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Combining Ability Analysis of Yield and Its Certain Components in Pea*

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ABSTRACT

Combining ability from parents, F_1 and F_2 generations was analysed from diallel crosses with five diverse varieties of pea, viz., T 163, Duke of Albany, Bonneville, Perfection new line and *Satha*. Yield and a few important components of yield studied. Though variance due to general and specific combining ability was significant, gca variance was predominant for all the characters except seed yield per plant for which sca variance was higher. The *per se* performance of the parents and crosses was not usually associated with the combining ability effects. Attempts to isolate pure lines from advanced generations for most of the characters may be worthwhile from crosses Bonneville x *Satha*, Perfection new line x *Satha* and Duke of Albany x *Satha*.

INTRODUCTION

In peas, variability with regard to yield and its components is yet to be adequately studied although some information is available on certain aspects of yield and its components from the work of Krarup and Davis (1970, 1970a), Marx and Mishanec (1962, 1967) and Zlamal (1972). Since information on some of the components is useful in adopting suitable breeding methodology, a study was undertaken to analyse combining ability of five diverse varieties of garden pea commonly in use in this area. Results of an analysis of data from parents and F_1 and F_2 generations are described herein.

MATERIALS AND METHODS

Diallel crosses were made between five diverse varieties of pea, T 163, Duke of Albany (DA), Bonneville (Bv), Perfection new line (PNL) and SATHA (S), a local variety. The 5 parents, 10 F_1 and 10 F_2 progenies were sown in the field in 1971—72 with 3 replications in a randomised block design. As statistical anlysis of the parents and F_1 data from the year 1970-71 showed no significant reciprocal difference (Kumar, 1973,) reciprocal crosses were not considered. Seeds were space planted 20 cm apart in 3m long rows.Each row was spaced 60cm apart. The parents and F_1 had one row each whereas each F_2 pro-

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geny had 3 rows. Ten plants from each plot of parent and F_1 and 50 plants from each plot of F_2 in each replication were selected at random. Data on numbers of primary branches, pods per plant, seeds per pod, pod length, 25 seed weight and seed yield per plant, were recorded. Combining ability analysis from F_1 and F_2 data were made separately according to Griffing (1956), method II, model 1.

RESULTS AND DISCUSSION

Analysis of variance for combining ability was carried out separately with F_1 and F_2 data (Table 1). The total genetic variance among the parents and crosses was partitioned into gca and sca components. Gca variance was significant for number of pods per plant and number of seeds per pod while only sca variance was significant for seed yield per plant. Both gca and sca variances were significant in F_1 and F_2 for number of primary branches, and 25 seed weight. sca variances were significant in F_2 for length of pod also.

Estimates of gca effects are presented in Table 2. High positive gca effect was shown by SATHA for number of primary branches, T. 163 for number of pods per plant, Duke of Albany for 25-seed weight and Bonneville for length of pod. SATHA also gave maximum gca effect for number of seeds per pod, although Perfection new line was a good general combiner for length of pod and number of seeds per pod. Though not significant, Duke of Albany and SATHA showed maximum promise for seed yield per plant.

TABLE 1 ANOVA of combining ability for yield and yield components in a 5x5 diallel set of pea

Sources of variation	DF	Generation	Characters — M. S. value					
			No. of primary branches	No. of pods per plant	Length of pod	No. of seeds per pod	25-seed weight	Seed yield per plant
General combining ability	4	F_1	0.59**	28.61**	1.41**	0.61**	0.45**	7 81
		F_2	0 33**	28.96**	2.17	0.47**	0 55**	2.91
Specific combining ability	10	F_1	0.06*	4.51	0.06	0.05	0.10**	12.54**
		F_2	0.06*	2.27	2.91**	0.03	0.14**	4. 87**
Error	28	F_1	0.02	2.36	0.03	0.02	0.02	2.93
		F_2	0.02	1.96	0.01	0.02	0.03	1.69
gca/sca	—	F_1	9.83	6.34	19.00	12.20	4.52	0.62
		F_2	5.50	12.75	0.74	15.67	3.96	0.59

* Significant at 5%

** Significant at 1%

TABLE 2. Estimates of gca effects for yield and yield components in a 5x5 diallel set of pea

Characters	Gene-ration	T 163	Duke of Albany	Bonne-ville	Perfection new line	Satha	SE gi	$\hat{u} \pm$ SE
No. of primary branches	F_1	0.206*	0.077	-0.194*	-0.394**	0.306**	0.048	2.293** ± 0.038
	F_2	0.070	-0.003	-0.174*	-0.217*	0.326**	0.048	2.250** ± 0.036
No. of pods per plant	F_1	2.326*	1.243	-2.043*	-2.186*	0.657	0.52	26.000** ± 0.388
	F_2	1.980*	1.566*	-1.966*	-2.406**	0.826	0.43	24.100** ± 0.361
Length of pod	F_1	—0.634**	-0.006	0.280*	0.4086**	-0.0486	0.062	6.64** ± 0.475
	F_2	—0.583**	-0.0114	0.317**	0.3890**	-0.0543	0.032	6.13** ± 0.0245
No. of seeds per pod	F_1	—0.134	-0.420**	0.009	0.237**	0.309**	0.050	4.20** ± 0.04
	F_2	—0.180*	-0.351**	0.077	0.263**	0.191*	0.048	4.03** ± 0.037
25-seed weight	F_1	—0.0229	0.3871**	-0.0100	-0.0257	-0.3249**	0.046	5.27** ± 0.036
	F_2	—0.0770	0.4206**	-0.0039	0.0191	-0.3594**	0.054	5.93** ± 0.04
Seed yield per plant	F_1	0.1686	0.5629	-1.4300	-0.6057	1.3057	0.5787	24.45** ± 0.44
	F_2	0.1000	0.4700	-1.0581	-0.1043	0.5930	0.4401	20.70** ± 0.34

* Significant at 5%
** Significant at 1%

Estimates of sca effects are presented in Table 3. In case of number of primary branches, crosses T 163 x DA (F_1) and Bv x PNL in both F_1 and F_2 while for number of pods per plant the cross T 163 x Bv (F_1) showed high significant positive effects. Maximum promise for length of pod was shown by crosses Bv x S in F_1 and T 163x Bv in F2. With regard to the number of seeds per pod, only Bv x S showed high positive sca effects in F_1. In case of 25-seed weight crosses T 163 x Bv, DA x Dv and PNLxS showed sifnificant positive sca effects in both F_1 and F_2. Crosses T 163 x Bv (F_1), DA x S (F_1) and DA x Bv (F_2) indicatec high sca effects for seed yield per plant.

The results show that for all the important components of yield, there is a preponderance of additive gene action although a substantial contribution of non-additive components is also indicated. Similar results were reported in pea by Marx and Mishanec (1962, 1967) and Zlamal (1972) although predominant non-additive component for seed yield per plant was not observed by (Krarup and Davis 1970, 1970a).

The estimates of combining ability provide guidance in choosing parents for hybridization. The choice of the parents should be based on the *per se* performance of the parents, crosses, and combining ability effects. Results indi-

TABLE 3. Estimates of SCA effects for yield and yield characters in a 5x5 diallel set of pea

T163xDA	T163xBv	T163xPNL	T163xS	DAxBv	DAxPNL	DAxS	BvxPNL	BvxS	PNLxS	S.E.sij
No. of primary branches										
0.420*	0.290*	-0.110	-0.010	-0.080	0.020	0.120	0.290*	-0.110	-0.210	0.130
0.170	-0.100	-0.010	-0.260	0.110	-0.140	-0.090	0.430**	-0.210	0.330*	0.120
No. of pods per plant										
1.728	4.213*	-0.544	1.313	-0.601	0.442	-1.001	1.028	-1.815	1.328	1.34
-0.550	0.580	-0.480	2.000	0.090	-0.660	-0.790	0.960	-2.260	-2.220	1.22
Length of pod										
0.133	0.248	0.319	-0.024	-0.181	0.191	0.048	-0.095	0.362*	-0.167	0.160
0.181	0.253*	0.081	-0.076	-0.019	-0.190*	-0.247*	-0.219*	0.024	0.053	0.083
No. of seeds per pod										
-0.052	0.219	-0.109	0.219	-0.195	-0.024	0.205	0.134	0.334*	-0.052	0.130
-0.095	-0.024	-0.010	-0.138	0.047	0.238	0.133	0.233	0.105	-0.281	0.125
25-seed weight										
0.017	0.364*	0.229	-0.409**	-0.354*	0.169	-0.153	-0.043	-0.436**	0.379*	0.120
0.270	0.334*	0.248	-0.154	0.443*	0.450*	-0 211	-0.045	-0.377*	-0.360*	0.143
Seed yield per plant										
-1.39	6.33**	1.04	1.29	0.01	2.42	4.43*	0.74	-0.42	1.53	1.49
-2.53	1.26	0.19	2.42	3.84**	0.21	-2.08	0.54	-3.15*	1.14	1.14

* Significant at 5%

** Significant at 1%

Upper and lower values correspond to F_1 and F_2 respectively.

cated that the *per se* performance of the parents and crosses was not usually associated with the combining ability effects. Similar results were observed in cotton by Singh and Gupta (1970) although Miller and Marani (1963) reported contrary results. The present study has indicated that on the basis of *per se* performance and combining ability the crosses Bv x S, PNL x S and DA x S merit study for isolation of superior progeny.

Where both additive and non-additive components are important, reciprocal recurrent selection may be a useful method of breeding. This method may not, however, be effective in a highly self fertilized crop like pea. As already suggested by Athwal and Borlaug (1967) in wheat and Singh and Singh (1970) in peas, isolation of desirable pure lines from advanced generation of the selected crosses, exploiting mainly additive components, is likely to be helpful in the present material.

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