Indian J. Genet., 49(3): 355–358 (1989)

GENETIC VARIATION FOR PHYSIOLOGICAL TRAITS IN RAPESEED

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(Received: August 1, 1988; accepted: December 24, 1988)

ABSTRACT

Jinks and Perkins [1] analysis was applied to study the additive (D), dominance (H), and epistatic components of variation for different physiological traits, viz., pod intensity (PI), seed : husk ratio (SHR), seed : husk nitrogen ratio (SHNR), harvest index (HI) and nitrogen harvest index (NHI) in two crosses of *Brassica napus*. In general, dominance component (H) was relatively more important than the additive component. Epistasis was of major importance in cross Bronowski × Topa. The j and i types of epistasis was prevalent for majority of characters while (i) type was nonsignificant in both crosses.

Key words: *Brassica napus*, physiological traits, triple test cross, genetic variation.

The exploitation of genetic variation depends on the extent of fixable and nonfixable variation, and the genetic model used. The study reported aims to obtain unbiased estimates of additive (D) and dominance (H) components in the absence of epistasis by the Jinks–Perkins model [1]. These estimates could be used in the formulation of proper breeding methodology in oilseed rape (*Brassica napus*) to develop/select genotypes with enhanced yield or higher seed protein concentration.

MATERIALS AND METHODS

Twenty and sixteen plants were randomly chosen from F_2 of crosses GSL–1 × Nikalis and Bronowski × Topa, respectivley. Each plant was then crossed as male to both the parents (P_1 and P_2) and F_1 to produce L_{1i}, L_{2i} and L_{3i} families. The families thus produced were raised in randomized block design with three replications. Observations were recorded on five competitive plants from each family for the following characters:

Pod intensity (PI). It was measured as the number of pods per cm length of the main snoot.

Seed : husk ratio (SHR). **Samples of 25 pods/plant were taken. The seed and chaff (husk) were weighed separately and the ratio calculated.**

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Seed : husk nitrogen ratio (SHNR). It was calculated as the ratio of seed nitrogen to husk nitrogen.

Harvest index (HI). It was calculated as the ratio of seed yield to biological yield.

Nitrogen harvest index (NHI). It was calculated according to Austin and Jones [2]:

$$\frac{\text{Seed yield} \times \text{Seed N \%}}{\text{Straw yield} \times \text{Straw N \%} + \text{Seed yield} \times \text{Seed N \%}}$$

The detection and estimation of additive (D), dominance (H), and epistatic component of genetic variation were carried out according to Jinks and Perkin [1].

RESULTS AND DISCUSSION

Significant epistasis was observed for HI, PI, SHR and NHI in the cross Bronowski × Topa; and for PI and SHR in GSL-1 × Nikalis (Table 1). Partitioning of epistasis revealed that additive × additive interaction was nonsignificant for all characters in both the crosses, while j and l type of epistasis was significant for HI, SHR and NHI in cross Bronowski × Topa, and only for SHNR in cross GSL-1 × Nikalis. The results indicate that the j and l type epistasis was important in the material under study Singh and Singh [3] also observed similar results in two crosses of wheat.

The components D and H were highly significant for HI and NHI whereas only additive component was significant for PI and dominance for SHR in cross

Table 1. Analysis of variance for epistasis in two test crosses for physiological traits in rapeseed

Source	Cross	d.f.	PI	SHR	SHNR	NHI	HI
Epistasis	Bronowski × Topa	16	0.06**	0.02*	1.11	21.7**	5.7**
	GSL−1 × Nikalis	20	0.03**	0.01	2.03**	9.1	4.8
Overall epistasis	Bronowski × Topa	1	0.64	0.05	0.01	55.7	16.3
	GSL−1 × Nikalis	1	0.16	0.02	0.20	2.5	15.1
j & l type epistasis	Bronowski × Topa	15	0.02	0.02**	1.18	19.5**	5.0**
	GSL−1 × Nikalis	19	0.02	0.03	2.12**	9.4**	4.3
Epistasis × replication	Bronowski × Topa	32	0.03**	0.01	0.89**	3.9	1.2
	GSL−1 × Nikalis	40	0.01	0.05	0.61**	6.4	4.4
Overall epistasis × replication	Bronowski × Topa	2	0.45**	0.03*	3.90**	32.6**	12.83
	GSL−1 × Nikalis	2	0.21**	0.03	3.69**	9.3	11.4**
j & l type epistasis × replication	Bronowski × Topa	30	0.01	0.01	0.69**	2.0	1.1
	GSL−1 × Nikalis	38	0.04	0.05	0.44	6.3	4.0**
Within family	Bronowski × Topa	576	0.01	0.01	0.18	6.6	1.4
	GSL−1 × Nikalis	720	0.02	0.03	0.33	5.3	1.5

*,**Significant at 5 and 1% levels, respectively.

Bronowski × Topa (Table 2). The dominance component was significant for all the characters in cross GSL-1 × Nikalis. Relatively higher estimates of H were found in comparison to D component. Since the cross Bronowski × Topa gave direct evidence of epistasis for all the characters, except SHNR, estimates of D and H were biased by epistasis to an unknown extent. However, in the second cross, GSL-1 × Nikalis, epistasis was absent for SHR, NHI and HI, indicating the true estimate of dominance for these attributes. Because of the unbiased estimates obtained in the absence of epistasis, it becomes easy to draw conclusions about the importance of the genetic components of variation in this cross.

Table 2. Analysis of variance for sums (additive) and differences (dominance) in two triple test crosses for different physiological traits of rapeseed

Source of variation	d.f.	Characters				
		PI	SHR	SHNR	NHI	HI
TTC−1 (Bronowski × Topa)						
(a) Analysis of sums (additive)	15	0.02*	0.004	0.59	18.79**	4.64**
Sums × replication	30	0.01	0.007**	1.87**	9.28	0.45
Within family	575	0.01	0.01	0.11	6.62	1.46
σ^2s		0.001	—	—	1.06	0.29
D		0.008	—	—	8.48	2.28
(b) Analysis of difference (dominance)	15	0.01	0.01**	0.65	18.32**	3.40**
Differences × replication	30	0.02*	0.007	0.65**	5.86**	1.76**
Within family	384	0.01	0.009	0.18	2.31	0.59
σ^2d		—	0.001	—	2.08	0.27
H		—	0.005	—	16.64	2.16
TTC−2 (GSL−1 × Nikalis)						
(a) Analysis of sums (additive)	19	0.03**	0.01	0.42	8.77**	13.47**
Sums × replication	38	0.02	0.01**	0.81**	7.41	6.11**
Within family	720	0.02	0.004	0.33	5.28	1.47
σ^2s		0.004	—	—	0.39	0.82
D		0.003	—	—	3.10	6.56
(b) Analysis of differences (dominance)	19	0.07**	0.02**	0.84**	9.30**	12.10**
Differences × replication	38	0.02	0.009**	0.61	7.07	5.85**
Within family	480	0.02	0.001	0.42	5.52	1.53
σ^2s		0.009	0.001	0.03	0.63	1.04
H		0.07	0.008	0.30	5.04	8.32

*, **Significant at 5 and 1% levels, respectively.

These results have clearly demonstrated the role of epistasis in the control of all the characters, except SHNR in cross Bronowski × Topa and for PI and SHNR in cross GSL-1 × Nikalis. Since *Brassica napus* is a self-pollinated crop, where the production of commercial hybrid is still in infancy, this type of epistasis is of little use. However, the epistatic component cannot be ignored when one is formulating breeding plans to improve the populations' for economic traits.

ACKNOWLEDGEMENTS

The first author is thankful to the Indian Council of Agricultural Research for financial help. Thanks are also due to Dr. S. S. Banga and Dr. D. R. Satija for help in statistical analysis.

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