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GENOTYPIC RESPONSE IN CANOLA (*BRASSICA* SPECIES) AGAINST APHID (APHIDAE: HOMOPTERA) ATTACK

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Present research work reports the results of work done, by determining the relative degree of responses of 12 canola genotypes (namely, Waster, CON I, CON II, CON III, Abasin-95, Dunkled, Rainbow, Shiralee, Hyola-42, Hyola-308, Hyola-401 and Oscar) against aphids' infestation, under field conditions. In order to understand genotypic response, parameters with respect to incidence of aphids' infestation and seeds yield obtained were recorded. Data pertaining to yield parameter as affected by different aphids infestation revealed that response of various genotypes were variable. The abundance of aphids was the least on Rainbow (44.92 aphids per plant), while, the most on CON. III (130.6 aphids per plant). Rainbow gave the better yield performance (3330.0 Kg/ha), while; the least yield (1720.0 Kg/ha) was obtained from genotype Hyola-401.

Keywords: Aphids, Canola, *Brassica,* Infestation, Host plant resistance

1. Introduction

The name "Canola" refers to cultivars of either species that produce seed with lower levels of glucosinolates and erucic acid than rapeseed cultivars. In Pakistan, "Canola" (*Brassica napus* L. and *B. campestris* L.) is attaining the status of leading oilseed crop, both as a source of edible oil for human and a protein supplement for animals. It is cultivated throughout the country, either alone as main crop or mixed with the other winter crops. The total canola area (223 thousand acres) and total production of the crop (136 thousand tons oilseed and 52 thousand tons oil) are lower than the other oil producing countries [1]. Low yield of crop is generally due to poor management, low yielding varieties and insufficient precipitation. Increasing the production of the crop through the acreage expansion has a limited scope in our country due to competition with other crops. Some efforts can be made to increase production through vertical expansion, which can be achieved by utilizing improved varieties and management practices.

Canola crop is heavily attacked by aphids, which cause poor growth and low yield. Under favourable conditions, their populations multiply very rapidly and they form dense colonies on plants. Hamid and Ahmad [2] reported that in Pakistan, winter oilseed *Brassica* crops are attacked by *Lipaphis erysimi* (Kalt.) and to a lesser extent by *Brevicoryne brassica* (L.) and *Myzus persicae* (Sulz.). Rustamani *et al.* [3] reported the aphids as the most important insect pests, causing 70-80% losses in yield.

The mustard aphid, *Lipaphis erysimi* (Kaltenbach) is a serious pest of rape and mustard in tropical regions of the world; its population reaches an asymptote when the crop is about 70 days old. This aphid has become one of the primary pests of fall- and spring-seeded canola and pressures just prior to and during bloom, aborts flower buds, deforms developing pods, and generally saps vigor from plants resulting in yield losses of upto 40 percent in untreated fields Agarwala and Datta [4].

Presently, the resistance of the host plant has been known to reduce the insects' population effectively. The performance of recently developed cultivars of canola on farmer fields is yet to be known against insects' infestation. The present study was therefore, conducted to evaluate the comparative susceptibility of different canola genotypes to aphids attack under natural field conditions.

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2. Materials and Methods

The present study was conducted during the years 2000-2001 and 2001-2002 at the NIA Tandojam. Twelve canola genotypes viz., Waster, CON I, CON II, CON III, Abasin-95, Dunkled, Rainbow, Shiralee, Hyola-42, Hyola-308, Hyola-401 and Oscar were sown in RCB design with 3 replications. All these genotypes were collected from Plant Genetics Division of this Institute. The unit plot size was 2.5 meter square. Normal agronomic practices were followed for the whole experiment. The crop was raised on fine, leveled and well-prepared seedbed, sown in rows, 30 cm apart. Fertilizers used were nitrogen and phosphorus applied at recommended doses. About 3 weeks after the seedling emergence, the plants were thinned to a distance of 10 cm apart. Hand weeding method was used to control weeds. The first irrigation was done one month after sowing and subsequent irrigations at 3 weeks intervals. Crop matured in about 175 days and was harvested when about 75% of the pods turned yellowish. The experimental field was left open to natural infestation of insect pests and no protective measures were undertaken against the insect pests. The resistance or susceptibility responses in the test genotypes were determined by recording aphids population and seed yield, which were reliable criteria. Observations on aphids' population appearance were started 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 (last week of January to second week of March). For recording aphids' population, both the winged and wingless adults and nymphs were counted from the selected plants. For data recording, aphids population was recorded from each of 5 randomly selected plants in every replicate. Population counts were made on per plant basis, by recording the aphids' number from leaves, stem and inflorescence. Collected data was then transformed to mean value to have the population estimation on per plant basis. After the crop was harvested and threshed, the seed yield was recorded. Aphids' population levels on the crop denoted the damage to the plants and potential for yield. Data thus, obtained was analyzed statistically to compare the mean values of both the interactions using analysis of variance techniques as described by Steel and Torrie [5], and Duncan,s Multiple Range Test was used to check the differences among treatment means. .

3. Results and Discussion

The results of observational trials on the performance of canola genotypes are presented in the Tables 1 to 3. From the perusal of results, it appears that all the genotypes were varied in degree of aphids' population and yield potential, which are discussed in the ensuing lines.

3.1. Aphids population

The mustard aphid, *Lipaphis erysimi* was the most frequented aphid species in the experimental site. During the years (2001 and 2002), the summaries of aphids' populations on different genotypes have been presented in Figures 1 and 2, respectively.

Both the figures apparently indicated that aphids' population was fluctuated when mean values for both the years were compared. Aphids' population started appearing during the last week of January and reached at peak during the third week of February, but declined during the second week of March (Fig. I). Aphids appeared during the first week of February and reached at maximum level during the third week of February. Thereafter, its population dwindled gradually, until it reached at minimum level during the second week of March (Fig. 2).

For both the years, pooled population estimates (2 seasons mean) indicated that a fluctuated and skewed pattern of aphids' infestation ranging from 47.79 to 184.5 aphids was observed. In general, it appeared on different canola genotypes during the last weeks of January and first of February, respectively. Its infestation increased gradually and attained the peak levels during the third week of February. Afterward, the pest was the least abundant, until it reached at lower level during the second week of March. At crop maturity stage (third week of March), all the genotypes were relatively free from infestation of this insect and the population was either not observed or very rarely encountered afterward. Of course, it may be due to the combination of different biotic and biotic resistances but no single factor was responsible for it. But the key factors contributing towards population fluctuation were temperature (ranged from 13.14 to 30.96 ^{0}C, and 13.75 to 30.82^{0}C) and relative humidity (varied from 63.29 to 60.33%), due to variations in these factors (Table 2) the pest population fluctuated accordingly (from 47.79 to 93.67, and 28.27 to 184.5 aphids) during the years 2001 and 2002, respectively.

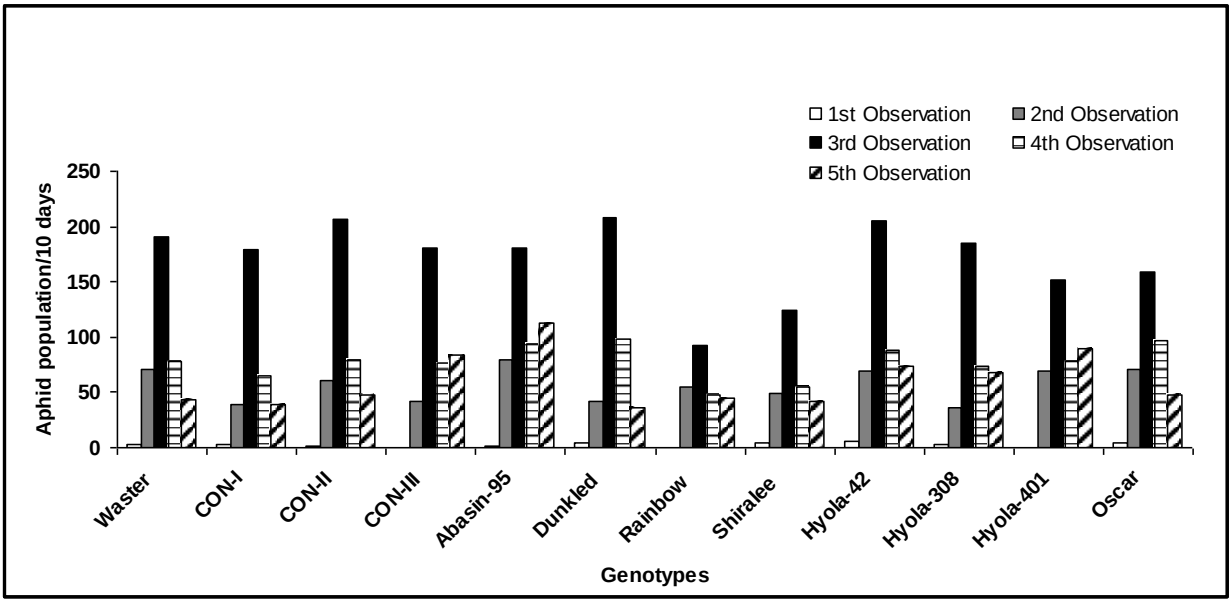

Figure 1. Aphids population on different Canola genotypes recorded at 10 days interval during 2001

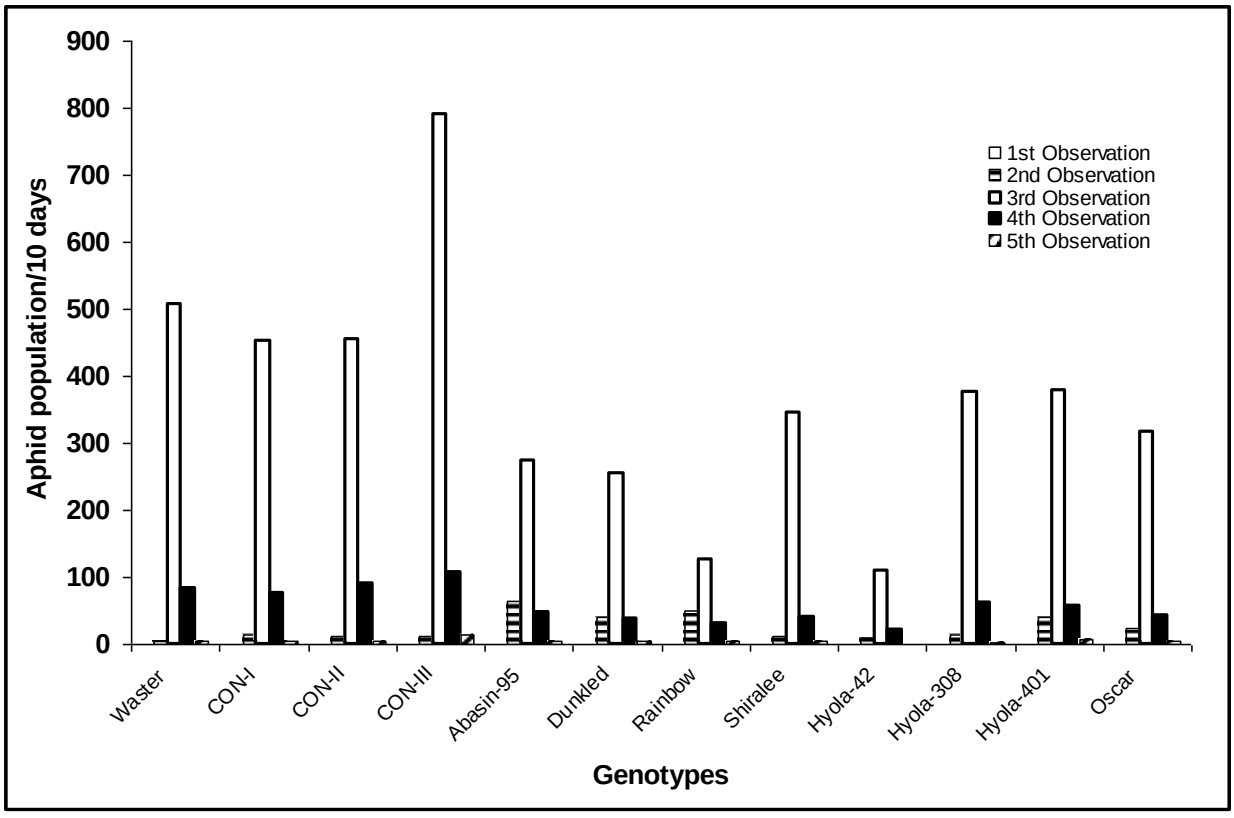

Figure 2. Aphids population on different Canola genotypes recorded at 10 days interval during 2002

Table 1. Mean aphids population on different canola genotypes during the years 2001 and 2002

Name of genotypes	Aphids population per plant 2001 (No.)	Aphids population per plant 2002 (No.)	Aphids population per plant (Pooled) (No.)
Waster	76.92 abc	119.9 b	98.40 b
CON-I	64.67 cd	109.7 bc	87.17 bc
CON-II	79.22 abc	112.8 bc	96.01 b
CON-III	76.58 abc	184.5 a	130.6 a
Abasin-95	93.67 a	78.00 efg	85.83 bcd
Dunkled	77.67 abc	67.80 fg	72.73 ef
Rainbow	47.79 de	42.05 g	44.92 h
Shiralee	55.0 d	80.53 def	67.77 fg
Hyola-42	88.50 ab	28.27 h	58.38 g
Hyola-308	73.06 bc	91.27 de	82.16 cde
Hyola-401	77.75 abc	96.27 cd	87.01 bc
Oscar	75.67 abc	77.87 efg	76.77 cdef
	LSD = 16.25	LSD = 16.25	LSD = 11.49

Table 2. Meteorological data during the years 2001-2002.

Year / Month 2000-2001	Temperature (^{0}C)		Relative Humidity%	Year /Month 2001-2002	Temperature (^{0}C)		Relative Humidity %
	Minimum (^{0}C)	Maximum (^{0}C)			Minimum (^{0}C)	Maximum (^{0}C)	
November	14.2	31.1	79.2	November	14.7	31.0	59.0
December	9.76	27.98	64.16	December	10.8	26.2	72.0
January	7.8	24.8	66.0	January	8.2	25.3	68.0
February	10.5	28.9	68.3	February	10.0	27.5	58.0
March	15.7	34.1	52.1	March	16.8	34.9	52.0
April	20.9	38.9	50.0	April	22.0	40.0	53.0
Mean	13.14	30.96	63.29	Mean	13.75	30.82	60.33

Source: Regional Agro Meteorological Center, Tandojam.

It is obvious from the data (Table I) that at the top merit, the most tolerant genotype was Rainbow, exhibiting 44.92 aphids per plant, this was followed by Hyola-42, Shiralee, Dunkled and Oscar, while, Hyola-308, Abasin-95, Hyola-401, CON-I, CON-II and Waster were moderate in sensitivity ranging from 58.38 to 98.40 aphids. The most sensitive at the bottom position was genotype CON-III having 130.6 mean aphids number, so there were great variations in the susceptibility/resistance ratings. Therefore, genotype Rainbow may be regarded as resistant and CON-III as susceptible genotypes to aphids.

3.2. Crop yield

The data on crop yield of different genotypes showed a wide range of variation among them.

Results showed (Table 3) that the best yielded genotype was Rainbow having a yield of 832.5 gm / 2.5m^2 plot (3330.0 Kg/Hectare), while, Hyola-42 was also of similar order (812.5 gm / 2.5m^2 plot) (3250.0 Kg/Hectare), both these genotypes were significantly more yielder than the rest of the genotypes, further, Abasin-95, Dunkled, CON-I and Oscars all contributed in the similar style. The increase in yield in these genotypes was due to

Table 3. Mean seed yield of different canola genotypes during the years 2001 and 2002.

S.No.	Name of genotypes	Yield / plot ($2.5m^2$) (Gram) 2001	Yield kg / Hectare (2001)	Yield / plot ($2.5m^2$) (Gram) 2002	Yield kg / Hectare (2002)	Yield / plot ($2.5m^2$) (Gram) Pooled	Yield kg / Hectare (Pooled)
1.	Waster	420.0 f	1680.00	601.7 f	2406.8	510.8 de	2043.2
2.	CON-I	703.3 b	2813.2	740.0 de	2960.0	721.7 b	2886.8
3.	CON-II	546.7 d	2186.8	693.3 e	2773.2	620.0 c	2480.0
4.	CON-III	476.7 e	1906.8	496.7 g	1986.8	486.7 e	1946.8
5.	Abasin-95	650.0 c	2600.00	806.7 c	3226.8	728.3 b	2913.2
6.	Dunkled	643.3 c	2573.2	805.0 c	3220.0	724.2 b	2896.8
7.	Rainbow	770.0 a	3080.00	895.0 b	3580.0	832.5 a	3330.0
8.	Shiralee	683.3 bc	2733.2	751.7 d	3006.8	717.5 b	2870.0
9.	Hyola-42	570.0 d	2280.00	1055.0 a	4220.0	812.5 a	3250.0
10.	Hyola-308	315.0 g	1260.00	746.7 d	2986.8	530.8 d	2123.2
11.	Hyola-401	240.0 h	960.00	620.0 f	2480.0	430.0 f	1720.0
12.	Oscar	663.3 bc	2653.2	775.0 cd	3100.00	719.2 b	2876.8
		LSD = 48.05		LSD = 48.05		LSD = 33.98	

their contributions to hold lower aphids populations and higher genetic yield potential. Hyola-401 gave the smallest seed yield of 430.0 gm / plot (1720.0 Kg/Hectare) as compared to other genotypes tested, which was significant statistically. This genotype showed its poorest plant stand due to aphids' infestation, resultantly, the least yield was obtained. It was followed by CON-III by yielding 486.7 gm of grains per plot (1946.8. Kg/Hectare). By taking into consideration in holding overall aphids population, genotype (CON-III), presented the highest aphids number, but was superior in performance for yielding more grains than Hyola-401. Both Hyola-401 and CON-III showed poorer performance because of their weaker plant stand due to aphids' infestation.

The results of present studies revealed that all the tested canola genotypes showed different response towards holding aphids infestation and seed yield, due to which they were easily marked either susceptible or resistant under the field conditions. Some of the research workers like, Chatta [6], Phadke [7], Hussain [8], Prasad [9], Prasad and Phadke [10], Ahmad [11], Kumar [12], Kher and Rataul [13], Talpur *et al.* [14], Hamed and Khattak [15], Mandal *et al.* [16], Khan and Akbar [17], and Ali *et al.* [18], have also recorded different varietal response of brassica's towards aphids infestation and grain yield. It was evidenced that tolerant varieties suffered little damage from aphids' infestation, although they were heavily infested. In contrast, susceptible varieties severely suffered from aphids' infestation, resulting in lower grain yield, which was envisaged from the findings under report. But Prasad and Phadke [19] were of the opinion that those varieties that were highly infested had lower losses in terms of yield than varieties that were least infested. Amjad and Peters [20] believed that insect populations with higher rates of increase have greater potential for causing plant injury. Vir and Henry [21] found that the aphids' infestation reduced plant height, number of secondary branches per plant, number of siliquae per plant and seed weight. It is logical to state that susceptible varieties may have plant sap, which increase palatability for this sucking insect, while, the sap of resistant genotypes might has distasteful influences against the insect concerned. The previous workers reported similar findings. Gill and Bakhetia [22] pointed out that in some *B. napus* and *B. campestris* strains increase in number of aphids per plant differed significantly with variety. There were few aphids on all *B. napus* than on *B. campestris*, which were found susceptible. Raj *et al.* [23] reported that among the cruciferous oil seeds genotypes screened against aphids, canola variety Waster was the second most resistant. In general, varieties in *B. juncea* and *B. carniata* groups were the most resistant than the varieties in the *B. napus* group. Anwar and Shafique [24] investigated that canola variety

Waster (*B. napus*) harboured the highest number of aphids and gave the lowest yield than *B. campestris*.

4. Conclusions

It could be inferred from these studies that all canola genotypes although were given the identical agricultural practices, yet they responded differently towards aphids' infestation and yield capabilities. These differences can be attributed due to variations in their genetic make up. The genotype Rainbow was least preferred by aphids over other genotypes and gave the highest yield under field conditions. It can also be of significant importance in varietal introduction programme as a source of resistance for further improvement of canola germplasms. Through the methods of hybridization and genetic recombination, pest resistant traits from resistant sources can be transferred to the agronomically acceptable genotypes. This resistant variety may help to minimize the possible use of insecticides and to improve future integrated pest management programme.

References

[1] Economic Survey, Govt. of Pakistan, Finance Division, Islamabad, (2002-2003) 19.

[2] S. Hamid and S. Ahmad, Biological assessment of three different insecticides sprayed against Lipaphis erysimi (Kaltenbach) on winter oil-seed crops. Proc. Pak. Congr. Zool., 30th April – 1st May, (1980) 283-290.

[3] M.A. Rustamani, U.F. Qaimkahni, G.H. Munshi and A.B. Chutto, Sarhad J. Agric., **4** (988) 659.

[4] B.K. Agarwala and N. Datta, J. Biosciences, **24** (1999) 223.

[5] R.G.D. Steel and J.H. Torrie, Principles and Procedures of Statistic. A biometric approach. Mc-Graw Hill Book Co. Inc. New York, (1980).

[6] N. Chatta, Screening of germplasm of oleiferous brassicae for resistance to aphid. Final Tech. Report PL-480, NIAB, Faisalabad, (1982) 97.

[7] K.G. Phadke, Ind. J. Entomol., **44** (1982) 136.

[8] T. Hussain, Pakistan J. Zool., **15** (1983) 95.

[9] S.K. Prasad, Ind. J. Entomol., **45** (1983) 501.

[10] S.K. Prasad and K.G. Phadke, Ind. J. Entomol., **46** (1984) 250-253.

[11] I. Ahmad, Management of mustard aphid. In research on rapeseed and mustard. Proc Indo-Swedish Symp, 4-6 Sept. 1989, Uppsala, Sweden (Ed. Ohlsson,I, Kumar,P.R.), (1990) 102.

[12] P.R. Kumar, Rapeseed and mustard improvement programme in India: an overview. In research on rapeseed & mustard. Proc Indo-Swedish Symp, 4-6 Sept. 1989, Uppsala, Sweden (Ed. Ohlsson,I, Kumar,P.R), (1990) 10-22.

[13] S. Kher and H.S. Rataul, Ind. J. Entomol., **53** (1991) 141.

[14] M.A. Talpur, T. Hussain, G.H. Nizamani and H. Baloch, Relative resistance of some olieferous Brassicae to mustard aphid, Lipaphis erysimi Kalt. Proc. Pakistan Congr. Zool., **11** (1991) 123.

[15] M. Hamed and S.U. Khattak, Screening of resistant oil seed brassicae against Brevicoryne brassicae L. aphids. Proc. Pakistan Congr. Zool., **13** (1993) 353.

[16] S.M.A. Mandal, B.K. Mishra and A.K. Patra, Orissa J. Agric. Res., **7** (1994) 58.

[17] S.M. Khan and M. Akbar, Pakistan J. Biol. Sci., **2** (1999) 1360.

[18] S. Ali, M. Naeem and E. Haq, Pak. J. Biol. Sci., **3** (2000) 991-992.

[19] S.K. Prasad and K.G. Phadke, Effect of mustard aphid, Lipaphis erysimi (Kalt.) infestation on the seed yield of different varieties of Brassica species. Pranikee, **4** (1983) 283 - 287.

[20] M. Amjad and D.C. Peters, J. Econ. Entomol., **85** (1992) 2003.

[21] S. Vir and A. Henry, Pesticides, **21** (1987) 30.

[22] R.S. Gill and D.R.C. Bakhetia, J. Oilseeds Res., **2** (1985) 227.

[23] D. Raj, N. Devi, Y.S. Chandel and Desh-Raj, Himachal J. Agric. Res., **18** (1992) 13.

[24] M. Anwar and M. Shafique, Pak. J. Zool., **31** (1999) 357.