Table 4. Hybrids identified based on mean performance, heterosis and sca effects for grain yield.

Mean Performance	Positive and significant heterosis	sca effects
Prabhat-1 x UMI 492	Prabhat-1 x UMI 492	UMI 492 x UMI 760
UMI 805 x UMI 760	Sartaj-1 x Pratap-1	Kesri-1x Prabhat-1
Prabhat-1 x Kesri-1	JM 3181-1 x Prabhat-1	UMI 492 x Sartaj-1
JM 3181-1 x Prabhat-1	JM 3181-1 x UMI 743	UMI 805 x UMI 760
UMI 760 x JM 3181-1	UMI 760 x JM 3181-1	Prabhat-1 x UM 492
	UMI 805 x UMI 760	UMI 760 x JM 3181-1

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Analysis of variability for seed yield and related characters in safflower (*Carthamus tinctorius* L.)

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Abstract : Thirty five genotypes of saffower are grown under four diverse environments. High genotypic coefficient of variation for yield per plant and number of seeds per capitulum was observed at all the environments and only for yield per plant over environments. Moderate coefficient of variation for number of primary branches per plant, number of secondary branches per plant, number of capitula per plant and harvest index was observed in pooled analysis. High heritability estimates were observed for days to maturity, number of capitula per plant, number of seeds per capitulum, yield per plant and hull content. Seed yield per plant, number of seeds per capitulum and harvest index had high genetic advance coupled with high heritability under individual environment, indicating scope for the improvement of these characters through selection. (***Key Words*** : *Safflower, Variability, Yield).*

Safflower is one of the most accepted crops in dry land agriculture and has been grown in different parts of India for high priced oil. Success in crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. The estimates of variability for yield and its heritable components in the material with which the breeder is working are, prerequisites for any breeding programme. Hence, it becomes necessary to split the phenotypic variability into heritable and non-heritable components with the help of certain genetic parameters such as genotypic and phenotypic coefficients (GCG and PCV), heritability and genetic advance. Improvement in yield is an ultimate aim of the plant breeder which calls for selection on the basis of yield components which are heritable. Therefore the present investigation was undertaken to determine genetic variability, heritability and genetic advance for seed yield and related characters under four different environments.

Materials and Methods

The material for the present investigation consisted of 35 genotypes of safflower. The experiment was laid out in four environments (season: 1991-92, sowing dates: 11-10-91, 11-11-91 and season: 1992-93, sowing dates: 09-10-92, 07-11-92) adopting a randomized block design with three replications in each environment. Each genotype was grown in a single row plot of twenty five plants spaced at 45 x 20 cm. Five competitive plants were selected at random for taking observations on eleven plant characters, *viz.*, days to first flowering, days to maturity, plant height, number of primary branches per plant, number of secondary branches per plant,

number of capitula per plant, number of seeds per capitulum, seed yield per plant, harvest index, oil content and hull content. The genetic parameters, *viz.*, genotypic and phenotypic coefficients of variation were computed as per Burton (1952). Heritability in broadsense was estimated as per Johnson *et al.*(1955) and genetic advance as per Allard (1960). Looking to the range of the character under study, it is grouped under low, medium and high category as under :

Parameters

Range	PCV%	GCV%	Heritability	GA
Low	0-10	0-10	0-30	0-25
Medium	11-20	11-20	31-50	26-50
High	21-50	21-50	51-100	51-100

Results and Discussion

Analysis of variance showed significant difference among the genotypes for all the characters studied (Table 1) indicating the existance of large variability among the genotypes tested under all four environments and pooled over environments. Moreover, the genotype were also showed significnt difference when tested against genotype x environment interaction indicating that the genotypes performs differently under different environments. The results revealed that the phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the characters studied (Table 2), indicating the presence of environmental influence to some degree or the other in the expression of these characters. Similar results were also reported by Makne *et al.* (1985) and Challawar (1986) for yield and yield components. In all the four environments number of seeds per capitulum, seed yield per plant and harvest index had high magnitude of variability as indicated by PCV and GCV values. Genotypic coefficient of variation under individual environments and pooled over environments for all the characters except days to first flowering and days to maturity is not in close confirmation indicating greater part of G x E interaction variance in these characters. The moderate values were observed for number of secondary branches per plant and number of capitula per plant under all the environments except, E_3. These results are in accordance with the results reported by Narkhede *et al.* (1985), Malleshappa *et al.* (1990) and Pawar *et al.*(1993). Low genotypic coefficient of variations were noticed for days to first flowering, days to maturity, plant height, number of primary branches per plant, oil content and hull content. In all four environments differences between

Table 1. Analysis of variance for different characters in 35 genotypes of safflower in four environments

Source		D.F.	Days to First flowering	Days to maturity	Plant height	No of primary branches per plant	No. of secondary branches / plant	No. of capitula per plant	No. of seeds per capitulum	Seed yield per plant	Harvest index	Oil content	Hull content
Genotype	E1	34	22.93*	82.60*	39.94*	5.01	177.77*	178.97*	79.59*	93.44*	62.30*	2.79*	67.89*
	E2		18.85*	74.26*	71.73*	2.85*	40.35*	42.09*	47.35*	14.95*	89.77*	1.86*	89.91*
	E3		32.14*	82.25*	77.26*	2.87*	57.15*	77.48*	61.34*	73.19*	46.62*	12.54*	129.21*
	E4		25.88*	76.03*	56.24*	1.91*	30.59*	44.59*	26.02*	12.18*	69.89*	10.20*	125.55*
Pooled			74.27*+	223.97*+	108.02*+	4.45*+	146.48*+	169.19*+	54.01*+	92.95*+	116.01*+	10.93*+	
164.80*+													
Genotype x Environment		102	8.51*	30.38*	45.72*	2.73*	53.13*	58.03*	33.24*	33.60*	50.86*	5.49*	82.58*
Error	E1	68	1.82	1.87	1.49	0.43	4.14	6.18	1.34	3.00	1.39	1.38	0.50
	E2		1.54	3.14	3.80	0.57	1.92	2.09	1.15	0.99	1.00	0.29	0.77
	E3		3.69	3.35	10.68	1.45	3.31	3.18	6.78	4.68	3.24	0.34	0.60
	E4		4.70	2.35	12.04	0.26	1.69	2.87	1.11	0.93	2.75	0.22	0.78
Pooled		272	2.94	2.69	7.00	0.68	2.76	3.58	10.37	2.40	2.10	0.56	0.66

*, + Significant against error and G x E interactions, respectively.

Environment	Location	Season	Date of Sowing
E_1	Junagadh	Rabi 91-92	11-10-1991
E_2	Junagadh	Rabi 91-92	11-11-1991
E_3	Junagadh	Rabi 92-93	08-10-1992
E_4	Junagadh	Rabi 92-93	07-11-1992

PCV and GCV values were found to be narrow for days to first flowering, days to maturity, plant height and hull content, which indicated that these characters were less influenced by environmental fluctuations and further improvement through selection for these characters would be effective.

High broad sense heritability values were obtained for days to maturity, number of capitula per plant, number of seeds per capitulum, yield per plant, number of secondary branches per plant, harvest index and hull content in all four environments but only days to first flowering and days to maturity shows high heritability when pooled over environments. The high expected genetic advance expressed as percentage of mean was noticed for yield per plant, number of seeds per capitulum, harvest index, and number of secondary branches per plant. Whereas, genetic advance calculated from pooled analysis was high for seed yield per plant, number of capitula per plant, harvest index and number of secondary branches per plant indicating that these characters were least affected by environmental fluctuations. The high heritability along with high genetic advance as percentage of mean was observed for the characters like seed yield per plant, number of seeds per capitulum and harvest index in all the environments (Table 2) indicating that these characters were under the influence of additive gene action and can be relied upon for further improvement through selection as also opined by Johnson *et al.* (1995). The results showing high heritability coupled with high genetic gain were also reported by Narkhede *et al.* (1985), Makne *et al.* (1985) and Pawar *et al.* (1993). High to moderate heritability coupled with moderate to low genetic gain was recorded for hull contents, days to maturity, days to first flowering and plant height. Similar results were also reported for various characters by Narkhede *et al.* (1985). High heritability coupled with low genetic advance may be due to non-additive or pleotropic gene effects.

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Table 2. Estimate of genetic parameters in 35 safflower genotypes on four environments

Genetic parameter		Days to First flowering	Days to maturity	Plant height	No of primary branches per plant	No. of secondary branches / plant	No. of capitula per plant	No. of seeds per capitulum	Seed yield per plant	Harvest index	Oil content	Hull content
Mean	E1	67.20	132.55	42.16	8.27	27.44	28.36	17.80	15.59	9.71	30.13	55.09
	E2	78.85	130.27	60.11	6.39	14.44	15.37	11.83	6.78	18.31	30.90	53.83
	E3	69.59	115.17	63.78	9.20	26.12	28.30	16.38	15.17	19.09	28.68	54.74
	E4	73.35	119.91	56.00	5.97	14.57	15.84	8.04	4.51	12.28	29.77	47.32
Pooled		72.50	124.48	5.51	7.46	20.64	21.97	13.50	10.51	14.85	29.87	52.75
Phenotypic	E1	4.43	4.05	8.97	16.92	28.70	28.16	29.42	36.93	47.98	4.51	8.70
coefficient	E2	3.39	3.98	8.56	18.05	26.57	25.56	34.38	35.04	30.22	2.92	10.26
of variation	E3	5.22	4.73	8.99	15.08	17.65	18.68	30.51	34.57	22.05	7.32	12.05
	E4	4.68	4.33	9.24	15.06	23.10	25.90	38.16	48.02	40.81	6.32	13.76
Pooled		4.42	4.26	9.02	16.45	25.33	25.34	32.90	40.08	32.85	5.45	11.19
Genotypic	E1	3.95	3.91	8.49	14.93	27.73	26.76	28.69	35.23	46.41	2.28	8.60
coefficient	E2	3.01	3.74	7.92	13.61	24.78	23.77	33.17	31.83	29.72	2.34	10.13
of variation	E3	4.43	4.45	7.39	7.48	16.22	17.59	26.04	31.49	19.93	7.03	11.96
	E4	3.62	4.13	8.85	12.41	21.31	23.58	35.84	42.97	38.51	6.13	13.63
Pooled		3.23	3.23	4.10	5.07	13.51	13.86	9.75	20.70	15.69	2.26	4.96
Heritability	E1	79.44	93.44	89.56	77.83	93.33	90.31	95.11	90.96	93.58	25.46	97.83
	E2	78.97	88.30	83.64	56.89	86.98	86.45	93.07	85.52	96.73	64.24	97.46
	E3	71.99	88.70	67.51	24.57	84.44	88.63	72.85	82.99	81.68	92.25	98.61
	E4	60.06	91.28	5.04	67.88	85.09	82.94	88.21	80.07	89.06	93.93	98.16
Pooled		53.34	57.51	20.69	9.49	28.46	29.89	8.78	27.87	22.83	17.11	19.67
Genetic	E1	7.25	7.79	16.55	27.12	55.18	52.39	57.63	69.21	92.49	2.37	17.53
advance as	E2	5.51	7.24	15.09	21.15	47.61	45.52	65.92	59.57	60.21	3.86	20.59
% of mean	E3	7.74	8.64	12.50	7.63	30.71	34.70	45.79	59.10	37.10	13.91	24.47
	E4	5.78	8.13	10.48	21.06	40.49	44.25	69.35	79.20	74.86	12.24	27.81
Pooled		4.86	5.04	3.85	3.22	14.85	15.60	5.95	23.01	15.45	1.92	4.53

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Impact of insecticides on predatory arthropods of the rice ecosystem

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Abstract : The influence of commonly used insectides on the predatory population was studied. The results indicated that acephate, chlorpyriphos and monocrotophos were safer to *Lycosa pseudoannulata, Tetragnatha javana* and *Paderus fuscipes* while acephate, was also found to be safe to *Microvelia atrolineata* and *Cyrtorhinus lividipennis.* Phorate and carbofuran were found to be more toxic to both predators. ***(Key words** : Predators, Rice, Insecticidal effect, Lycosa pseudoannulata, Tetragnatha javana, Paderus fuscipes, Microvelia atrolineata, Cyrtohinus lividipennis)*

The potential of natural enemy action in the regulation of rice pests is affected by the result of interference of these beneficial agents through indiscriminate insecticidal usage. Successful biocontrol of rice insect pests is still feasible as is evident from the apparent occurence of naturally occurring biological control. Regular application of insecticides is found to almost totally suppress the beneficial arthropod population. The present study was taken up during the year 1994-95 at the Paddy Breeding Station, Tamil Nadu Agricultural Univeristy, Coimbatore with a view to assess the influence of certain insecticides used for suppressing the leaf and planthoppers on the non-target, predatory fauna on rice.

Materials and Methods

To assess the effect of recommended insecticides on selected natural enemies of hoppers, a field trial was laid out with a plot size of 50 sq. m. The treatments are presented in Table 1.

Observations were taken on the predators of leaf and planthoppers of rice on 20 hills at random per plot 10 days after each application. All the treatments were given on 10, 30 and 50 days after transplanting (DAT). Individual plots were isolated by bunds and channels to regulate water movement from one plot to another and efforts were also made to eliminate drift between treatments while spraying. Observation on *Microvelia atrolineata* (Berqroth) was taken as implied by Bhathal and Dhaliwal (1991). The area between four adjacent rows were taken as equivalent to one hill to count the predators floating on water.

Results and Discussion

The population of the wolf spider *Lycosa pseudonnulata* Boes. et. Str. was significantly lower