Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1817 - 1825
Received 08 November 2021; Accepted 15 December 2021.

Population Density of Canola Aphid, *Lipaphis Erysimi* (Kalt.) (Homoptera: Aphididae) And Its Related Natural Enemies in Three Brassica Lines

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ABSTRACT

The current study was performed at Malakandher farm, The University of Agriculture Peshawar during the year 2021 to assess the population density of *L.erysimi* and their related natural enemies in adding to the comparative resistance determination against *L.erysimi* in different Brassica lines and their responses to its related natural enemies. Three different Brassica lines Hashmi 13, Duree e NIFA Peshawar and Pre basic Peshawar were studied, which were triplicate in Randomized Complete Block Design. The maximum population of aphids per leaf was observed during 3rd week of February and minimum population of aphids per leaf was observed during 5th week of February at all brassica lines. Amongst all the Brassica lines, Pre basic Peshawar reportedrelatively more resistance in comparison to Duree e NIFA Peshawar and Hashmi 13. Pre basic Peshawar recordedminimum resistance towards*L. erysimi*, which was reported to be the most susceptible line of canola. Pre basic Peshawar was also noticed superior in case of natural enemies. Peakpopulation of all natural enemies was observed on this variety followed by Duree e NIFA Peshawar. Leastpopulation of natural enemies was reported by Hashmi 13.

Keywords: *Lipaphis erysimi,* Green lace wing, Ladybird beetle,*Diaeretiella rapae*

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INTRODUCTION

Throughout the country Canola has been cultivated. Canola oil is prepared via crushing the genetically modified rapeseed processing. Its oil has many more non-food usage, and most often replaces nonrenewable resources in products *viz.*,lubricants industries, candles industries, biofuels, lipsticks manufacturing, and newspaper inks (Brown *et al.*, 1996). Amongst different factors which are responsible for the lowest yield of canola crop attackedby aphids. Canola crop is heavily suffered by different aphids species, which leadsto poor growth and minimized yield. Under favorable conditions, populations of aphids may multiply very rapidly and they make dense colonies on plants surface. Aphids also transmit plant viral diseases, *viz.*, turnip mosaic virus, which can be only suppressed by effective controlling of aphids. Aphids are the most significant insect pests which causing 70-80 percent losses in yield (Bedford and Henry, 1998). In most terrestrial habitats, aphid colonies succumb to attack by predators, parasitoids and pathogens which are often termed as aphidophaga. Among aphid predators (killers); adults & larvae of coccinellid beetles & larvae of lacewings, dipteran predatory midges andsyrphids (Volkl*et al.,* 2007). Parasitization (endoparasitic as aphid mummies) by several species of wasps and a few dipteran flies has been reported and these are being employed in biological control programs. Larvae of these parasitoids especially wasps' complete their development in aphid, kill them and pupate within or below the hardened cuticle (the mummy). The adult parasitoids are free living, feed on nectar of crops while females continue sucking haemolymph of stung aphids. Aphid killing ladybeetles especially of subfamilies coccinellinae&scymninae have more than 5000 species of which 261 species of 57 genera have been reported predaceous in India (Omkar and Pervez, 2004). The predominant species in India are; *Coccinellaseptumpunctata* Linn.*C. transversalis* (Fab.), *Brumoidessuturalis* (Fab.), *Hippodamia variegate* (Fab.), *Propyleadissectas* (Mulsant), *Harmoniaoctomaculata* (Fab.) and *Menochilussexmaculatus* (Fab.). There are different methodologies used for the controlling aphids like resistant variety, bio-control agents and use of pesticides. Pesticides resistance, Secondary pest outbreaks, more stringent pesticide regulation and concern about environmental quality and human health have renewed the interest in integrated pest management programs that emphasize biological control. The screening of different lines and resistance determination in different linestowards aphids is the main component of an integrated pest management package. No work has been done on the population density of *L. erysimi* and its proper identified natural enemies on the different

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Brassica cultivars. Based on the above information the presentexperiment was performed to estimate population density of *L. erysimi* and their related natural enemies, in addition to comparative resistance determination in different Brassica cultivarstowards*L. erysimi* and their responses to its related natural enemies.

MATERIAL AND METHODS

Study area

The present experiment was conducted at The University of Agriculture, Peshawar, Pakistan, during 2020 to study the "population trend of canola aphid, *Lipaphiserysimi* (kalt.) (homoptera: aphididae) and its associated natural enemies in three brassica lines".

Population density of *L. erysimi*

The subsequent parameters were considered: (1) Population density of *L. erysim*, (2) Population density of natural enemies.

Population density of *L. erysimi*

To organize the study of population densities of *L. erysimi*, three different numbers of Brassicacultivarscontaining Hashmi 13, Durre e NIFA Peshawar and Pre basic Peshawar were sown in different sub plots. All tested Brassica cultivars were triplicates. Population of aphids was counted on the 3 leaves, top, middle and bottom region of four randomly selected plants in each cultivar in each replication avoiding the boarder rows from every plot. Data were collected on the basis of weekly intervals.

Population densities of natural enemies

To organized the study of population densities of natural enemies, three multiple Brassica cultivars, Hashmi 13, Durre e NIFA Peshawar and Pre basic Peshawar were sown in multiple subplots. All these Brassica cultivars were triplicates. The numbers of natural enemies like,*Diaeretiella rapae*, green lacewing and ladybird beetle were counted on four randomly selected plants from each testedcultivar, from each replication. Data were collected on weekly basis.

Statistical Analysis

Data were analyzed by Statistix 8.1, using Randomized Complete Block Design..

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RESULTS

Population density of *L. erysimi*

Table 1 recorded the mean quantity of *L. erysimi*(per leaf) of *Brassica*crop at different time observation. The maximummean population was observed by V1 in 3rd week (3.96 aphids per leaf), followed by 2nd week (2.32 aphid per leaf), 1st week (1.67 aphid per leaf) 4th week (1.62 aphid per leaf) and 5th week (1.22 aphid per leaf). Similarly, the maximummean population was observed by V2 in 3rd week (2.72 aphids per leaf), followed by 2nd week (2.09 aphid leaf^{-1}), 1st week (1.55 aphid leaf^{-1}) 4th week (1.42 aphid leaf^{-1}) and 5th week (1.09 aphid per leaf). Moreover, the highestmean population was observed by V1 in 3rd week (1.26 aphids per leaf), followed by 2nd week (2.06 aphid per leaf), 1st week (1.40 aphid per leaf) 4th week (1.26 aphid per leaf) and 5th week (1.02 aphid per leaf). The highestaverage number of aphids (2.15aphids per leaf) was observed in the V1, followed by V2 (1.77 aphids per leaf), the leastaverage population (1.63 per leaf) was recorded in V3.

Table 1: Average number of *Lipaphis erysimi* (Kalt) plants per leaf at different time interval (weeks) of different Canola lines during 2020.

Canola Lines	W1 Jan 29	W2 Feb 05	W3 Feb 13	W4 Feb 20	W5 Feb 27	Mean
Hashmi 13	1.67^{c}	2.32^{c}	3.96^{a}	1.62^{ef}	1.22^{gi}	2.15
Duree e NIFA Peshawar	1.55^{ef}	2.09^{d}	2.72^{b}	1.42^{fg}	1.09^{hi}	1.77
Pre basic Peshawar	1.40^{fg}	2.06^{d}	2.41^{c}	1.26^{gh}	1.02^{i}	1.63
Total mean	1.54^{c}	2.15^{b}	3.03^{a}	1.43^{c}	1.11^{d}	--

Means followed by different letters in columns and rows are significantly different at 5 % of probability

W1: 1st week, W2: 2nd week, W3: 3rd week, W4: 4th week, W5: 5th week

Green lacewing population

Table 2 reported the mean number of green lacewing population at different time observations. Among the *Brassica* lines, the number of green lace wing was recorded in V3 at different time of observations as followed (4th, 3rd, 2nd, and 5th week) 1.63, 1.33, 0.82, 0.71 leaf^{-1} respectively.

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Similarly, maximum green lacewing (1.40 leaf^{-1}) was recorded on V2 at week 4th followed by green lacewing leaf^{-1}week 3rd, 2nd and 5th (1.01, 0.51, 0.50 leaf^{-1}), while the least number of green lacewing was recorded at 1st week (0.00leaf^{-1}). Moreover, highest number of green lacewing (1.28 leaf^{-1}) was recorded on V1 at week 4th of observation followed by week 3rd, 2nd and 5th (0.57, 0.41, 0.0.30 per leaf), while the least number of green lacewing was recorded at 1st week (0.00leaf^{-1}). In about all cases aphid population was observed lowest as compared with the onwardinterval. Highest population was observed in week 4th, after that decreased in population was started. Among all interactions highest number (green lacewing per leaf) was observed for week 4th.

Table 2: Average number of green lace wing per leaf of plants at different time interval (weeks) of different Canola lines during 2020.

Canola Lines	W1 Jan 29	W2 Feb 05	W3 Feb 13	W4 Feb 20	W5 Feb 27	Mean
Hashmi 13	0.00^{j}	0.41^{h}	0.57^{g}	1.28^{c}	0.30i	0.51
Duree e NIFA Peshawar	0.00^{j}	0.51^{g}	1.01^{d}	1.40^{b}	0.50^{g}	0.68
Pre basic Peshawar	0.00^{j}	0.82^{c}	1.33^{bc}	1.63^{a}	0.71^{f}	0.89
Total mean	0.00^{j}	0.58^{c}	0.97^{b}	1.43^{a}	0.50^{d}	--

Means followed by different letters in columns and rows are significantly different at 5 % of probability

W1: 1st week, W2: 2nd week, W3: 3rd week, W4: 4th week, W5: 5th week

Ladybird beetle population

The average number of green lacewing population at different time observation was presented in Table 3. Among the *Brassica* lines, the number of lady bird beetle was recorded in V3 at different time of observations as followed (3rd, 4th, 5th and 2nd week) 0.93, 0.71, 0.61 and 0.60 leaf^{-1} respectively while the least number of lady bird beetle was recorded in the 1st week of observation (0.55 leaf^{-1}). Similarly, maximum lady bird beetle (0.72 leaf^{-1}) was recorded on V2 at week 3rd followed by lady bird beetle leaf^{-1}week 4th, 5th and 2nd (0.52, 0.47, 0.40 leaf^{-1}), whereas the least number of lady bird beetle was recorded at 1st week (0.35 leaf^{-1}). Moreover, highest number of lady bird beetle (0.45 leaf^{-1}) was recorded on V1 at week 3rdof observation followed by week 4th, 5th and 2nd (0.35, 0.32, 0.31 leaf^{-1}), while the least number of lady bird

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beetle was recorded at 1st week (0.26leaf^{-1}). In almost about all cases aphid population was observed lowestincomparison with the onward intervals. Peak population was observed in week 3rd. Among all interactions highest number (lady bird beetleper leaf) was observed for week 3rd.

Table 3: Average number of lady bird beetle leaf^{-1} of plants at different time interval (weeks) of different Canola lines during 2020.

Canola Lines	W1 Jan 29	W2 Feb 05	W3 Feb 13	W4 Feb 20	W5 Feb 27	Mean
Hashmi 13	0.26^{i}	0.31^{gh}	0.45^{c}	0.35^{fg}	0.32^{hi}	0.33
Duree e NIFA Peshawar	0.35^{fh}	0.40^{ef}	0.72^{b}	0.52^{d}	0.47^{c}	0.49
Pre basic Peshawar	0.55^{cd}	0.60^{c}	0.93^{a}	0.71^{b}	0.61^{c}	0.68
Total mean	0.38^{d}	0.43^{c}	0.70^{a}	0.52^{b}	0.46^{c}	--

Means followed by different letters in columns and rows are significantly different at 5 % of probability

W1: 1st week, W2: 2nd week, W3: 3rd week, W4: 4th week, W5: 5th week

***Diaeretiella rapae* beetle population**

The average number of *Diaeretiella rapae* population at different time observation was presented in Table 4. Among the *Brassica* lines, the number of *Diaeretiella rapae* was recorded in V3 at different time of observations as followed (3rd, 4th, 2ndand 5th week) 0.95, 0.70, 0.63 and 0.60 leaf^{-1} respectively while the least number of *Diaeretiella rapae* was recorded in the 1st week of observation (0.59 leaf^{-1}). Similarly, maximum *Diaeretiella rapae* (0.75 leaf^{-1}) was recorded on V2 at week 3rd followed by *Diaeretiella rapae* leaf^{-1} week 4th, 5th and 2nd (0.51, 0.46, 0.43 leaf^{-1}), whereas the least number of *Diaeretiella rapae*was recorded at 1st week (0.38 leaf^{-1}). Moreover, highest number of *Diaeretiella rapae* (0.47 leaf^{-1}) was recorded on V1 at week 3rd of observation followed by week 4th, 2ndand 5th(0.36, 0.34, 0.31 leaf^{-1}), while the least number of*Diaeretiella rapae* was recorded at 1st week (0.29 leaf^{-1}). In almost about all cases aphid population was observed lowest in comparison with the onward intervals. Peak population was observed in week 3rd. Among all interactions highest number (*Diaeretiella rapae* per leaf) was observed for week 3rd.Firstly the average number of *Diaeretiella rapae* population was observed lower, but with the passage of time increased noticed and highest average population (*Diaeretiella rapae* leaf^{-1}) was observed during week 3rd.

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Table 4: Average number of *Diaeretiella rapae*per leaf of plants at different time interval (weeks) of different Canola lines during 2020.

Canola Lines	W1 Jan 29	W2 Feb 05	W3 Feb 13	W4 Feb 20	W5 Feb 27	Mean
Hashmi 13	0.29^{i}	0.34^{gh}	0.47^{c}	0.36^{fg}	0.31^{hi}	0.35
Duree e NIFA Peshawar	0.38^{fh}	0.43^{ef}	0.75^{b}	0.51^{d}	0.46^{c}	0.50
Pre basic Peshawar	0.59^{cd}	0.63^{c}	0.95^{a}	0.70^{b}	0.60^{c}	0.69
Total mean	0.42^{d}	0.46^{c}	0.72^{a}	0.52^{b}	0.45^{c}	--

Means followed by different letters in columns and rows are significantly different at 5 % of probability

W1: 1st week, W2: 2nd week, W3: 3rd week, W4: 4th week, W5: 5th week

DISCUSSION

L. erysimi is the mainly serious pest of *Brassica* spp. and causes highest yield losses in Brassica so it is significantly important to study its population trends and thus to manage at least minimize their losses. Weibull and Melin (2003) studied that canola crop is seriouslyinfected by aphids under favorable environmental conditions and decrease its yield severely. Parallel results were observed by Rana (2006) who confirmed that the population started multiplying and reached to a peak during the weeks 3rd and 4th of March. After 3rd week the population begin to decreased and lowest population was observed on week 5 (4th week of March). The Brassica line F6B7 recorded best response in dipping the aphids population. No literature is available to confirm these findings. In the current study the populations of green lacewing have been significantly different for different Brassica lines. At the beginning the average green lacewing population was lowest but with the passage of time, green lacewing population increased and highest population was recorded in 4thweek, while lowest population was found in 1st week. Among the Brassica lines, maximum green lacewing population was observed on F6B7 while minimum green lacewing population was observed in F6B3. Our results are in conformity with Sirimachan*et al.* (2005). Seven spot ladybird beetles (*C. septempunctata*) were a principal predator in Brassica spp. Mustard aphid and *C. septempunctata* appeared at once in early march (Agarwala and Bardhanroy, 1999). In the present study significant variation occurred in the ladybird beetle population on different Brassica lines. Mean ladybird beetle population increased with the passage of time and highest population was observed in 3rd week, after that population

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decreasedand lowest number of population was recorded in 1st week. Among Brassica lines highest population of ladybird beetle leaf^{-1} was observed on F6B7 while least of ladybird beetle was recorded on F6B3. Our results are in conformity with Singh and Sachan (2001) who showed that *C. septempunctata* appeared variably late in February during the studies of 3 consecutive years in Brassica crops.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The highest aphid population per leaf was observed during 2nd while the lowest population were observed during 4th week of February. *L. erysimi*was found to be attacked more on Hashmi 13 due its susceptible nature, while Pre basics Peshawar recordedrelatively more resistance towards its attack. The early population of green lace wing started in the 1stand was maximum on 3rd week of February and then declined. Ladybird beetle, *Diaeretiella rapae* were the key natural enemies recorded in the experiment. Ladybird beetle and *Diaeretiella rapae* were observed at the starting of the season compared to green lace wing population. The main natural enemies that were observed in the field were ladybird beetle, *Diaeretiella rapae* and green lacewing.

Recommendations

The *Brassica* line Duree e NIFA Peshawar should be preferred for cultivation in district Peshawar, due to the least preference by the *L. erysimi*. Rearing and mass production of *Diaeretiella rapae* and Ladybird beetle is recommended for the control of *L. erysimi* population. Green lace wing comes late and may not be flourishing in district Peshawar.

Authors' Contributions

Yasir Ali: Conducted research work.
Muhammad Younas: Main Supervisor.
Sagheer Ahmad and Muhammad Salman Khan: Wrote the Article.
Muhammad Tanvir and Saeeda: Proof reading.
Muhammad Tanvir: Co-Supervisor
QurratulAinTahira and Muhammad Akif: Financial Support.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1817 - 1825
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