Indian J. Genet., 51 (4): 400–404 (1991)

COMPARATIVE STUDY ON DIALLEL, PARTIAL DIALLEL AND LINE x TESTER ANALYSIS IN MUSTARD (*BRASSICA JUNCEA* L. (CZERN & COSS)

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(Received: August 25, 1990; accepted: November 30, 1990)

ABSTRACT

Consistency of the results of diallel, partial diallel and line x tester analysis in mustard (*Brassica juncea* L. Czern & Coss) was studied. The size of the diallel was 8 x 8, partial diallel with s=5 and s=3, and line x tester with l=6 and t=2. The diallel cross analysis emerged as the most comprehensive and useful method of understanding the gene effects governing expression of quantitative traits. In partial diallel using s=5, the results were fairly close to that of diallel analysis. The line x tester may be preferred when large number of lines are to be tested.

Key words: Diallel cross, line x tester, mustard.

Diallel analysis has been widely used for understanding the nature of gene effects both in cross- and self-pollinated crops. However, a full diallel set becomes unmanageable with increase in the number of parents. Diallel cross with small number of parents give poor estimates of genetic parameters because of large sampling error. The line x tester analysis of combining ability has also been commonly used since long, but the choice of the number and nature of the tester parents continued to be unsolved. Partial diallel cross analysis has also been proposed and used by several workers for this purpose [1–6]. In partial diallel, a large number of parents are involved, but only a sample of all possible crosses among them is required for analysis. Voluminous literature is available on the use of diallel, partial diallel and line x tester cross analyses. However, very little work has been done on comparative study of these designs, particularly in mustard.

This paper discusses only gene effects. The gca and sca effects are not discussed as they also follow the same pattern as gene effects in all the three methods of analysis.

MATERIALS AND METHODS

The experimental material consisted of diallel set excluding reciprocals of eight varieties/strains, viz. Kranti, RW-2-2, Krishna, RW-15-6, RK-8405, RC-781, YRT-3, and

RLC-1359. The crosses were made during rabi 1985–86. The 28 F_1s and eight parents were planted in randomized block design with three replications in rabi 1986–87. This 28 F_1 diallel experiment was used to derive information from the partial diallel and line x tester analyses also. In partial diallel, 's' and 'n' both should not be simultane- ously odd or even. Since n=8 in this case, s was kept as three and five so that the numbers of crosses (ns/2) analysed were 12 and 20, respectively. In the line x tester analysis, six lines and 2 testers were used. Out of the eight parents used in the diallel, the testers were divided into the two categories: (i) the widely adapted testers, Kranti and Krishna, and (ii) the specifically adapted testers RK-8405 and RLC-1359. In each case two parents worked as testers and the remaining six were used as lines. Therefore, 6 x 2 (l x t) = 12 crosses in each case were sampled for line x tester analysis. Data on 10 random plants in each entry were recorded for 12 characters, viz. days to flowering and maturity, plant height, pri- mary and secondary branches/ plant, length of main shoot, siliquae on main shoot, siliquae/plant, seeds/siliqua, seed yield/plant, 1000-seed weight, and oil content. The data collected on different characters were analysed using diallel [7], partial diallel [1] and line x tester [8] analyses.

Table 1. The estimates of $\hat{\sigma}^2g$, $\hat{\sigma}^2s$ and mean degree of dominance $(\hat{\sigma}^2s/\hat{\sigma}^2g)^{1/2}$ for different characters in diallel analysis

Character	Variance		Degree of
	$\hat{\sigma}^2$gca	$\hat{\sigma}^2$sca	dominance
Days to flowering	36.1	13.6	0.613
Days to maturity	12.29	6. 5	0.712
Plant height	275.4	44.8	0.403
Primary branches/plant	0.53	–2.41	—
Secondary branches/plant	0.21	1.80	2.94
Length of main shoot	34.6	5.69	0.405
Siliquae on main shoot	–0.50	–30.21	—
Siliquae/plant	–858.24	1012328.90	34.34
Seeds/siliquae	0.05	–0.67	—
Seed yield/plant	–0.01	3.48	—
1000-seed weight	0.06	0.07	1.12
Oil content	0.86	0.27	0.56

Table 2. The estimates of $\hat{\sigma}^2g$, $\hat{\sigma}^2s$ and mean degree of dominance $(\hat{\sigma}^2s/\hat{\sigma}^2g)^{1/2}$ for different characters in partial diallel set of crosses

Character	Sample	Variance		Degree of
	size	$\hat{\sigma}^2$gca	$\hat{\sigma}^2$sca	dominance
Days to flowering	5	17.6	4.94	0.53
	3	16.0	10.18	0.80
Days to maturity	5	11.3	3.24	0.53
	3	12.2	5.57	0.67
Plant height	5	123.0	24.10	0.44
	3	100.4	–10.28	—
Primary branches/plant	5	0.85	–0.605	—
	3	0.75	–0.149	—
Secondary branches/plant	5	0.91	6.74	2.71
	3	–4.57	12.55	—
Length of main shoot	5	37.41	37.13	1.00
	3	51.17	–9.17	—
Siliquae on main shoot	5	–2.67	12.83	—
	3	–0.59	2.47	—
Siliquae/plant	5	7246.2	11513.9	1.26
	3	8236.5	15827.9	1.38
Seeds/siliqua	5	0.12	–0.08	—
	3	0.39	–0.33	—
Seed yield/plant	5	1.08	3.75	1.86
	3	2.24	2.73	1.10
1000-seed weight	5	0.06	0.16	1.57
	3	0.06	0.11	1.31
Oil content	5	1.16	1.10	0.97
	3	1.86	0.420	0.47

RESULTS AND DISCUSSION

In diallel analysis, predominance of additive gene effects was observed for days to flowering and maturity, plant height, length of main shoot, and oil content. However, predominance and non-additive gene effects was observed in respect of number of secondary branches and siliquae/plant, and 1000-seed weight. Partial diallel cross analysis with s=5 and s=3 exhibited importance of additive gene effects for days to flowering and maturity, and oil content. However, predominance of nonadditive gene effects was observed for number of siliquae and seed yield/plant, and 1000-seed weight in both sets of partial diallels. Line x tester cross analysis indicated the importance of additive gene effects for days to flowering and plant height irrespective of the nature of testers used. The nonadditive gene effects were important for days to maturity, secondary branches and siliquae/plant, 1000-seed weight, and oil content (Tables 1–3).

The findings of the partial diallel analysis with s=5 were generally in agreement with those of diallel cross analysis for ten out of 12 characters. Among these characters, days to flowering and maturity, plant height, primary branches/plant, main shoot length, seeds/ siliquae, and oil content were determined by additive gene action, and number of secondary branches and siliquae/plant, and 1000-seed weight were due to predominance of non-additive genes in both the diallel as well as partial diallel with s=5. How- ever, partial diallel with s=3 was in general agreement with those of diallel cross analysis for seven characters only. These results are in agreement with the findings of [1 – 6, 8] (Table 4).

It is thus evident that diallel cross analysis gave a more precise estimate of gene action over partial diallel and line x tester analysis.

Table 3. The estimates of $\hat{\sigma}^2 2g$, $\hat{\sigma}^2 s$ and mean degree of dominance $(\hat{\sigma}^2 s/\hat{\sigma}^2 g)^{1/2}$ for different characters in line x tester analysis

Character	Tester	Variance		Degree of
		$\hat{\sigma}^2$gca	$\hat{\sigma}^2$sca	dominance
Days to flowering	W	6.58	2.44	0.61
	S	8.60	8.41	1.00
Days to maturity	W	1.59	2.64	1.28
	S	3.90	6.51	1.29
Plant height	W	45.35	9.34	0.45
	S	54.25	11.07	0.45
Primary branches/plant	W	0.10	0.26	1.58
	S	0.30	–0.34	—
Secondary branches/plant	W	0.88	2.82	1.78
	S	0.03	4.85	12.93
Length of main shoot	W	11.71	8.77	0.86
	S	11.38	30.98	1.64
Siliquae on main shoot	W	0.44	13.73	5.61
	S	–2.01	35.95	—
Siliquae/plant	W	238.59	1147.27	2.19
	S	470.33	18774.30	6.31
Seeds/siliquae	W	0.03	0.09	1.75
	S	0.12	–0.26	—
Seed yield/plant	W	0.35	0.20	0.76
	S	0.05	4.66	9.55
1000-seed weight	W	0.01	0.08	3.33
	S	0.00	0.27	16.37
Oil content	W	0.30	2.63	2.97
	S	0.16	0.61	1.94

W—widely adapted tester, S—specifically adapted tester.

However, partial diallel with s > n/2 gave fairly close results to that of diallel analysis. Partial diallel had additional advantage of involving more parents by attempting less number of crosses. However, with decrease in s, the partial diallel was unable to give precise estimates of gene action as it was observed in the case of diallel analysis and partial diallel with s > n/2. The loss of precision in the estimates of gene action in partial diallel with s < n/2 is mainly due to the fact that average S. E. (gi-gj) also increased with decrease in s. It, therefore, suggests that s should not be less than n/2. Line x tester analysis can be preferred only in those situations when large number of parents are to be tested.

Table 4. Gene effects for different characters as revealed by diallel, partial diallel and line x tester cross analyses

Character	Diallel	Partial diallel		Line x tester	
		s=5	s=3	W	S
Days to flowering	PA	PA	PA	PA	PA
Days to maturity	PA	PA	PA	PNA	PNA
Plant height	PA	PA	A	PA	PA
Primary branches/plant	A	A	A	PNA	A
Secondary branches/plant	PNA	PNA	NA	PNA	PNA
Length of main shoot	PA	PA	A	PA	PNA
Siliquae on main shoot	A	NA	NA	PNA	NA
Siliquae/plant	PNA	PNA	PNA	PNA	PNA
Seeds/siliqua	A	A	A	PNA	A
Seed yield/plant	NA	PNA	PNA	PA	PNA
1000-seed weight	PNA	PNA	PNA	PNA	PNA
Oil content	PA	PA	PA	PNA	PNA

W—widely adapted testers, S—specifically adapted testers, PA—predominance of additive, NA—nonadditive, s—No. of crosses sampled per parent, PNA—predominance of nonadditive, and A—additive.

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