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Screening of mustard genotypes for antixenosis and multiplication against mustard aphid, *Lipaphis erysimi* (Kalt) (Aphididae: Homoptera)

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Abstract
Assessment of antixenosis and aphids multiplication was carried out in the randomly selected genotypes of rapeseed against *Lipaphis erysimi* K. Selection of genotypes was based on our previous findings, categorized into different levels of resistance/susceptibility. Total of eight and six genotypes were randomly selected for antixenosis and aphid's multiplication test from the pool of different levels of resistance/susceptibility. In antixenosis test, 'G9' (16.9) and 'G29' (5.7) proved to be highly susceptible, while 'G28' highly resistant (3.8) (1.7) in terms of mean number of aphids per flower and mean number of aphids per pod, respectively. 'G9' proved to be highly susceptible (21.4) while 'G28' proved to be highly resistant (5.5) out of eight tested genotypes in mean number of total aphids per accession. In aphid multiplication test, genotype 'G9' produced maximum number of offspring (93.8) while 'G7' produced minimum number of aphids (61.2) as compared to other tested genotypes.

Keywords: Rapeseeds-mustard (*Brassica napus*), Mustard Aphid (*Lipaphis erysimi* Kalt.), Antixenosis, Aphids multiplication

1. Introduction

In Pakistan, cotton and rapeseed-mustard (*Brassica napus*) are the important sources of edible oil. Nationally, rapeseed-mustard is cultivated over an area of 219.5 (000) hectares with annual production of 191.9 (000) tones (886 kg per hectare), contributing up to 17% of the local edible oil production while in Khyber-Pakhtunkhwa it is grown on 17.1 (000) hectares. Rapeseed and mustard seed is a rich source of oil (46-48 %) and protein (43.6 %) and also an excellent feed for animals [25].

Brassica crops are susceptible to a number of insect pests including mustard aphid, *Lipaphis erysimi* Kalt., Cabbage aphid, *Brevicoryne brassicae* L., whiteflies, painted bugs, mustard leaf eater, thrips etc. in which aphids are the real and serious pest by contributing up to 70-80% of yield losses caused by all insect pests. Mustard aphid, *L. erysimi* (Aphididae: Hemiptera) is causing a maximum of 97.6% yield losses in brassica and is the one of the most prominent pest among the other insect pests [19]. Cabbage aphid cause 35-75% losses in yield [26] along with the 6% oil contents reduction [27]. The aphids feeding on the plant directly results in stunted growth, yellowing, wilting and distortion of plants while indirectly it transmit several diseases leading to huge losses. Both the adults and nymphs cause damage to mustard plant at vegetative, flowering and pod formation by sucking sap from the plant. In case of intense infestation leaves become curled, plant give up to develop pods; the young pods when developed do not get maturity and not able to produce healthy seeds. As a result, plant losses its health and growth is stunted [19].

Development of resistant varieties to the insect pests is an important tool of integrated pest management [6, 21] and effective access for the formulation of a rational policy of pest management. Several researchers have suggested the use of resistant varieties as one of the most promising methods of insect pests' management [5, 6, 15, 16, 22]. In host selection, the role of nutrients as attractants has been shown by many workers as attractant role of lecithin, sucrose and serine for *Leptinotarsa* by Hsiao [9]. Auclair [1] evaluated that the susceptible strains for aphids had higher contents of glutamine, homoserine and asparagine. The secondary metabolites or allelochemicals have impact on the growth, behaviour and survival of herbivores which might be toxins, repellents and insufficient nutrients or reduced digestibility components. Keeping the importance of resistance, a case study was designed for the exploration and identification of antixenosis (preference and non-preference) of *L. erysimi* to mustard crop and aphids multiplication at the Department of Plant protection, The University of Agriculture, Peshawar-Pakistan during 2013-2014.

Materials and Methods

Genotypes

A total of 46 genotypes of mustard were provided by the Institute of Biotechnology and Genetic Engineering (IBGE), The University of Agriculture, Peshawar-Pakistan for field resistance test against mustard aphid, *L. erysimi* and were categorized on the basis of their resistance results (Table 1.) [19]. Total of eight genotypes (G9, G4, G29, G21, G27, G7, G35, G28) were randomly selected from the Table 1 for antixenosis test while six genotypes (G7, G35, G28, G9, G27, G29) for aphids multiplication test.

Table 1: Frequency distribution of Brassica lines to aphid infestation (based on mean percent (%) infestation) under field condition, during 2013-14.

Categories	Accessions name	Mean % infestation of plants	Standard deviation	Coefficient of variation (%)
Highly resistant	G7, G28, G46	3.33	1.52	45.82
Resistant	G1, G27, G31, G35, G36, G37	16.82	2.42	14.38
Moderate	G3, G6, G11, G12, G14, G24, G25, G29, G30, G43	24.51	2.26	9.24
Susceptible	G2, G4, G5, G18, G19, G20, G22, G39, G45	33.47	3.00	8.97
Highly susceptible	G9, G10, G21	42.75	1.21	2.84

Mustard aphids

Mustard aphids, *L. erysimi* were collected from brassica plants grown in IBGE experimental field at New Developmental Farm (NDF), The University of Agriculture Peshawar.

Antixenosis

A free choice test was conducted in a completely randomized design (CRD) under laboratory conditions by providing aphids the excisions of eight randomly selected mustard lines plants (Table 2.). During test healthy and fresh inflorescences (7cm) and pods were cut and brought to the laboratory. One inflorescence and two pods of each genotype were kept randomly and spaced equidistantly in a circular pattern at the periphery of large clay pots (40cm diameter x 7cm height) followed by the release of starved 130 motile wingless aphids for four hours in the centre of the pot on paper. This process was repeated 10 times and data was recorded after 24 hours according to Wiseman [24] and Khan [10].

Aphid’s multiplication

The experiment for aphid multiplication was done on the randomly selected six brassica lines in a net house. Plants were raised in 10 cm square plastic pots and randomized in trays. Total six trays (replicates) were used. At 4-6 true leaf stage all the plants were infested with two wingless adult mustard aphids in clip cages and left overnight [23]. On the following morning, two new born nymphs were left undisturbed on the leaf and the adults along with the excess nymphs were removed. Aphids were replaced if they died within 24h. The total number of aphids produced in each clip cage for 18 days was recorded.

Data Analysis

The data obtained were subjected to ANOVA for testing significance by using the statistical package Statisitix 8.1 [2].

Results and Discussion

Antixenosis

During free choice test maximum number of 16.9 aphid/inflorescence was attracted by genotype ‘G9’ while minimum number 3.8 of aphids/inflorescence was recorded on genotype “G28” in terms of flower portion of the plant (Table. 2.). Similar conclusion was also derived by Bakhetia [4] and was because of either more vulnerability of flowering stage to aphid attack or the coincidence of flowering period with weather condition favours to aphid multiplication but in our case the weather parameters were not taken in consideration. In case of pod portion of the plants, maximum number of 5.7 aphid/pods was observed on genotype ‘G29’ and minimum number of 1.7 aphid/pod were recorded on plants of ‘G28’ genotypes. These attraction/deterrence qualities were further verified by counting the total number of aphid per accession. Thus, genotype ‘G9’ was statistically most preferred by *L. erysimi* (21.4/ accession) and proved highly susceptible among the tested genotype while genotype ‘G28’ retained minimum number of aphids (5.5/ accession) and found the least preferred to the pest. In antixenosis test the yellow inflorescence of mustard were found more attractive to the aphid as compare to the green pods. The vulnerability of aphid to yellow colour is also determined by Dilawari [8] who concluded that *L. erysimi* were attracted more towards yellow colour than green, red and white and the choice of yellow colour by aphids remained same throughout the day. Kundu [13] in his earlier study observed the flowering and pod initiation stages as the most favoured by aphids. Our results tally with Kumar [12], who mentioned the preference of *L. erysimi* on excised leaves of *Brassica* species and revealed that the mustard aphid showed maximum preference to BSH-1 while *B. fruticulosa* was recorded as least preferred, followed by AD-4 with the number of aphid settled on circular leaf bits of these genotypes after 24 and 48hr in antixenosis test. These results are also in agreement with Saljoqi [18], however, his research was on potato aphid but the antixenosis test was significantly different on resistant cultivars compared to the susceptible cultivars. Results of this study suggest that genotype ‘G28’ proved clear antixenosis having minimum attraction of 5.5 aphids throughout the test period while genotype ‘G9’ served as the most susceptible, supported 21.4 number of aphid per accession. Our results are in agreement with many such researchers who worked with *Brassica* plants and found highly resistant to aphid while different species of *Brassica* showed diversity in their relation to *L. erysimi* from highly susceptible to highly tolerant [3, 7, 11, 17, 20,].

Table 2: Free choice antixenosis test of mustard genotypes to mustard aphid *Lipaphis erysimi* (Kalt.) under laboratory conditions, during 2013-14.

Accessions name	Mean no of aphids on flower	Mean no of aphids on pods	Mean no of total aphids per accession
G9	16.9a	4.5ab	21.4a
G4	10.7b	3.5bc	14.2b
G29	8.3bc	5.7a	14b
G21	9.7bc	2.4cde	12.1bc
G27	7.6c	3.1cd	10.7c
G7	7.7c	2.1de	9.8cd
G35	4.8d	2.5cde	7.3de
G28	3.8d	1.7e	5.5e
LSD (0.05)	2.46	1.30	2.94
CV	31.72	45.87	27.81

Aphid's multiplication

Maximum numbers of 93.8 offspring were produced on accession "G9" as susceptible while on plants of genotype 'G7', lower number of 61.2 aphid were produced and proved statistically significant resistant as compared to the other tested plants. The differences in multiplication rate of *L. erysimi* among the mustard varieties were also observed by Mamun [14] which ranged from mean value of 40 to 157.7 aphids per plant for 10 days after infestation. They released unknown number of aphid but in our case, there were two aphids and infested plants were kept for more than two weeks.

Table 3: Multiplication response of *Lipaphis erysimi* K. on randomly selected mustard genotypes, during 2013-14.

Genotypes	Progeny produced by *L. erysimi* (Kalt.)	Standard Deviation	Coefficient of variance
G7	61.2 d	10.16	16.62
G35	73.7 bcd	13.38	18.16
G28	65.5 cd	14.91	22.76
G9	93.8 a	9.78	10.42
G27	79.0 bc	13.17	16.67
G29	81.2 ab	9.06	11.16
LSD (0.05)	14.1		

Conclusion

Free choice antixenosis test reveals that overall genotype 'G9' proved to be highly susceptible and 'G28' as highly resistant out of total eight randomly selected genotypes while in multiplication test 'G7' proved to be least preferred and 'G9' to be most preferred genotype in total of six randomly selected genotypes.

The use of moderately resistant genotypes should be incorporated with highly resistant cultivars in future cropping system to minimize insecticides uses, encourage biological control agents and to avoid selection pressure. Highly resistant genotypes may be used standard in future screening/breeding program. Highly susceptible genotypes may be used as standard in future insects rearing program.

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