agreement with Carbaret (1996) who reported non significant differences between egg count before and after treatment with homeopathic 'Cina' in lambs.

The haemobiochemical studies revealed significant rise in PCV, eosinophil % and reduced blood glucose and serum protein and albumim levels (Bhongade *et al.*, 1993). AT 15th day post treatment with 'Cina' the PCV was near normal (Brauah *et al.*, 1979), blood glucose level still significantly lower, eosinophil % remained significatly higher (Nakanishi *et al.*, 1993), and total serum protein and albumin levels raised significantly (Table2).

From the above study it can be concluded that 'Tr. Cina' as it did not reduce the faecal egg output and also not restored to normal altered haemobiochemical parameters except PCV and total serum protein and albumin, is not effective anthelmintic in buffalo calves.

LITERATURE CITED

Baruah, P.K.; R.P., Singh; M.K., Bali (1979) : Studies on some of the biochemical and haematological changes in buffalo calves infected with *Neoascaris vituloram. Haryana Veterinarian* 18 : 107-110.

Bhongade, H.G.; D.B. Sarode; A.M., Rode; V.A., Sapre (1993) : Effect of anthelmintic therapy on haematobiochemical profile of dairy cows. *Indian J. of Vet. Med.* 13 : 75-76.

Cabaret J. (1996) : The homeopathic 'Cina' does not reduce the egg output of digestive tract nematodes in lambs. Abst. Vet. Bull., 2546.

Hawk, P.B. and B.L. Oser (1965) : Determination of glucose. Hawk's physiological chemistry, P.52, 14th ED. Tata Mc. Graw Hill publishing Co., New Delhi.

Nakanishi, N;Y. Nakamura; S., Ura; N, T. Tsuji, N. Taira; N. Tanimura; M. Kubo, 1993. Sudden death of calves by experimental infection with *Strongyloides papillosus* III. Haematological, biochemical, histological examinations. Veterinary Parasitology 47 : 67-76.

Sapre, V.A. (1997) : Abst. published Souvenir of International Conference On Ethno Vet. Medicine, Pune : P 21.

Soulsby, E.J.L. (1982) : Helminths, Arthropods and Protozoa of dometicated animals, 7th Ed. Bailliere Tindall, 1st Anne's Road Eastbourne, East Sussex : PP 766.

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Source of Resistance of Wheat Rust

Wheat is second important crop of Maharashtra state. In the state, the crop mainly suffer from incidence of rust. Some varieties which were earlier resistant to rust like Lok-1, MACS 2496 and Kalyasona are found badly affected with brown rust in Vidarbha region. In order to select resistant donors, it felt necessary to evaluate wheat varieties against rust pathogens.

168 wheat entries were screened against rust during *rabi* season of 1996-97 and 1997-98 at Wheat Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola. The nursery was sown in first week of December. Artificial inoculation with suspension of rust inoculum powder having brown rust races i.e. 12-2, 77-2, 77-5, 104-2 and black rust races i.e. 11,40A, 117-6 and 122 was done with syringe inoculation method. The observations on rust were recorded fortnightly according to the Modified cobb's scale described by Nayar in 1996 in his trap Nursery Data Book.

Out of 168 wheat strains, only 66 wheat strains were found immune to brown and Black rust (Table 1.) Out of remaining 102 strains, 36 strains showed resistant reaction and 66 strains susceptible to brown rust, one strain resistant and 18 strains susceptible to black rust. The varieties viz. AKW 1071, HD2189, HD 2380 which are under cultivation in the state were observed resistant to brown as well as black rust. But

Table 1. Source of resistance to wheat rust.

Reactions	ACI value	Name of wheat strains		
Immune to Brown and block rust	'O'	[66 strains] :- UP 2386, HW 1081, HW 1084, HW 1085, HUW 434, HP 1748, CPAN 3067, CPAN 4078, WH 595, GW 244, K9107, HD 2639, CPAN 4066, CPAN 4138, CPAN 4159, DL-218-6, 9CMH-74, CDWR9510, CDWR 9518, CDWR 9522, CDWR9524, CDWR 9574, CDWR 9575, CDWR9549, CDWR 9597, CDWR 9536, K9305, K9324, K9330, K9367, VL 738, JWS 17, HD2667, JOB666, DL788-2, DL975-1, DL1014-2, HS 364, K8020, RD179, RD 194, HI 6896, PDW 233, NIDW 9, MACS 2846, A-9-30-1, SU-CULLUGU, SUGU-20, TOSKA, SU-CULLUGU-8, RD 108, RD 140, TAR-2, BACANORAT 88, SILVER 15, TR 211, HW 2004, HPW 89, HD 29, W 485, H 567-7, TL 2597, M-41-198-5, RD 45, P 10987, WR 544.		
Resistant to brown rust	1 to 10	[36 strains]		
Susceptible to brown rust	Above 10	[66 strains]		
Resistant to Black rust		One strain (CPAN 4079)		
Susceptible to Black rust		[18 strains]		
			Checks	
			Brown rust	Black rust
Susceptible		Kalyansona	60 S	30 S
		Sonalika	40 S	--
		A 206	50 S	30 S

the varieties viz. MACS 2496, AKW 381, HI 977, Vijay and N-59 have exhibited highly susceptible reaction to brown rust of wheat. Gupta and Singh (1981) tested ten wheat varieties during 1977-79 in the field condition and observed HI 601, Up 283, J-40 and WG 1203 tolerant and C-306 susceptible to brown rust. Arora *et al*. (1988) reported that of 158 aestivum and durum wheats screened, only nine cultivars showed resistant reaction to *P. recondita tritici*. Tandon *et al*. (1990) reported that of 50 wheat strains and 36 F1 hybrids screened, only 19 strains and 15 F1 hybrids were resistant to brown rust. Sharma *et al.* (1998) reported that out of 18 varieties screened only 10 varieties gave resistant reaction and 7 varieties susceptible to brown and black rust.

LITERATURE CITED

Arora, P.C., A. Gupta, R. Basant and S. Singh, 1998. Screening of wheat germplam against brown and yellow rust. Indian J. Mycol. and Plant Path. 17 (1) : 69-71.

Gupta, R.P. and A. Singh, 1981. Field evaluation of tolerance in wheat to brown rust. Indian phytopath. 34(3) : 300-303.

Nayar, S.K., 1997. Method for recording cereal rust. TPN Data Book 2-4.

Sharma, A.K., D.P. Singh, J.Kumar, A.K.Singh and S. Nagarajan, 1998. Adult plant response of AVT (II year) lines against brown and black rust under field condition (Artificial inoculations) during 1997-98. DWR progress Report (1998) C.P. Vol. V : 5.

Tandon, G., V. Chawla, R.K. Singh and O.O Luthra, 1991. Leaf rust resistance at different development stages. Agril. Sci. Digest 11(2) : 87-90.

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Characterisation and Classification of Soils of Patur Road Farm, Dr. PDKV, Akola

Knowledge of the soils in detail is highly essential as it has got potentials and problems. It is, therefore, essential to get familiaries with the soils to know its potentialities and limitations, the methods of management for sustained use under agriculture. The information on the soils of Patur Road Farm of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is less. Hence the efforts have been made to characterised and classify the soils which enable to find out the potentials and problems of such soils.

The Patur Road Farm of Dr. PDKV, Akola is located on Akola-Patur road, about 7 km from the Akola city. The farm is extended over 99 ha. The general slope of the farm is nearly leveled to gently sloping topography (1 to 3 per cent slope). Seven pedons from the farm were examined, out of which the characteristics of three representative pedons are discussed. Horizonwise soils samples were collected, processed and analysed by commonly followed standard methods (Jackson, 1987, Black *et al.*, 1965 and Richard 1954).

Morphology

The morphometric characteristics of the soils (Table 1) revealed that the soils of the farm are very deep (> 1m), poor to imperfect drainage, clay through

Table 1. Morphometric characteristics of the soils of Patur Road Farm, Dr. PDKV, Akola.

Horizon	Depth (m)	Colour	Texture	Structure	consistancy	Effervescence	Drainage	Crack width (cm)	Crak depth (cm)	Other features
Pedon 1 Patur Road Farm Survey No. 20 B										
Ap	0.00-0.22	10 YR 3/3	c	m2 sbk	sh fr s p	e	poor	0.5	35	Slickenside
A1	0.22-0.45	10 YR 3/2	c	m2 sbk	h fr s p	es				titled at an
Bss1	0.45-0.90	10 YR 3/2	c	m3 abk	vh fr vsvp	es				angle of 25^0
Bss2	0.90-1.17	10YR 3/2	c	m3 abc	vh fi vsvp	es				to the horiz-
Bss3	1.17-1.57	10 YR 3/2	c	m3abk	vh fi vsvp	es				ontal axis
Pedon 2 Patur Road Farm Survey No. 19-20 A										
Ap	0.00-0.23	10 YR 3/3	c	m2 sbk	sh fr s p	es		1.0	50	Slickenside
A1	0.23-0.43	10 YR 3/3	c	m2 sbk	sh fr s p	es	Mod			titled at an
Bss1	0.43-0.76	10 YR 3/2	c	m3 abk	h fi vsvp	es	-era			angle of 20^0
Bss2	0.76-1.13	10 YR 3/2	c	m3 abc	vh vfi vsvp	es	-tely			to the horiz-
Bss3	1.13-1.38	10 YR 3/2	c	m3 abk	vh vfi vsvp	es	well			ontal axis
Pedon 3 Patur Road Farm Survey No. 51										
Ap	0.00-0.16	10 YR 3/3	c	m1 sbk	sh fi s p	es	poor	0.7	60	Slickenside
A1	0.16-0.32	10 YR 3/3	c	m2 sbk	sh fi s p	ev				titled at an
Bss1	0.32-0.61	10 YR 3/3	c	m2 abk	h fi s p	ev				angle of 30^0
Bss2	0.61-0.99	10 YR 3/3	c	m3 abc	h fi s p	ev				to the horiz-
Bss3	0.99-1.27	10 YR 3/3	c	m3 abk	h fi s p	es				ontal axis

Table 2. Physico-chemical characteristics of the soils.

Hori-zon	Depth (m)	Particle size distribution (%)			Hydraulic condutivity cm hr^{-1}	pH (1:2)	EC (1:2) dSm	Organic carbon (%)	$CaCO_3$ (%)
		Sand	Silt	Clay					
Pedon 1									
Ap	0-0.022	16.5	32.0	51.5	0.78	8.2	0.15	0.47	9.89
Al	0.22-0.45	16.5	32.0	51.5	0.72	8.4	0.19	0.34	15.47
Bss1	0.45-0.90	20.5	22.0	53.5	0.54	8.5	0.22	0.44	18.63
Bss2	0.90-1.17	18.5	22.0	59.5	0.32	8.7	0.31	0.50	17.94
Bss3	1.17-1.57	12.5	20.0	67.5	0.17	8.7	0.31	0.33	16.56
Pedon 2									
Ap	0-0.23	21.0	22.4	56.5	2.04	8.3	0.16	0.70	14.03
A1	0.23-0.43	25.5	28.0	46.5	1.98	8.4	0.17	0.68	12.42
Bss1	0.43-0.76	29.5	24.0	46.5	0.84	8.4	0.16	0.66	10.58
Bss2	0.76-1.13	17.5	26.0	56.5	0.29	8.4	0.15	0.66	14.49
Bss3	1.13-1.38	19.5	26.0	54.5	0.40	8.4	0.19	0.53	10.08
Pedon 3									
Ap	0-0.16	25.5	26.0	48.5	0.70	8.5	0.19	0.37	20.47
A1	0.16-0.32	33.5	16.0	50.5	0.26	8.9	0.19	0.30	20.07
Bss1	0.32-0.61	33.5	20.0	46.5	-	9.1	0.50	0.25	23.00
Bss2	0.61-0.99	25.5	28.0	48.5	-	9.2	0.73	0.03	22.31
Bss3	0.99-1.27	27.5	22.0	50.5	-	8.9	1.48	0.06	15.87

out the depth with colour varing from very dark grayish brown (10 YR 3/2) to dark brown (10 YR 3/3). The effervescencent with dilute HCl were slight to violent, indicating the calcareousness of the soil. The cracks 0.5 to 1 cm wide extending up to 1 m or more and also well developed slickensides titled at an angle of 20 - 30° to the horizontal axis. It shows these soils have high shrinking and swelling potentials but they have problems of workability due to high clay content (46-67%) and its nature.

Physico-chemical properties

Data (Table 2) revealed that the soils are clay (44.5 to 67.5 %). The higher clay content was noticed at about 0.40 to 0.60 m depth. The hydraulic conductivity range from 0.26 to 2.04 cm hr^{-1} and it decrease with the soil depth. It is observed that the hydraulic conductivity was very low (P_1 & P_2) within 0.5 m from the surface. The soils of the farm are mildly to moderately alkaline in soil rection (pH 8.2 to9.2), EC non saline (EC 0.15 to 1.48 dSm^{-1}) while organic carbon content range from 0.37 to 0.70 per cent at the surface and $CaCO_3$ range from 9.9 to 23.0 per cent indicated the calcarious nature which rearly posing problem for uptake of nutrients and output per unit area.

In general the soils of the farm are very deep (> 1 m), Clay 44 per cent to 67 per cent with dark grayish brown to dark brown colour, Deep wide cracks and well developed slickensides are also noticed in all the pedons. The soils are characterised with low hydraulic conductivity (0.15 to 2.04 cm hr^{-1}) which decrease with depth. The soils are mildly to moderately alkaline (pH 8.2 to 9.2) in rection, non-saline (EC 0.15 to 1.48 dSm^{-1}), low to moderate in organic carbon content, and $CaCO_3$ ranged from 9.9 to 23.0%. The soils are classified as (P_1 & P_2). Typic Haplusterts and Typic Calciusterts (P_3).

LITERATURE CITED

Black, C.A., D.D. Evans, L.E. Ensminger, J.L. White, P.E. Clark and R.c. Dibaur. 1965. Method of Soil Analysis, Part I Am. Soc. Agron. Inc. Pub. madison, Wisconsin, USA.

Jackson, M.L. 1987. Soil Chemical Analysis. Printice Hall Pvt. Ltd., New Delhi.

Richards, L.A. (Ed), 1954. Diagnosis and Improvement of Saline and Alkali Soils. Agril. Handbook No. 60, USDA, Washington D.C., USA.

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