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GENETIC ANALYSIS OF RESISTANCE TO DOWNY MILDEW [*PERONOSPORA ARBORESCENS* (BERK) DE-BARY] IN OPIUM POPPY (*PAPAVER SOMNIFERUM* L.)

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ABSTRACT

Four susceptible, two moderately resistant and two resistant opium poppy varieties to downy mildew (*Peronospora arborescens*) were used in a diallel analysis. The F_1s along with the parents were tested under three sowing dates for downy mildew infection index. Both additive and nonadditive gene actions were involved, the latter being more important. Interaction variances due to gca x dates were also significant. UO 185 and MOP 539 were good general combiners, while the cross NBPGR 1 x UO 185 was a good specific cross combination.

Key words: Combining ability, downy mildew resistance, opium poppy.

Improved varieties of opium poppy are highly susceptible to downy mildew [*Peronospora arborescens* (Berk) de-Bary]. The estimated loss ranges from 7 to 37% [1, 2]. Therefore, breeding for downy mildew resistance is a high priority research area to achieve stability in opium and seed yields. The present paper presents information on the nature of gene action in opium poppy for resistance to downy mildew.

MATERIALS AND METHODS

Four susceptible (MOP 278, NBPGR 1, IC 128, NOP 4), two moderately resistant (NBRI 3, UO 185) and two resistant (MOP 539, MOP 507) opium poppy varieties to downy mildew were crossed in a diallel fashion, excluding the reciprocals. The parents and the F_1s were planted in single row plot of 1.5 m length; the spacing of 30 x 10 cm. The experiment was planted in randomised block design with two replications on three dates, viz., 10, 16 and 22 November, 1988.

Sick field was created artificially by applying infected leaf powder of a highly susceptible variety JA 16 in the previous year at the rate of 10 g/m of running furrow just before sowing. Two rows of the susceptible variety were sown all along the border of the experimental field. Irrigation channels were made on both the sides of each block. Frequent irrigation was given and channels were kept filled with water for maintaining high humidity in the field. In addition, aqueous conidial suspension, prepared from heavily infected leaves of primary infected plants, was uniformly inoculated at the rate of ½ liter per row every week starting from 20-day seedling stage to flowering stage during early hours of morning.

The scoring for downy mildew was done on five random plants in each row at late flowering stage on a 0–5 scale [3]. Infection index was calculated [4] and the data subjected to angular transformation. Combining ability analysis was performed using the Griffing Model I, Method II [5]. Pooled analysis over environments was computed by the procedure of Singh [6, 7].

RESULTS AND DISCUSSION

The mean squares due to both general (gca) and specific combining ability (sca) were highly significant in all the three dates of sowing and in the pooled analysis (Table 1). This indicates the importance of both additive and nonadditive gene actions in the developments of this trait. Significant variance due to dates indicated that sowing dates influenced the incidence of downy mildew. The pooled analysis revealed significant gca x dates interaction, thereby indicating instability of gca over different environments. But the sca x dates interaction was nonsignificant, indicating a smaller effect of environments on the nonadditive gene effects.

MOP 539 and UO 185 showed significant and negative gca effects for downy mildew infection index in the pooled analysis as well as in the different dates of sowing, thus they are good general combiners for downy mildew resistance

Table 1. Combining ability analysis (mean squares) for downy mildew infection index in three environments in opium poppy

Source	d.f.	MS sowing dates : November 1988			
		10	16	22	pooled
Gca	7	170.1**	61.2**	63.5**	185.4**
Sca	28	40.4**	45.5**	35.3**	88.8**
Dates	2				397.0**
Gca x dates	14				54.7**
Sca x dates	56				16.2
Error	35	11.9	15.7	11.8	—
Pooled error	105				13.1
σ^2_A		25.9	6.3	11.3	38.6
σ^2_D		28.5	29.8	23.8	75.6

**Significant at 1% level.

Table 2. Estimates of general combining ability effects for downy mildew infection index in three environments in opium poppy

Parent	Gca effects on different sowing dates of November 1988			
	10	16	22	pooled
MOP 539	-8.90^{**}	-2.58^{*}	-3.65^{**}	-5.04^{**}
MOP 507	-2.39^{*}	4.10^{**}	1.79	1.16
MOP 278	2.07^{*}	1.70	2.51^{*}	2.27^{**}
IC 128	3.68^{**}	-0.20	2.18^{*}	1.89^{**}
NBPGR 1	2.81^{**}	2.39^{*}	1.14	2.11^{**}
NBRI 3	-0.43	-2.02	-0.30	-0.92
NOP 4	2.39	-2.39^{*}	0.26	0.08
UO 185	0.24	-1.00	-3.93^{**}	-1.56^{*}
SE (g_{ii})	1.02	1.17	1.02	0.70
SE (g_i-g_j)	1.54	1.77	1.54	0.94

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

(Table 2). MOP 278 x NOP 4, IC 128 x NBRI 3, MOP 278 x NBRI 3 and NBPGR 1 x UO 185 recorded significant and negative sca effects in pooled analysis and in one or more dates of sowing (Table 3). Similar results were reported from combining ability analysis for resistance to sorghum downy mildew [8] and downy mildew resistance in pearl millet [9].

Table 3. Crosses showing significant specific combining ability effects in the desirable direction for downy mildew infection index

Cross	Sca effects on different sowing dates of November 1988			
	10	16	22	pooled
MOP 278 x NBRI 3	4.70	-8.90^{**}	-5.37	-1.20
MOP 278 x NOP 4	-7.47^{*}	-8.90^{**}	0.86	-5.17^{**}
IC 128 x NBPGR 1	-7.06^{*}	-9.45^{**}	0.21	-5.44^{**}
NBPGR 1 x UO 185	-8.38^{*}	-4.46	-5.79	-6.22^{**}

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

The results indicated that additive as well as nonadditive components of genetic variability determined downy mildew resistance in the present material.

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