RELATIVE ABUNDANCE OF APHIDS POPULATION ON DIFFERENT BRASSICA GENOTYPES

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ABSTRACT

Twelve Brassica genotypes i.e. Westar, Ganyou-5, Rainbow, Oscar, Vangard, Crusher, Torch, Legend, Altex, Raya Anmol, Peela Raya and T-16-401 representing four Brassica species including B. napus, B. juncea, B. carinata and B. campestris were tested for aphid's density and yield in the Research Farm of The University of Agriculture, Peshawar, Pakistan. Data on aphid's density showed that average aphid's density per plant on 12 brassica genotypes during 2006-07 and 2007-08 was at peak during the 2nd and 3rd weak of January. The aphid density 37.94, 34.87, 30.47, 27.57, 26.86, 25.39, 24.89, 23.55, 23.41, 21.57, 18.42 and 12.84 aphids plant-1) were recorded on Legend, Ganyou-5, Oscar, Raya Anmol, Rainbow, Torch, T-16-401, Peela Raya, Westar, Altex, Crusher and Vangard, respectively. Statistically there were significant differences in the number of aphids per plant among the genotypes. Non of the genotype was found completely free from aphids attack. Vangard with minimum (12.84) aphids /plant was the most tolerant followed by Crusher, Altex, Westar, Peela Raya, T-16-401, Torch, Rainbow, Raya Anmol, Oscar, Ganyou-5 while Legend as most susceptible, in the order. Peela Raya had moderately high density of aphids per plant.

Keywords: **Aphids, Brassica Genotypes, Relative Resistance**

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INTRODUCTION

Pakistan is constantly scarce in production of edible oil and meets its requirements through import from other countries which cost an enormous amount of foreign exchange. Its import bill is continuously the second largest after petroleum and constitutes the single largest expenditure on any of the imported food items. During 2009-2010, Pakistan imported 1.246 million tones of edible oil that cost 77.78 billion rupees (MINFA, 2010). An additional amount of Rs. 24.368 billion was spent on the import of seed by solvent industry for crushing during the said period, thus the total import bill was further raised. In Khyber Pakhtunkhwa (KPK), Rapeseed and Mustard is grown on 17.7 thousand hectares with total production of 7.4 thousand tones. Its average yield is 418 kg hectare^{-1} (MINFA, 2009), which is even less than the national average yield (812 kg ha^{-1}), indicating a serious need to improve the yield at least to the level of national yield. The factors responsible for low yield have been identified as the lack of suitable varieties and several abiotic and biotic environmental stresses; the more important are insect pests, diseases, drought and frost (Swati, 2005 and USDA, 2011). This huge edible oil expenditure can only be reduced by improving the domestic oilseed production and developing more local varieties that are resistant to insect pest and give more production.

Lipaphis erysimi (Kaltenbach), *Brevicoryne brassica* (L.) and *Myzus persicae* (Sulz.) are the most important aphid species attacking rape and mustard crops and causing tremendous losses from 70-80% (Swati, 2005; Wiess, 1983; Landian, 1982; Bakhetia and Ghorbandi, 1987).

One of the important methods to manage insect pest population is by developing plant varieties resistant to insects through various breeding procedures. Many insect-resistant crop varieties have played vital, integral roles in sustainable systems of agricultural production. Resistant varieties are nonpolluting; ecologically, biologically, and socially acceptable; and economically feasible as a means of pest control. Plant resistance to insects is defined as "the relative amount of heritable qualities possessed by the plant that influence ultimate degree of damage done by the insects". Practically it is the performance of a cultivar to produce more of a good quality compared to other cultivars under similar insect population level (Painter, 1951).

Resistant varieties constitute the choicest tactic to control or suppress pest damage to crops to a worthwhile low level. They serve as an ideal component of an integrated pest management (IPM) programme. They can be very cost effective, usually environmentally safe and involve no elaborate technology transfer to the farmers. Their effect is relatively stable. Resistant varieties are generally compatible with other pest management approaches including chemical, biological, cultural and other control methods. Normally adverse weather does not alter the action of resistant varieties as is often experienced with biological and chemical control. They provide an inherent mechanism

of crop protection against the pest. Apparently, aphid resistant varieties of brassica oilseeds would provide an ideal way for managing aphid menace (Swati, 2005). When a good resistant variety is available, a farmer may not have to change his desirable cultural practices or pay the costs of insecticides (Packard and Martin, 2010).

In Pakistan, a number of efforts have been undertaken to improve the rapeseed-canola cultivars to improve the quality, production and resistance against aphids. In this respect new genotypes and varieties have been evolved and tested in different parts of Pakistan. The new genotypes are better in quality, oil contents and vigor (Swati, 2005). In the present study these genotypes were tested for resistance against aphid's attack and population built-up.

MATERIALS AND METHODS

The experiments were conducted at the Research Farm of The University of Agriculture, , Peshawar, Pakistan during 2006-08. Twelve different brassica genotypes representing from brassica species including *Brassica napus*, *Brassica juncea*, *Brassica carinata* and *Brassica campestris* obtained from the Institute of Biotechnology and Genetic Engineering (IBGE), The University of Agriculture, Peshawar, Pakistan (Table-1). The genotypes were grown in randomized complete block design with four replications. Each row was 5 m long and the plot size was 5x4 meters. The plant to plant and row to row distance was 30-40 cm and 75 cm, respectively. Recommended agronomic practices were applied.

Table 1. ***List of genetically diversified brassica genotypes tested against aphids during 2006-08***

S.No.	Brassica Genus	Genotype
1	Brassica napus	Westar
2	B. napus	Ganyou-5
3	B. napus	Rainbow
4	B. napus	Oscar
5	B. napus	Vangard
6	B. napus	Crusher
7	B. napus	Torch
8	B. napus	Legend
9	B. napus	Altex
10	Brassica juncea	Raya Anmol
11	Brassica carinata	Peela Raya
12	Brassica campestris	T-16-401

Fertilizers were applied at the rate of 75 kg nitrogen and 60 kg phosphorous ha^{-1} at the time of sowing. Thinning was carried out after 30 days of emergence and crop was harvested at maturity.

Population of aphid was recorded from the plant emergence to crop maturity. The data on aphids population was recorded at 10 days intervals, commencing from first occurrence of pest and continued till the infestation ceased (second week of March). For recording aphids' population, both the winged and wingless adults and nymphs were counted from the selected plants. Population counts were made on per plant basis, by recording the aphids' number from lower leaves, middle leaves and top 5 cm apical portion from ten randomly selected plants from two central rows of each plot.

The recorded data were converted to mean values to have the population estimation on per plant basis. Data were analyzed statistically using analysis of variance techniques as described by Steel and Torrie (1980). Duncan's Multiple Range Test was used to check the differences among treatment means.

RESULTS AND DISCUSSION

Aphid's density Plant^{-1} on 12 Brassica Genotpes during 2006-07

The results in Table 2 revealed that aphids density on 15th February, 2007 was highest (37.53 aphids plant^{-1}) on Legend and lowest (7.67 aphids plant^{-1}) on Vangard. On 25-02-07 the highest aphid's density (69.25 aphids plant^{-1}) was on Legend and the lowest (15.00 aphids plant^{-1}) on Vangard. On 08-03-07 aphids density was highest (41.67 aphids plant^{-1}) on Legend and lowest (8.17 aphids plant^{-1}) on Vangard. On 18-03-07 highest number of aphids (19.56 aphids plant^{-1}) was recorded on Raya Anmol and lowest on Crusher (3.35 aphids plant^{-1}). On 28-03-2007 the highest aphids density was on genotype Rainbow (10.25 aphids plant^{-1}) and lowest on Vangard (2.92 aphids plant^{-1}). The overall mean density of aphids was highest on Legend (34.56 aphids plant^{-1}) and lowest on Vangard (7.57 aphids plant^{-1}).

Table 2. *Mean aphid's density/plant on different brassica genotypes during 2006-07*

S.No.	Genotypes	Mean number of aphids/plant on brassica genotypes on different dates					Mean
		15-02-07	25-02-07	08-03-07	18-03-07	28-03-07	
1.	Westar	13.82 def	28.33 c	14.58 ef	5.082 cd	3.42 ab	13.05 ef
2.	Ganyou-5	15.02 cdef	16.63 c	21.92cde	6.50b cd	3.75 ab	12.76 ef
3.	Rainbow	10.32 ef	19.27 c	13.58 ef	5.88b cd	10.25 a	11.86 fg
4.	Oscar	16.42 cdef	50.58 b	27.17 cd	8.75 bcd	6.64 ab	21.91 bc
5.	Vangard	7.67 f	15.00 c	8.17 f	4.10 d	2.92 b	7.57 g
6.	Crusher	26.25abcd	19.79 c	17.69 def	3.35 d	3.61 ab	14.14 def
7.	Torch	8.14 ef	57.75 ab	29.83 bc	9.75 abcd	7.875 ab	22.67 b
8.	Legend	37.53 a	69.25 a	41.67 a	15.39 abc	8.98 ab	34.56 a
9.	Altex	12.48 ef	30.58 c	25.00 cd	15.88 ab	3.59 ab	17.51 bcde
10.	Raya Anmol	20.46bcde	66.67 ab	37.80 ab	19.56 a	4.36 ab	29.77 a
11.	Peela Raya	30.54 ab	26.41 c	18.86 de	5.38 bcd	3.15 b	16.87 cdef
12.	T-16-401	27.22 abc	31.17 c	18.42 de	10.95abcd	3.80 ab	18.31 bcd

Means within a column followed by similar letters are non-significantly different at 5% level of probability (LSD test).

Statistical analysis of the data (Table 2) showed that non-significant differences in aphid population were recorded on Legend, Crusher, Peela Raya and T-16-401 on 15-02-07. On 25-02-07 aphid population was non-significantly different on Legend, Torch and Raya Anmol. On 08-03-07, Legend and Raya Anmol were non-significantly different. On 18-03-07, Raya Anmol, Torch, Legend, Altex and T-16-401 were non-significantly different. On 28-03-07 all genotypes were non-significantly different except Rainbow and Vangard which were significantly different from each other. Over all for the year 2006-07 Legend and Raya Anmol had the highest aphid's density, which were non significantly different from each other. Vangard had the lowest aphid's density which was significantly different than the other genotypes.

Aphid's Density Plant^{-1} on 12 Brassica Genotypes during 2007-08

The results (Table 3) revealed that during the year 2007-08 highest aphids density on 5-02-08 was recorded on Ganyou-5 (44.31 aphids plant^{-1}) and lowest on Raya Anmol (5.04 aphids plant^{-1}). On 15-02-08 highest aphid's density was on Ganyou-5 (105.8) and lowest on T-16-401 (21.78 aphids plant^{-1}). On 25-02-08 highest aphid's density was on genotype T-16-401 (85.73 aphids plant^{-1}) and lowest on Legend (14.25 aphids plant^{-1}). On 05-03-08 highest aphid's density was recorded on Ganyou-5 (61.00 aphids plant^{-1}) and lowest on Vangard (10.83 aphids plant^{-1}). On 15-03-08 highest number of aphids per plant was recorded on Ganyou-5 (50.04 aphids plant^{-1}) and lowest on Vangard (3.13 aphids plant^{-1}). The overall mean density of aphids for 2007-08 was highest on Ganyou-5 (56.97 aphids plant^{-1}) and lowest on Vangard (18.10 aphids plant^{-1}).

Analysis of the data showed that on 05-02-08 Ganyou-5 had significantly highest aphid's density. This was followed by Legend which was non-significantly different than Rainbow and Westar in number of aphid's density. Raya Anmol had the lowest aphid's density which was non-significantly different than Altex and T-16-401. On 15-02-08, Ganyou-5 had the highest aphid's density which was non-significantly different than Legend, Oscar and

Rainbow. While T-16-401 had the lowest aphids density that was non-significantly different than Raya Anmol, Peela Raya, Torch, Altex and Crusher. On 25-02-08 T-16-401 had significantly the highest aphids density followed by Raya Anmol which was non-significantly different than Altex and Torch. Legend had the lowest aphid's density which was non-significantly different than Westar, Ganyou-5 and Vangard.

Table 3. ***Mean number of aphids/plant on different brassica genotypes during 2007-08***

Name of Genotype	Mean number of aphids/plant on brassica genotypes					Overall mean aphids density/plant
	5-02-08	15-02-08	25-02-08	05-03-08	15-03-08	2007-08
Westar	21.81 bcd	63.42b c	23.88 hi	42.42 bc	17.38 cde	33.78 bcd
Ganyou-5	44.31 a	105.8 a	23.69 hi	61.00 a	50.04 a	56.97 a
Rainbow	22.39 bc	84.21 ab	30.54 fgh	37.83 cd	34.31 b	41.85 b
Oscar	15.32 ef	82.58 ab	39.83 efg	27.50 cde	29.92 bc	39.03 bc
Vangard	11.24 fg	37.17 cd	28.17 ghi	10.83 e	3.13 f	18.10 f
Crusher	10.66 g	35.29 d	51.08 cde	10.88 e	5.58 ef	22.70 ef
Torch	17.86 de	41.79 cd	57.63 bcd	14.17 e	9.13 def	28.11 de
Legend	25.85 b	97.83 a	14.25 i	57.04 ab	11.58 def	41.31 b
Altex	7.66 gh	33.67 d	58.96 bc	16.38 e	11.52 def	25.64 def
Raya Anmol	5.04 h	29.04 d	66.40 b	17.50 e	8.86 def	25.36 def
Peela Raya	21.08 cd	41.96 cd	44.25 def	23.58 de	20.23 cd	30.22 cde
T-16-401	7.53 gh	21.78 d	85.73 a	20.63 de	21.63 bcd	31.46 cde

Means within a column followed by similar letters are non-significantly different at p=0.05(LSD test).

On 05-03-08 Ganyou-5 had the highest aphids which were non-significantly different than Legend. Vangard had the lowest aphid's density which was non-significantly different than crusher, Torch, Altex, Raya Anmol, Peela Raya and T-16-401 and Oscar. On 15-03-08 Ganyou-5 had significantly the highest aphid's density followed by Rainbow, Oscar and T-16-401, which were non-significantly different in aphid's density. Vangard had the lowest aphid's density which was non-significantly different than Crusher, Legend, Raya Anmol, Altex and Torch. Over all for the year 2007-08 Ganyou-5 had significantly highest aphid's density. It was followed by Rainbow, Legend, Oscar and Westar. Lowest aphid's density was recorded in Vangard, which was non-significantly different than Crusher, Raya Anmol and Altex.

Mean aphid's density plant^{-1} on 12 brassica genotypes during 2006-07 and 2007-08

The results in Table 4 show that on the basis of two years mean data on 12 brassica genotypes highest aphids density per plant was recorded for Legend (37.94 aphids plant^{-1}) which was significantly different than all the other genotypes. The lowest aphids density was found on Vangard (12.84 aphids plant^{-1}), which was also significantly different than the other genotypes.

The aphid frequently reported on Brassica in this area is Mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Agarwala and Datta, 1999; Siraj-ud-din, 2000). Aphids appeared on different brassica genotypes in the 1st and 2nd week of February in 2008 and 2007, respectively. During cropping season 2006-07 aphids' population started appearing during the 2nd week of February 2007 and reached the maximum in third week of February 2007. In 2007-08 aphids population started appearing during the first week of February and reached at maximum level during the third week of February. After that, its population decreased gradually, until it reached at minimum level during the 4th week of March during 2007 and second week of March during 2008. Aslam *et al.* (2005) indicated that aphids' population in Brassica fluctuated over time. During the last week of January Aphids' population started and reached to maximum during the third week of February, and declined during the second week of March. The difference could be due to variation in temperature and overall weather.

The present results agree with Amjad (2007). He recorded the 2nd and 3rd week of February as most suitable time for the propagation of aphid population (136.47 per 10 cm inflorescence) and (134.33 per 10 cm inflorescence), respectively. The observation on seasonal incidence of aphids are in conformity with findings of and Pal (2009) who observed that aphids infestation was at peak during 2nd and 4th weak of February. Amer et al. (2009) recorded highest aphid's population during last week of February to second week of March that is in conformity with the present findings.

The results of experimental trials on the performance of brassica genotypes are presented in the Table 2-4. From the perusal of results, it appears that no genotype was completely free of aphid's infestation. All the genotypes varied in degree of aphids' density and showed different response towards holding aphid's infestation under the field conditions due to which they are easy to mark as susceptible or resistant. Vangard exhibited high tolerance to aphids (12.84 aphids plant-1) which was followed by Crusher (18.42), Altex (21.57), Westar (23.41) and Peela Raya (23.55) while, T-16-401 (24.89), Torch (25.39), Rainbow (26.86), Raya Anmol (27.57) and Oscar (30.47) were moderate in sensitivity against aphids. Legend (37.94) and Ganyou-5 (34.87) had highest mean number of aphids. Therefore, genotype Vangard may be regarded as tolerant and Legend as susceptible genotype to aphids.

Table 4. ***Mean aphids density/plant on different brassica genotypes during 2006-07 and 2007-08***

Brassica Type	Name of Genotype	Aphids density (2007)	Aphids density 2008	Overall mean Aphids density
B. napus	Westar	13.05 ef	33.78 bcd	23.41 def
B. napus	Ganyou-5	12.76 ef	56.97 a	34.87 ab
B. napus	Rainbow	11.86 fg	41.85 b	26.86 cde
B. napus	Oscar	21.91 bc	39.03 bc	30.47 bc
B. napus	Vangard	7.57 g	18.10 f	12.84 g
B. napus	Crusher	14.14 def	22.70 ef	18.42 f
B. napus	Torch	22.67 b	28.11 de	25.39 cde
B. napus	Legend	34.56 a	41.31 b	37.94 a
B. napus	Altex	17.51 bcde	25.64 def	21.57 ef
B. juncea	Raya Anmol	29.77 a	25.36 def	27.57 cd
B. carinata	Peela Raya	16.87 cdef	30.22 cde	23.55 def
B. campestris	T-16-401	18.31 bcd	31.46 cde	24.89 de

Means within a column followed by similar letters are non-significantly different at p=0.05(LSD test).

Our results are in concurrence with those of Jatoi *et al.* (2002). They found Oscar as intermediately susceptible and Crusher relatively resistant among 22 cultivars of *Brassica napus* against turnip aphid, *Lipaphis erysimi* Kalt. Mamun *et al.* (2010) concluded that the resistant variety had lower aphid infestation. Vangard had less aphid population showed some degree of resistance as compared to the other varieties. Khattak and Hamed (1993) reported that susceptibility of a crop to insect pest depended on multiple factors including biotic, abiotic and ecological. The most important amongst these could be the crop genetic potential, insect species and the prevailing environment. Sarwar *et al.* (2004) reported per plant aphid's population for Westar (98.40), Rainbow (44.92) and Oscar (76.77) as compared to 23.41, 26.86 and 30.47 aphids plant^{-1} in the present study, respectively confirming similar pattern. Aslam *et al.* (2005) observed that none of the variety was completely free from aphid's infestation among the ten tested canola varieties. Maximum mean aphid population was recorded on con-I (57.8), followed by Oscar (55.9 aphids), Con-III (50.5 aphids), Dunkeld (48.9), Shiralee (45.5 aphids), Westar (41.9 aphids), Con-II (41.6 aphids), Rainbow (36.9 aphids) and Abaseen (35.7 aphids). In comparison we had in our study 30.47 aphids plant^{-1} on Oscar, 23.41 aphids plant^{-1} on Westar and 26.86 aphids plant^{-1} on Rainbow, respectively, showing perfect parity with results of Aslam *et al.* (2005). Khan and Begum (2005) concluded from an experiment on 6 canola varieties that none of the variety was resistant/tolerant to the attack of aphids. Aphid population started in 3rd week of December and reached to its peak in 4th week of February due to optimum environmental temperature. The results are similar to ours except the difference in start and end date of aphids population due to weather conditions. Malik (1988) tested *B. juncea*, *B. napus*, *B. nigra* and 3 cultivars of *B. compestrus* their resistance against *L. erysimi* in India during 1973-75. All of the tested cultivars were found susceptible to the attack of *L. erysimi*. This is also in conformity with our results that none of the genotype showed absolute resistance against aphids.

Our result disagree with Choudhury and Pal (2009). They stated that *B. campestris* varieties as a group harbored relatively higher populations of aphid than *B. juncea* varieties. In our case *B. juncea* group harboured more aphids than *B. campestris*, however the difference was non significant. Also, our results were contrary to those of Gill and Bakhetia (1985). They found fewer aphids on all *B. napus* than on *B. campestris*. Our results showed more aphids on some genotypes in *B. napus* than *B. Campestris*. Amjad et al. (1999) found significantly high reproduction on *B. campestris* and *B. napus* than *B. juncea* and *B. carinata*. In our results *B. juncea* had more aphids population than *B. napus, B. campestris* and *B. carinata*, however, the difference among the aphid population among the different groups was non significant. Amer (2009) found all the varieties evaluated susceptible against two aphid species (*B. brassicae* and *L. eyrsimi*.) that were significantly similar in Population. Our result also agree with

Vekaria and Patel, (2000) who found no genotype immune against any of the forty promising Brassica and allied genotypes against mustard aphid, *Lipaphis eysimi* (Kaltenbach). However, our results do not agree with their statement that Mustard genotypes belonging to *B. campestris* group were more susceptible to aphid than that of *B. juncea*. Our result agrees with Amjad (2007) who found *B. napus* (var. Bubul-98) susceptible to *B. campestris* (var. Peeli Sarson).

CONCLUSION AND RECOMMENDATIONS

All the genotypes were infested with aphids and no one was completely free of aphid's infestation means that non of the genotype was absolutely resistant. The aphids appeared in late January or early February and after reaching to its peak at the end of February or first week of March its population was decreased. The differences in aphids population can be attributed due to variations in their genetic make up. The genotype Vangard with 18.10 aphids plant^{-1} was least preferred by aphids over other genotypes. It can be of significant importance in varietals introduction programme as a source of resistance for further improvement of Brassica germplasm. This resistant genotype may help to minimize the possible use of insecticides and to improve future integrated pest management programme. In the 2nd and 3rd week of February close attention should by paid to the aphids appearance on the brassica and control measures applied if necessary.

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