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ANALYSIS OF COMBINING ABILITY IN LINSEED (*LINUM USITATISSIMUM* L.)

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ABSTRACT

In linseed seed yield and plant height were found to be governed by additive genetic variance and remaining by non additive genetic variance. Three crosses - R552 x GP440, R17 x R556 and GP194 x GP440 were promising. For reciprocal effects, cross R17 x R556 was most promising.

KEY WORDS : Linseed, Combining ability.

Combining ability studies to determine the genetic effects governing quantitative traits of linseed and of identify promising crosses were undertaken and their results presented.

MATERIALS AND METHODS

Six varieties of linseed IPI 6, R 17, R 552, R 556, G 194 and G 440 of diverse origin were crossed in a diallel fashion in 1982-83 rabi season. Six parents, 15 direct and 15 reciprocal F_1s were planted in 1983-84 rabi season. The trial was conducted in randomized block design with three replications. Plot size comprised of two rows 3 m length and spaced 40 cm apart. Plant to plant distance within rows was 10-15 cm. The characters measured on 10 plants were plant height (cm), number of tillers/plant, number of capsules/plant, seed yield/plant (g), 100 seed weight (g) and number of seeds/capsule. The data were analysed following Griffing (1956).

RESULTS AND DISCUSSION

Highly significant differences were observed among the 36 genotypes for the six characters studies suggesting adequate genetic diversity among six parental lines, 15 direct and 15 reciprocal F_1s (Table 1).

Combining ability analysis revealed that general combining ability and specific combining ability were highly significant for all the characters implying the importance of additive genetic variance. Further, both additive and non-additive genetic variance components are important for the variation observed in these characters as also reported by Shehata and Comstock (1971). Badwal and Gupta (1970) found that the magnitude of variance attributable to specific combining ability was larger than that due to GCA. Although there may be difference of opinion regarding the predominance of additive or non-additive genetic variance for these attributes, it is certain that both are important. These results are in agreement with Badwal and Gupta (1970).

Reciprocal effects were found to be significant for all the attributes except 100 seed weight. They have been reported to play a significant role in the inheritance of

Table 1. ANOVA for Combining ability for six characters in 6 x 6 diallel of linseed (mean square)

Source	D.F.	Plant height	Tillers/ plant	Capsules plant	Seed yield/ plant	100 seed weight	No. of seeds/pod
GCA	5	11.440**	7.519**	668.212**	3.470**	0.004**	1.112**
SCA	15	4.972**	15.292**	374.911**	9.887**	0.009**	0.651**
Reciprocals	15	6.361**	17.726**	618.083**	1.322**	0.001	0.745**
Error	70	1.436	1.020	93.663	0.276	0.001	0.053

** Significantly at 5% and 1% level respectively

Table 2. General for Combining ability for six characters in 6 x 6 diallel of linseed (mean square)

S.No.	Parent	Plant height	Tillers/plant	Capsules / plant	Seed yield/ plant	100 seed weight	No. of seeds/pod
1.	IPI 6	5.055**	-0.056	1.768*	-0.230	-0.023**	0.447**
2.	R 17	-1.977**	-0.276	-0.287	0.953**	0.026**	0.278**
3.	R 552	-1.194**	0.416	1.185	-0.270	0.016**	-0.078
4.	R 556	-2.444**	-1.417**	0.186	-0.122	-0.008	-0.368**
5.	GP 194	-1.361**	0.694**	-0.010	-0.341*	-0.013*	-0.092
6.	GP 440	1.972**	0.639*	-1.842*	-0.528	0.002	-0.187
	S.E. gi	0.315	0.267	0.743	0.138	0.006	0.104
	S.E. (gi-gj)	0.498	0.410	1.151	0.214	0.001	0.160

* Significant at 5% level. ** Significant at 1% level.

plant height (Marcochenkov, 1973), number of capsules (Anand and Murty, 1969) and number of seed/pod (Anand and Murty, 1969 and Marcochenkov, 1973). Present study suggested that yield components such as tillers/plant, capsules/plant, number of seeds/capsule are governed by reciprocal effects and, therefore, it is not surprising to observe that seed yield is also influenced by this component.

In order to identify desirable combiners for the characters under investigation, the general combining ability effects were estimated. Parents with positive general combining effects are more desirable in linseed for plant height. IPI 6 appeared to be the most desirable combiner for this

Table 3. Specific combining ability effects for six characters in Linseed.

S.No.	Cross	Plant height	Tillers/plant	Capsules/ Plant	Seed yield/ Plant	100 Seed weight	Number of Seeds/ capsule
1.	IPI 6 x R 17	0.194	0.778	11.246	0.913**	0.089**	-0.184*
2.	IPI 6 x R 552	-2.139**	-0.415	-4.310	0.886**	-0.056**	-0.077
3.	IPI 6 x R 556	-8.389**	0.384	-21.092**	-1.272**	0.040**	0.257**
4.	IPI 6 x GP 194	-2.972	-2.693**	-18.343**	-1.677**	0.022	1.659**
5.	IPI 6 x GP 440	-0.306	-2.138**	-5.342	-3.626**	0.024	-1.143**
6.	R 17 x R 552	-3.056**	-0.694	-15.524**	-0.577	-0.072**	-2.801**
7.	R 17 x R 556	4.694**	-0.359	-6.417	0.669*	0.063**	1.380**
8.	R 17 x GP 194	-6.389**	-1.307*	-14.216*	-0.682*	0.005	-0.724**
9.	R 17 x GP 440	-2.222**	-2.252**	-3.055	-2.115**	0.011	0.405**
10.	R 552 x R 556	1.861**	0.777	-8.192	-2.232**	0.010	0.450**
11.	R 552 x GP 194	0.778*	-0.501	-3.357**	-1.348**	0.014	1.016**
12.	R 552 x GP 440	2.444**	2.054**	19.974**	1.123**	-0.093**	1.735**
13.	R 556 x GP 194	1.028	-1.336*	13.615*	-0.494	-0.081**	-0.553**
14.	R 556 x GP 440	2.194**	-1.111	-11.554	-0.699*	-0.006	-0.180
15.	GP 194 x GP 440	4.111**	-2.054**	12.026*	0.695*	0.066**	0.372**
	S.E . Sij	0.720	0.607	5.816	0.316	0.014	
	SE (Sij-Sik)	1.094	0.922	8.835	0.479	0.021	
	SE (Sij-Ski)	0.978	0.825	7.902	0.429	0.019	

* Significant at 5% level. ** Significant at 1% level.

attribute (Table 2). GP 194 and GP 440 were found to be superior for tillers/plant character over other parents by virtue of having highly significant positive *gca* effects. For capsules per plant, IPI 6 seemed to transmit more desirable genes to its progeny. GP 440 was undesirable because it had significant negative *gca* effect. Only one parent was desirable for seed yield per plant *viz* R 17. On the other hand, GP 440 and GP 194 had significant and negative *gca* effect for this character. They had a tendency to transmit genes for low yield to their progeny. R 17 and R 552 had significant positive *gca* effects for 100 seed weight. On the other hand, IPI 6 and GP 194 appeared to be most undesirable combiners for seed weight. Although IPI 6 was a poor combiner for seed weight and did not seem promising for seed yield, it was superior with respect to number of seeds/capsule. However, it was *on par* with R 17 for this attribute. R 556 was a poor combiner.

On the whole, IPI 6 emerged as a desirable combiner for three out of six characters studied. R 17, however, was desirable for yield.

Since *sca* was significant for all the attributes, specific crosses were identified for each character which were desirable. F_1 crosses R 17 x R 556, GP 194 x GP 440 were desirable specific combiners for plant height (Table 3), and were significantly superior to R 552 x GP 440, R 556 x GP 440 and R 552 x R 556. Crosses IPI 6 x R 556 and R 17 x GP 194 manifested highly significant negative *sca* effect and were thus undesirable F_1 combinations. On the basis of *per se* performance, GP 194 x GP 440 was most desirable cross combination.

Only one cross appeared to possess *sca* effect in the desirable direction and significantly different for number of tillers (Table 3).

Number of capsule is an important component of yield in linseed. None of the crosses involving the only desirable combiner (IPI 6) had *sca* effect in desirable direction as well as significantly different from zero. R 552 x GP 440 and GP 194 x GP 440 which involved poor combiner GP 440 were desirable specific combinations. There was an agreement between the *per se* performance of the cross and *sca* effect. R 552 x GP 440 was superior on mean performance basis also.

For seed yield plant, R 552 x GP 440, IPI 6 x R 17, IPI 6 x R 552, GP 194 x GP 440 and R 17 x R 556 had significant positive *sca* effects and, therefore, desirable crosses. There was no agreement between the cross selected on the basis of *per se* performance and its *sca* effects. Jatasra and Paroda (1979) had also reported that the crosses selected on the basis of *sca* effects and the *per se* performance are not the same. Crosses involving parents with low productivity, in general, manifest large specific combining ability effects. Since *sca* depends upon non additive genes action, it is not surprising to find that poor parents when crossed manifest more deviation from expected performance on the basis of *gca* effects of parents involved.

R 552 x GP 440, IPI 6 x R 17, GP 194 x GP 440, IPI 6 x R 556 were found to be desirable specific combinations for 100 seed weight by virtue of having positive significant *sca* effect. For number of seeds/pod, IPI 6 x R 17, R 556 x GP 440, R 552 x GP 440 and IPI 6 x R 552 had significant and positive *sca* effects. IPI 6 x R 17 is a cross in which both the parents were desirable combiners.

Since the reciprocal effects also significantly influenced the inheritance of several traits, reciprocal effects were estimated. R 552 x IPI 6 manifested significant positive reciprocal effect for plant height (Table 4). However, neither the

Table 4. Reciprocal crosses effect for six characters in Linseed.

S.No.	Cross	Plant height	Tillers/plant	Capsules/ Plant	Seed yield/ Plant	100 Seed weight	Number of Seeds/ capsule
1.	R 17 x IPI 6	-1.500	3.835**	16.665	1.500**	0.007	-0.065
2.	R 552 x IPI 6	4.000**	3.665**	13.165	0.880*	0.023	0.556**
3.	R 556 x IPI 6	-6.500**	3.000**	9.500	0.690	0.008	1.300**
4.	GP 194 x IPI 6	-1.000**	1.335	15.000	0.485	0.012	0.350*
5.	GP 440 x IPI 6	-5.000**	2.165**	0.665	0.480	0.008	0.400*
6.	R 552 x R 17	-5.000**	1.835*	-0.835	0.335	0.017	-0.610**
7.	R 556 x R 17	-4.500**	2.665**	20.665**	0.765*	0.017	0.445**
8.	GP 194 x R 17	114.500**	3.830**	6.000**	0.165	0.010	0.140
9.	GP 440 x R 17	0.000	2.500**	15.835	0.425	0.010	0.680**
10.	R 556 x R 552	-6.500**	2.165**	14.000	0.750*	0.010	1.500**
11.	GP 194 x R 552	-0.500	3.670**	21.335**	1.115**	0.007	0.565**
12.	GP 440 x R 552	-0.500	5.500**	40.000**	0.500	0.010	0.003
13.	GP 194 x R 556	-4.500**	2.000**	16.665	0.935*	0.010	-0.225
14.	GP 440 x R 556	-3.000**	2.330**	16.830	1.015**	0.010	0.290
15.	GP 440 x GP 194	-4.000**	3.000**	18.500**	1.040**	0.016	0.485**
	S.E ±rij	0.847	0.714	6.843	0.371	0.023	0.162
	SE (rij-rkl)	1.198	1.010	9.779	0.525		0.229

* Significant at 5% level. ** Significant at 1% level.

sca effects, nor the *per se* performance indicated the desirability of this cross combination. GP 440 x R 552 manifested large positive reciprocal effects for tiller plant. However, it was *on par* with the effects of R 17 x IPI 6, GP 194 x R 17, GP 194 x R 552 and R 552 x IPI 6. Since R 552 x GP 440 was the best specific combination, it would be desirable to cross in reciprocal fashion since the reciprocal effect was large for this cross. GP 440 x R 552 also revealed large and significant positive reciprocal effect for capsule number. However, reciprocal effects of GP 194 x R 552 and R 556 x R 17 were found to be desirable in magnitude and direction. It would be desirable to cross R 552 x GP 440 in a reciprocal manner to exploit the reciprocal effect for number of capsule observed for this cross. For seed yield, large magnitude of reciprocal effects were observed for R 17 x IPI 6 and a few other crosses. Since this cross manifested large significant *sca* effect for yield, it may be perpetuated reciprocally.

From the results, there crosses emerged as promising *viz.* R 552 x GP 440, R 17 x R 556 and GP 194 x GP 440, if seed yield and plant height are taken into consideration. Since reciprocal effects also have significant contribution to the variation, R 17 x R 556 may be chosen as most promising. The *per se* performance of this cross is also superior to other cross.

Since both additive and non additive genetic variance govern the inheritance of all the attributes, biparental mating in F_2 generation followed by conventional breeding procedure may exploit the gene action and enable selection of desirable genotype.

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PAIYUR 1 - A NEW HIGH YIELDING SAMAI VARIETY FOR THE MARGINAL LANDS OF TAMIL NADU

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ABSTRACT

A high yielding samai culture DPI 1213 has been developed through pure line selection. It was released as Paiyur 1 for general cultivation in the marginal and sub-marginal drylands of Tamil Nadu. This strain with a high yield potential of 873 kg/ha, matures in 105-110 days, and is suitable for early monsoon sowings.

KEY WORDS : Samai, Paiyur 1, New Variety.

Among small millets, samai (*Penicum miliare*) forms the principal food crop in the marginal and sub-marginal rainfed farming situations of Dharmapuri-Salem region of Tamil Nadu. Out of the total State area of 1.4 lakh hectares under this crop, 42 per cent is grown in this region accounting for 76 per cent (0.46 lakh tonnes) of the total production. The presently available improved strain Co 2 is shorter in duration and less productive in poor and marginal soils. Moreover, it does not withstand early season drought which is a common occurrence in this tract. Therefore research work was carried out at Regional Research Station, Tamil Nadu Agricultural University, Paiyur to identify a new high yielding type with different genetic make up from the presently cultivated ones, and the results are reported.

MATERIALS AND METHODS

The single plant selections totalling 185 numbers collected at farmers' holdings in different parts of the State were evaluated for yield and other attributes in progeny rows under rainfed condition during 1979. The promising accessions were evaluated in preliminary yield trial during 1980. A high yielding accession DPI 1213 which was a pure line selection from Santhur local was tested in advanced yield trials for three years from 1981-'84. It was tested in other Research Stations of Tamil Nadu Agricultural University during 1983 and 1984 and in All India Co-ordinated trials from 1982-'85. On-farm trials were

Table 1. Performance of DPI 1213 Samai Culture at Regional Research Station, Paiyur.

Year	Grain Yield (kg/ha)		Straw yield (t/ha)	
	DPI 1213	Co 2	DPI 1213	Co 2
1981	725	512	4.2	3.4
1982	300	218	—	—
1983	893	702	3.0	2.3
1984	644	530	1.3	0.5
Mean	641	490	2.6	1.9
% on CO 2	130	100	137	100

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