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A study on Losses due to *Brevicoryne brassicae* in different *Brassica* genotypes under screen house conditions

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Abstract

A study on losses due to *Brevicoryne brassicae* in 12 Brassica genotypes under screen house conditions was conducted under screen house conditions during 2006-08. For the experiments artificial infestation of 5, 10 and 15 aphids/plant at flower-bud initiation stage was done in all the 12 genotypes. The results of the experiment of 5 aphids/plant infestation revealed that aphid density was significantly higher (106.2 aphid plant⁻¹) on Rainbow and lower (27.67 aphid plant⁻¹) on Raya Anmol and Peela Raya (30.17 aphid plant⁻¹). In the experiment of 10 aphids plant⁻¹ infestation, mean density of aphid was significantly higher on Legend (125.7 aphids plant⁻¹) and Westar (117.0 aphids plant⁻¹) while lower on Raya Anmol (57.67 aphids plant⁻¹) and T-16-401 (54.50 aphids plant⁻¹). In the experiment of 15 aphids aphids plant⁻¹, mean aphid density was significantly higher (200.70 aphids plant⁻¹) on Rainbow and lower (82.83 aphids plant⁻¹) on Ganyou-5. In control (0 aphids aphids plant⁻¹), Raya Anmol yielded significantly higher (7.32, 7.33 and 7.33 g plant⁻¹) and Oscar lower (3.62, 3.62 and 3.60 g plant⁻¹) in the 5, 10 and 15 aphids plant⁻¹, respectively. Among the 5, 10 and 15 aphid infested plants, Ganyou-5 (4.98, 4.57, 3.45 g plant⁻¹) yielded significantly higher and while Oscar (2.55, 1.60, 1.22) lower, respectively. The percent yield losses were significantly higher in Crusher (43.83%) and Torch (44.50%) and lower (11.08%) in T-16-401 in 5 aphid infested plant; significantly higher (62.15%) in Vanguard and lower in Legend (23.65%) and T-16-401 (22.09%) in 10 aphid/plant, and significantly higher (75.88%) in Vanguard and lower (29.14%) in T-16-401. The present results might be helpful in using host plant resistance in an integrated pest management program against *B. brassicae* on Brassica genotypes.

Keywords: *Brevicoryne brassicae*, Brassica Genotypes, Losses.

1. Introduction

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.). Aphids are the most important insect pests, causing 70-80% yield losses [1, 2].

Among these, the cabbage aphid (*B. brassicae*) is most predominant on cabbage; cauliflower, rape and turnip rape throughout the European and American countries [3]. The green peach aphid or potato aphid (*M. persicae*) is a well-known vector of several plant pathogens of worldwide occurrence and of great economic importance. It is of minor significance to cruciferous oilseeds. The mustard aphid (*L. erysimi*) though a cosmopolitan is of major economic consequences to brassica crops in the Indian sub-continent [4, 5].

B. brassicae feeds on all cultivated and wild cruciferous plants. A native of Europe, the cabbage aphid is now found in many areas of the world. In the Tropics they are usually confined to higher altitudes. Colonies of these aphids are found on both lower and upper leaf surfaces and in leaf folds of developing heads, on leaf stalks, and on leaf axles. They are occasionally found on at the soil level. Aphids feed by sucking sap from their hosts. Infested seedlings may become stunted and distorted. Continued feeding on mature plants causes wilting, yellowing and stunting of the plants.

Brassica crop is attacked by a number of pests; amongst these aphids are more serious. The species of aphids, i.e. cabbage aphid, *Brevicoryne brassicae* L., turnip aphid, *Lipaphis erysimi* Kalt. and green peach aphid *Myzus persicae* Sulz. are abundant and widely distributed [6]. *Brevicoryne brassicae* L. and turnip aphid *Lipaphis erysimi* Kalt are the most devastating pests of Canola [7]. Of these, cabbage aphid is the most destructive to the members of Brassicaceae.

Its attack, results in severe distortion of leaves and heavy losses to crops by forming large Colonies on leaves, stems and inflorescence. Aphids infested plants show slow growth, which result in seed loss of 9-77%. Aphids also cause an 11% reduction in seed oil content [8]. In India aphids alone attribute 30-70% losses in rapeseed yield in different agro climatic conditions with an average loss of 52.2% [9]. Under favorable circumstances, aphid's populations increase very rapidly by making dense colonies on all parts of plants. The economic impact of aphid damage can be from 80% yield losses to complete crop failure, if attack comes at seedling stage [10].

In Pakistan, cabbage aphid and mustard aphid are important pests of *Brassica* [11]. Cabbage aphid causes 35-75% yield losses [12, 13] and 6% losses in oil contents [14].

Objective of the study

To determine relationship between aphids density and yield losses in different *Brassica* genotypes under screen house conditions.

2. Materials and Methods

The present study was conducted under screen house conditions at the New Developmental Farm (NDF) of the University of Agriculture, Peshawar (UAP) during the cropping seasons of 2006-2008. Twelve *Brassica* genotypes were obtained from the Institute of Biotechnology and Genetic Engineering (IBGE), UAP and grown in the NDF of the UAP for the experiments.

To determine relative abundance of aphid's population on *Brassica*, twelve *Brassica* genotypes were sown in plots measuring 5x4 meters, having rows of 5 meters, with 75 cm row-to-row distance and 40-50cm plant-to-plant distance with four replications using a Randomized Complete Block Design (RCBD). Each genotype was sown in four rows. Standard agronomic practices were applied to the crop throughout the cropping season.

The experiment was carried out for two consecutive growing seasons (2006-07 and 2007-08). During 2006 the crop was sown on October 21 and in 2007 on November 2.

During the months of February and March data on aphid's population was recorded at ten days interval from five randomly selected plants from each row each time of data collection. Number of aphids was recorded from 1st, 2nd and

3rd leaf from the top of each plant and number of aphids/5cm of panicle/shoot (inflorescence).

To determine losses caused due to *B. brassicae* in *Brassica* genotypes under screen house conditions, twelve *Brassica* genotypes were sown in the screen house in plastic pots at the rate of two plants per pot, at the Institute of Biotechnology and Genetic Engineering (IBGE), KP Agricultural University Peshawar on 25-10-2006 and 03-11-2007. At flower-bud initiation stage (coinciding with natural infestation) plants of each genotype in the pot were infested with 0, 5, 10 and 15 aphids/plant.

Aphid's population was recorded when the pest level was at its peak (March 24-28) from stem 5 cm (lower, middle and top-inflorescence), branches 5 cm (lower, middle and apical portion), and leaves (lower, middle and top). Aphid's population and its effects on yield losses were determined. Yield data was recorded by threshing individual plant. Each treatment was replicated three times and the experiment was laid out in CRBD.

Percent yield losses were calculated from the yield data in infested (treatment) and un-infested (Control) plants by using the following formula [14]:

$$W = \frac{(M-Y) \times 100}{M}$$

Where:

W is the percent yield loss

M is attainable yield in Control

Y is yield in the treatment.

3. Results and Discussion

The results of the experiment of 5 aphids/plant infestation revealed that aphid density significantly higher (106.2 aphid plant⁻¹) on Rainbow and lower (27.67 aphid plant⁻¹) on Raya Anmol and Peela Raya (30.17 aphid plant⁻¹) (Table 1). In control, Raya Anmol yielded significantly higher (7.32 g plant⁻¹) and Oscar lower (3.62 g plant⁻¹). Among the artificially aphid infested plants, Westar (4.83), Ganyou-5 (4.98) and Raya Anmol (4.82) yielded significantly higher while Oscar (2.55) and Peela Raya (2.76) lower. The yield losses were significantly higher in Crusher (43.83%) and Torch (44.50%) and lower (11.08%) in T-16-401.

Table 1: Yield losses of *Brassica* genotypes under screen house conditions with 5-aphids per plant infestation at flower-bud initiation stage during 2006-08.

Genotype (Scientific name)	Genotype (Common name)	Aphid Density /Plant	Actual Yield (Control)	Grams Yield/plant (Infested)	% Yield Losses
<i>Brassica napus</i>	Westar	70.00 bc	5.97 b	4.83 a	19.19 cde
	Ganyou-5	37.83 ef	6.09 b	4.98 a	17.92 de
	Rainbow	106.2 a	5.41 bc	4.05 bc	25.01 bcde
	Oscar	49.33 de	3.62 f	2.55 e	29.38 abcd
	Vanguard	74.33 b	4.93 cd	3.21 de	34.58 ab
	Crusher	68.50 bc	5.70 bc	3.22 de	43.83 a
	Torch	59.33 cd	6.01 b	3.31 cde	44.50 a
	Legend	69.67 bc	4.81 cde	4.02 bc	16.25 de
	Altex	73.83 b	5.54 bc	4.55 ab	16.99 de
	<i>Brassica juncea</i>	Raya Anmol	27.67 f	7.32 a	4.82 a
<i>Brassica carinata</i>	Peela Raya	30.17 f	4.46 def	2.76 de	37.50 ab
<i>Brassica campestris</i>	T-16-401	37.33 ef	3.97 ef	3.50 cd	11.08 e

Means within a column followed by similar letters are non-significant from each other using LSD test at 5% level of probability.

In the experiment of 10 aphids-plant infestation, the results revealed that mean density of aphid was significantly higher on Legend (125.7 aphids plant⁻¹) and Westar (117.0 aphids plant⁻¹) while lower on Raya Anmol (57.67 aphids plant⁻¹) and

T-16-401 (54.50 aphids plant⁻¹) (Table 2). In control the Raya Anmol yielded significantly higher (7.33 g plant⁻¹) and Oscar lower (3.62 g plant⁻¹). Among the artificially aphid infested plant, the Ganyou-5 yielded significantly higher (4.57 g plant⁻¹)

¹), and Oscar (1.60 g plant⁻¹) and Vanguard (1.83 g plant⁻¹) lower. Yield losses were significantly higher of 62.15% in Vanguard and lower of 23.65% in Legend and 22.09% in T-16-401.

Table 2: Yield losses of *Brassica* genotypes under screen house conditions with 10-aphids per plant infestation at flower-bud initiation stage during 2006-08.

Genotype (Scientific name)	Genotype (Common name)	Aphids Density /Plant	Actual Yield (Control)	Grams Yield/plant (Infested)	% Yield Losses
<i>Brassica napus</i>	Westar	117.0 a	5.973 b	3.923 ab	34.05 cdef
	Ganyou-5	62.67 cd	6.090 b	4.570 a	24.66 ef
	Rainbow	110.0 ab	5.407 bc	3.787 abc	29.48 def
	Oscar	108.0 ab	3.620 f	1.600 f	55.38 ab
	Vanguard	97.00 abc	4.930 cd	1.833f	62.15 a
	Crusher	95.83 abc	5.703 bc	2.867 de	49.85 abc
	Torch	77.67 bcd	6.013 b	2.950 de	50.34 abc
	Legend	125.7 a	4.807 cde	3.670 bcd	23.65 f
	Altex	97.00 abc	5.543 bc	3.180 bcd	41.90 bcde
	<i>Brassica juncea</i>	Raya Anmol	57.67 d	7.327 a	3.810 abc
<i>Brassica carinata</i>	Peela Raya	63.50 cd	4.457 def	2.410 ef	45.67 abcd
<i>Brassica campestris</i>	T-16-401	54.50 d	3.973 ef	3.060 cde	22.09 f

Means within a column followed by similar letters are non-significant from each other using LSD test at 5% level of probability.

In the experiment of 15 aphids/plant, mean aphid density was significantly higher (200.7 aphids plant⁻¹) on Rainbow and lower (82.83 aphids plant⁻¹) on Ganyou-5 (Table 3). In control, mean yield of brassica seed was significantly higher (7.33 g plant⁻¹) of Raya Anmol and lower (3.60 g plant⁻¹) of Oscar.

Among the artificially aphid infested plants, mean yield was significantly higher (3.45 g plant⁻¹) and lower in Oscar (1.22 g plant⁻¹), Vanguard (1.19 g plant⁻¹) and Peela Raya (1.40 g plant⁻¹). The losses by aphid infestation were significantly higher (75.88%) in Vanguard and lower (29.14%) in T-16-401.

Table 3: Yield losses of *Brassica* genotypes under screen house conditions with 15-aphids per plant infestation at flower-bud initiation stage during 2006-08.

Genotype Scientific name	Genotype (Common name)	Aphids Density /Plant	Actual Yield (Control)	Grams Yield/plant (Infested)	% Yield Losses
<i>Brassica napus</i>	Westar	137.7 cd	5.97 b	3.29 ab	44.67 de
	Ganyou-5	82.83 f	6.09 b	3.45 a	43.35 e
	Rainbow	200.7 a	5.41 bc	3.00 abc	43.97 e
	Oscar	184.3 ab	3.62 f	1.22 f	66.04 abc
	Vanguard	132.7 cde	4.93 cd	1.19 f	75.88 a
	Crusher	142.0 c	5.70 bc	2.29 de	59.80 bc
	Torch	101.2 def	6.01 b	2.74 cd	54.08 cde
	Legend	149.2 bc	4.81 cde	2.08 e	56.37 bcde
	Altex	101.5 def	5.54 bc	2.28 de	57.92 bcd
	<i>Brassica juncea</i>	Raya Anmol	100.7 ef	7.33 a	2.77 bcd
<i>Brassica carinata</i>	Peela Raya	103.5 def	4.46 def	1.40 f	68.38 ab
<i>Brassica campestris</i>	T-16-401	85.17 f	3.97 ef	2.773 bcd	29.14 f

Means within a column followed by similar letters are non-significant from each other using LSD test at 5% level of probability.

Overall yield losses in *Brassica* genotypes ranged from 11.08–44.50%, 22.09 – 62-15%, 29.14-75.88% with 5, 10 and 15 aphids plant⁻¹ infestation, respectively. Different workers have reported different levels of losses under different conditions in various genotypes of *Brassica* and species of aphids under different agro-climatic conditions, e.g. 80.0 to 97.6% yield loss in *Brassica juncea* without plant protection [15]; Yield losses caused by any of the aphid species in wheat were in the range of 35 to 40% at 15 aphids per plant [16]; cabbage aphids caused 85% leaf damage on the most susceptible cultivar, Drumhead, and 30.9 and 44.6% on resistant cultivars, Grandslam and Copenhagen Market, respectively [17]; cabbage aphid may cause 85% yield loss and may induce the increase in glucosinolate content in rape seed [18]; 57.8 to 80.6 per cent yield loss due to mustard aphid [19]; the avoidable losses in yield of *Brassica* species caused by the mustard aphid varied from 28.8 to 52.5% in *B. juncea* cv. RLM 619 and 22.6 to 51.7% in *B. napus* cv. GSL 1 [20]; 42.1 per cent yield loss in brown sarson under different agro climatic conditions [21]; on an average 7.19 aphids per tiller on wheat reduced 16.38%

yield [22]; the damage caused by aphids in rape seed mustard vary from 9 to 95 percent depending upon various biotic and a biotic factors at different locations [23]; 29.5% and 2.6% grain yield losses in yellow sarson and Rai, respectively [24]; the avoidable losses in yellow sarson due to mustard aphid *Lipaphis erysimi* up to 69.6 per cent [14]; mustard aphid alone attributes 30-70% losses in yield potential in different agro-climatic zones with a mean loss of 54.2% in India in rapeseed mustard [9]; Population level increased beyond 9.45 aphids per plant; reduce the seed yield by 59.3 per cent with an economic injury level of 2.04 aphids/ plants with an index of 0.98 [25].

Conclusion and Recommendation

Overall yield losses in *Brassica* genotypes ranged from 11.08–44.50%, 22.09 – 62-15%, 29.14-75.88% with 5, 10 and 15 aphids plant⁻¹ infestation, respectively. From the above findings it was concluded that to avoid losses from aphid infestation, control measures should be applied when aphid densities reach 5 aphids plant⁻¹ at flower-bud initiation stage on the *Brassica* genotypes.

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