Environment & Ecology 27 (1A) : 378—380, 2009
 ISSN 0970-0420

Screening for Resistance to Mustard Aphid (*Lipaphis erysimi* Kalt.) in Indian Mustard

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Abstract

Mustard aphid (*Lipaphis erisimi* Kalt.) is the most serious pest of *Brassica* spp. In India it alone inflicts upto 96% of yield loss. Developing resistant cultivar has become a promising component of integrated pest management instead of chemical control. Finding an effective methods of screening for sources of resistance is the first step of developing resistant cultivar. In the present work, seven genotypes selected for aphid resistance and high yield under late sown condition, two early genotypes and one susceptible check were sown in split split-plot design with two replications in two dates of sowing and two protection levels. Screening was done on the basis of ratio of yield unprotected to yield protected, and on the basis of regression of yield unprotected to yield protected. The variance of yield unprotected / yield protected was significant at both the dates of sowing implying that genotypes differ significantly in their level of resistance. The regression analysis showed that a few genotypes tend to lie consistently above the line indicating their resistance to aphid. Significant variance of deviations indicated that genotypes did differ significantly in their levels of resistance.
Key words : Mustard aphid, Screening resistance, Indian mustard.

Mustard aphid (*Lipaphis erysimi* Kalt.) is the most serious pest of *Brassica* spp. in India. The yield losses caused by aphid were variable in different years and different locations depending upon the magnitude of its infection and climate of the area. Mustard aphid alone has been reported to inflict upto 96% of yield loss in *Brassica* spp. (1). Plant resistance to insects was used as a primary method of insect control long before the advent of synthetic inorganic insecticides. Complete dependence on pesticides in modern agriculture led to development of insect resistance to insecticide and increase in hazards of environmental pollution. Awareness to these problems have shifted dependence on chemical control to integrated pest management. In the over all context of integrated pest control, one of the most promising component of management is resistant cultivars (2). The first step in a breeding program for increasing the level of plant defense to insect attack is to identify sources of defense mechanisms. Efforts were made to develop efficient screening techniques in rapeseed and mustard by several authors (3, 4). Transfer of the resistance trait to a adaptive and high yielding background would be the next step in resistance breeding.

Methods

Seven genotypes selected for aphid resistance and high yield under late sowing conditions in the field for six successive years were used in the present study along with a susceptible check, PR-16. Two early genotypes were also included which were moderately resistant but low yielding. In all, ten genotypes were sown in a split split-plot design in two replications, the main plots comprised of two dates of sowing 7 November (D_1) and 21 November (D_2). The plot size of each main plot was approximately 6 m × 6 m. Each main plot was divided into four sub-plots. One sub-plot was sprayed with insecticide (protected) and the other was left as such (unprotected) in each replication at both the dates of sowing. Each sub-plot consisted of 10 sub-sub plots of two rows each and 2 m long. One border line was kept on both the sides of each sub-plot. Distance of 30 cm and 15 cm were maintained from row to row and plant to plant respectively. Fertilizers (NPK) were applied at the rate of 30 : 20 : 20 kg per hectare. Seeds of ten randomly selected plants harvested in both protected and unprotected plots of both the dates of sowing were collected as bulk and then seed yield/ plant was derived.

Table 1. Anova of yield unprotected / yield protected in each date of sowing. * Significant at 5% level.

Date of sowing	Source of variation	D	SS	MS	F
D_1	Replication	1	0.0238	0.0238	3.66
	Genotype	9	0.2986	0.0332	5.10*
	Error	9	0.0585	0.0065	
D_2	Replication	1	0.0252	0.0252	4.32
	Genotype	9	0.1372	0.0152	2.61*
	Error	9	0.0524	0.0058	

Screening for aphid resistance was done on the basis of ratio of yield unprotected to yield protected the unprotected yield/plant of each genotype in each replication (Yu) was divided by the protected yield/ plant of the same genotype (Yp) in the same replication. The new variable Yu/ Yp was then subjected to a randomized block analysis of variance with the genotype as treatment factor following Galway and Evans (5). A significant effect of genotype was taken to indicate that genotypes differ in their level of resistance.

On the basis of regression of yield unprotected on yield protected, the regression line of yield unprotected on yield protected was drawn after combining two dates of sowing. The deviations from the regression line were used as a measure of resistance. The new variable called R was then subjected to analysis of variance. A significant effect of genotype was taken to indicate that genotypes differ in their level of resistance. The regression analysis was performed using the mean of genotype of Yu on Yp based on Galway and Evans (5).

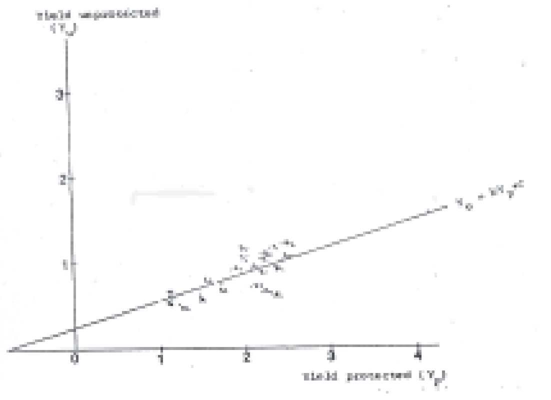

Figure 1. The regression of yield unprotected on yield protected combined over two dates of sowing. A, B,C and so on =genotypes; 1, 2 = replications; b=slope of regression line; c=intercept of regression line. A = P. R. -16; B= P.R. - 39-R; C = Rik-80-3-R; D=RLM-612-1; E= RW-351-3; F= P.R.-36-1; G=B-85-E; H = Appressed Mutant-E; J = KRV Bala-L; K=KRV Bala-2.

Table 2. Mean ratio of yield unprotected to yield protected.

Genotypes	Date of sowing D_1	D_2
PR-16	0.420	0.255
PR-39R	0.560	0.270
RIK 80-3-R	0.760	0.150
RLM 612-1	0.795	0.155
RW-351-3	0.805	0.255
PR 36-R	0.485	0.125
B-85-E	0.640	0.220
App. Mut. E	0.690	0.315
KRV Bala-L	0.680	0.390
KRV Bala-2	0.610	0.155
Mean	0.645	0.229
CD (5%)	0.18	0.17

Results and Discussion

The analyses of variance (Table 1) of yield unprotected / yield protected (Yu / Yp) were significant at both the dates of sowing which implied that genotypes differ significantly in their levels of resistance to aphid. In the first date of sowing high mean ratios (Table 2) were observed for the genotypes RW-351-3 and RLM-612-1 whereas in second date of sowing high mean ratios were observed for KRV Bala-L and App. Mut-E. This method seems to be less efficient in isolating the desirable genotype as it takes into account seed yield ratios only. Therefore, App. Mut-

Table 3. Slopes and intercepts of the regressions of yield unprotected on yield protected.

Date of sowing	Coefficient	Estimate
D_1	Slope	0.2895
	Intercept	0.6773
D_2	Slope	0.2353
	Intercept	–0.0009
Combined	Slope	0.3095
	Intercept	0.2465

Table 4. Anova of R-calculated for yield. * Significant at 5% level.

Date of sowing	Source of variation	Df	SS	MS	*F*
D_1	Replication	1	0.5753	0.5753	13.9*
	Genotype	9	0.7075	0.0786	1.90*
	Error	9	0.3709	0.0412	
D_2	Replication	1	0.0756	0.0756	3.01
	Genotype	9	0.5876	0.0653	2.60*
	Error	9	0.2259	0.0251	

E being a low yielder has given high mean ratio which in actual term is not a desirable genotype.

Regression Analysis. Another method of accounting for the dependence of Yu on Yp which makes fewer assumptions about the form of the relationship between these variables, is to regress Yu on Yp. The relationship between yield unprotected to yield protected combined over two dates of sowing is presented in Figure 1 and the corresponding regression coefficients were presented in Table 3. The scattered diagram indicated that the genotypes neither divided into two aribitrary groups nor was there any curvilinearity in the relationship between yield unprotected and yielded protected. The regression analysis is performed on two points from two replications, and therefore the residual sum of squares must be zero.A significant effect of genotype was taken to indicate that genotypes differ significantly in resistance. This means that a few genotypes tend to lie consistently above the regression line, and others, consistently below it. There are some genotypes which cluster closely around the regression line and explains its slope. Significant variance of deviations (Table 4) indicated that the genotypes did differ in their levels of resistance. The regression analysis combined over two dates of sowing showed (Fig. 1) that genotypes J (KRV Bala-L) and E (RW 351-3) lie above the regression line indicating their high yielding ability under unprotected level. All other genotypes including the check were inconsistent and therefore could be considered as susceptible to aphid. This result corroborates with the result obtained from screening on the basis of ranking of genotypes by Mahapatra and Sinhamahapatra (6).

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