Bulgarian Journal of Agricultural Science, 26 (No 3) 2020, 585–589

Incidence of green peach aphid, *Myzus persicae* on Brassica crop and its chemical control in the field

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Abstract

Khan, R. A. & Naveed, M. (2020). Incidence of green peach aphid, *Myzus persicae* on Brassica crop and its chemical control in the field. *Bulg. J. Agric. Sci., 26 (3)*, 585–589

Myzus persicae, green peach aphid is a polyphagous pest infesting a number of economically important agricultural crops. The current research studies were planned to investigate the population dynamics in relation to metrological factors such as, temperature and relative humidity. Our results showed that the population of the aphid remained at its highest point during the second and third week of March corresponding to the maximum temperature and relative humidity ranges of 25, 28, 31 and 63, 57, 51% respectively. Among the insecticides used for their effectiveness against the green peach aphid, chlorpyriphos remained highly effective both in recommended field dose and two fold serially diluted dose. The other insecticides were ranked as, lefnuron, lambda cyhalothrin, buprofazin, emamectin benzoate and trichlorfon, respectively after 72 hours post treatment.

Keywords: Myzus persicae; population dynamics; meteorological factors; temperature; relative humidity

Introduction

Brassica compestris and *Brassica napus* generally known as rapeseed are cultivated for their high rich edible oil (Dupont et al., 1989). This crop has very high potential in Pakistan because of low production of edible oil and in return high imports to meet the requirement. The annual production of rapeseed and mustard accounts 179000 metric tons and cultivated in an area of 19300 hectares (Anonymous, 2017). Sucking pest poses different biochemical and physiological disorders in host plant by producing secondary plant metabolites which stimulate the reactive oxygen species in plant feeding insects (Krishnan et al., 2007; Lukasik et al., 2012). Aphids causes a lot of problems to Brassica crop by infesting its floral and vegetative parts, ultimately reducing the yield (Desneux *et al.,* 2005; Vir & Henry, 1987; Sarwar *et al.,* 2011).

The variety of hosts feeding, which constitutes different nutrients and also have a diverse nature of defense mechanism among each other encourage the genetic variability among aphids (Zitoudi et al., 2001; Ferrari et al., 2008; Vorburger & Ramsauer, 2008). Many of the crops are infested by more than one aphid species, like Brassica, which is shared by *Myzus persicae*, *Bravicorny brassicae* and *Lipaphis erysimi* (Abbas et al., 2017). Due to their damage plant looses its height, reduces secondary branches and ultimately reduces yield by reducing seed weight (Vir & Henry, 1987; Sarwar et al., 2011). Along with direct infestations caused by aphids, they also excrete a sugary material "honey dew" which becomes an attractive for the growth of sooty mold which finally block the photosynthetic spiracles of the plant and hinder its growth (Sarwar, 2008; 2009)

M. persicae commonly known as the green peach aphid is a polyphagous pest infesting more than 1600 plants from 64 different families (Blackman & Eastop, 2000, van Emden & Harrington, 2007, Singh et al., 2015). It reproduces by having male and female copulations on peach plant (*Prunus persicae*, L.) as preliminary host (van Emden et al., 1969) and on another host; parthenogenetic females produce young

ones through viviparity (Blackman & Eastop, 2000; Petrovic-Obradovic, 2003).

Temperature, humidity and rainfall and sunshine hours greatly influence on the population of aphids (Kisimoto & Dyck, 1976). Severe infestation of aphid is reported during the month form December-February (Ekbom, 1995). Other than that bio-control agents also significantly reduces the population of aphid. Most of the predatory fauna coincide with the population of aphid and their population increases as the aphid population increase. Among the bio-control agents coccinellid beetles attain very high rank in reducing the population and minimizing the pesticide use (Mathur, 1983). So the present studies are conducted to determine the population of *M. persicae* on Brassica crop and the influence of meteorological factors on the fluctuation of an aphid population.

Materials and Methods

Field location

The experimental work was carried out on the Nuclear Institute for Agriculture & Biology (NIAB) experimental farm, Faisalabad, located at geographic coordinates, 73°1′49″ E, 30°24′0″ N, with an altitude of 469.16 feet.

Experimental layout

The experiment designed in Randomized complete block design. A Brassica variety, Punjab-sarson, was cultivated for the purpose. It was sown at an area of 300×100 ft^2 by using hand drill. The crop was cultivated in 8 beds which serve as replication of the treatment, each sizing 35×100 ft^2. The field was separated with 3 ft of inter field path and each bed was separated by 2 ft of inter replicate path.

Aphid data

The data acquisition of green peach aphid was initiated as soon as the aphid population appeared on brassica plants during the mid of February and continued up-till the end of March as the population of aphids starts disappearing. The data was recorded in the morning. The green peach aphids were counted on the 2 inches apical/ florets, top, middle and bottom portion of the plants at three days interval (Khan et al., 2015). The data were recorded from five selected plants within a replication. The field was divided in a total of eight replications.

Metrological data

Metrological data, such as maximum temperature (°C), relative humidity (RH %) and rainfall (mm) were generated in a mini. weather station with data logger installed on the NIAB experimental farm area. (Table 1).

Insecticides and field bioassay

Six insecticides of different group's viz., Emamectin Benzoate, Trichlorfon, Buprofezin, Lambda Cyhalothrin, Lefnuron and Chlorpyriphos were used in recommended and ½ diluted doses in the field (Table 1).

Statistical analysis

A One-Way Analysis of Variance (ANOVA) was performed to analyze the experimental data and means were subjected to statistical significance by Tuckey's Multiple Comparison Test (TMCT) at the ≤ 0.05 alpha level of significance using statistical software (Statistix 8.1, Tallahassee, Florida, USA).

Results and Discussion

Population of the green peach aphid remained significantly different during the month of February and March depending upon the variations in metrological factors such as, temperature, humidity and rainfall. Incidence of the aphid started in the second week of February with population of 4.90, 1.05, 1.67 and 5.90 on apical, top, middle and bottom portions of the plant, respectively, corresponding with the mean maxi. Temperature and relative humidity were of 26°C and 56%, respectively, during the year 2017. The population of the aphid continue to increase afterwards and reached its peak level in the third week of March with 43.97, 26.20, 27.02 and 22.92 on apical, top, middle and bottom portions

Table 1. Details of insecticides belonging to different groups used in the field for the control of green peach aphid

Sr.	Trade name	Active ingredient (AI)	Formulation	Manufacturer	Dose range
1	Lefnuron®	*Lefnuron*	5 EC	Jiangsu flag chemical industry Co., Ltd, China	600 ml/acre
2	Lorsban®	*Chlorpyriphos*	40 EC	Dow Agro Sciences	600 ml/acre
3	Buprofezin®	*Buprofezin*	25 WP	Welcare Chemicals corporation	250 g/acre
4	Diptrex®	*Trichlorofon*	80 SP	Bayer Crop Sciences	150 g/acre
5	Proclaim®	*Emamectin Benzoate*	19 EC	Syngenta	200 ml/acre
6	Karate®	Lambda Cyhalothrin	2.5 EC	Syngenta	330 ml/acre

of the plant, respectively, corresponding with the mean maximum temperature of 25°C and relative humidity of 63%, respectively. The sharp decline of aphid population was observed in the fourth week of March corresponding with the mean maximum temperature of 35°C and relative humidity of 54%, respectively (Table 2).

In second part of the experiment, insecticides belonging to different groups were evaluated in the field in recommended and its two fold dilutions. The results showed significant variation in the toxicities of different insecticides at

Table 2. Abundance of green peach aphid in Brassica crop in relation with meteorological factors

Dates	Parts of Brassica plants				Metrological data		
	Apical	Top	Middle	Bottom	Mean Maxi. Temp. (°C)	Mean RH, %	Mean Rainfall mm
15-Feb	4.90^{F}	1.05^{H}	1.67^{J}	5.90^{I}	26	56	0
18-Feb	5.57^{F}	8.20^{G}	7.20^{I}	9.57^{GH}	26.67	54.33	0
21-Feb	6.30^{F}	12.10^{F}	9.97^{H}	10.70^{FG}	27	69.00	4.33
24-Feb	13.05^{E}	12.27^{F}	13.35^{G}	10.70^{FG}	25.33	49.33	0
27-Feb	15.50^{E}	12.27^{F}	15.07^{FG}	13.57^{F}	27.33	53.00	0
2-Mar	25.87^{C}	15.30^{E}	19.30^{E}	18.95^{DE}	25.67	56.00	0
5-Mar	28.90^{C}	15.72^{E}	20.00^{E}	20.20^{CD}	26.00	48.00	0
8-Mar	36.65^{B}	16.77^{DE}	20.67^{DE}	21.90^{C}	23.67	71.00	3.00
11-Mar	36.92^{B}	18.52^{CD}	21.35^{CDE}	21.97^{C}	19.67	74.67	9.33
14-Mar	37.67^{B}	18.87^{CD}	23.27^{BCD}	22.05^{C}	23.33	55.33	0
17-Mar	43.97^{A}	26.20^{A}	27.02^{A}	28.72^{A}	25.00	63.00	0.33
20-Mar	42.77^{A}	21.62^{B}	25.52^{AB}	25.17^{B}	28.67	57.67	0
23-Mar	41.65^{A}	19.07^{C}	23.65^{BC}	22.92^{BC}	31.67	51.00	0.33
26-Mar	20.05^{D}	15.30^{E}	16.25^{F}	16.60^{E}	33.00	54.33	0
29-Mar	5.47^{F}	7.17^{G}	7.05^{I}	6.92^{HI}	35.67	54.67	0
SE	1.82	1.15	1.31	1.47	–	–	–
LSD value	3.62	2.29	2.60	2.93	–	–	–

Table 3. Control of green peach aphid in recommended doses of the insecticides at different intervals post treatment

Insecticides	Pre-treatment	Time Post Treatment			RT*	Rank
		24 h	48 h	72 h		
Lefnuron	33.91^{A}	7.16^{D}	8.66^{E}	4.16^{DE}	0.75	2
Chlorpyriphos	33.83^{A}	4.00^{E}	4.41^{G}	3.16^{E}	1	1
Buprofezin	32.83^{A}	7.66^{CD}	10.83^{D}	10.08^{C}	0.31	4
Trichlorfon	31.16^{A}	12.83^{B}	16.33^{B}	14.08^{B}	0.22	6
Emamectin Benzoate	30.91^{A}	8.91^{C}	13.25^{C}	10.16^{C}	0.31	5
Lambda Cyhalothrin	29.41^{A}	8.00^{CD}	6.33^{F}	5.58^{D}	0.56	3
Control		32.72^{A}	32.01^{A}	34.75^{A}		

RT* = Relative Toxicity

Table 4. Control of green peach aphid in diluted doses of the insecticides at different intervals post treatment

Insecticides	Pre-treatment	Time Post Treatment			RT*	Rank
		24 h	48 h	72 h		
Lefuron	35.33^{A}	10.16^{C}	11.00^{E}	6.08^{E}	0.68	2
Chlorpyriphos	33.58^{A}	6.41^{D}	7.58^{F}	4.16^{F}	1	1
Buprofezin	32.66^{A}	10.66^{C}	15.83^{D}	14.00^{C}	0.29	5
Trichlorfon	31.50^{A}	17.08^{B}	22.50^{B}	19.41^{B}	0.21	6
Emamectin Benzoate	30.41^{A}	11.66^{C}	19.00^{C}	13.25^{C}	0.31	4
Lambda Cyhalothrin	29.00^{A}	11.50^{C}	11.91^{E}	10.33^{D}	0.40	3
Control		32.58^{A}	32.26^{A}	34.45^{A}		

RT* = Relative Toxicity

different intervals post treatment. The results revealed that chlorpyriphos remained highly toxic to green peach aphid followed by lefnuron, lambda cyhalothrin, buprofazin, emamectin benzoate and trichlorfon, respectively. The 72 h post treatment population was found to be 3.16, 4.16, 5.58, 10.08, 10.16 and 14.08 in chlorpyriphos, lefnuron, lambda cyhalothrin, buprofazin, emamectin benzoate and trichlorfon, respectively (Table 3).

The insecticides in two fold dilutions of recommended doses also showed statistically significant variations among one another. The results indicated that chlorpyriphos remained highly toxic followed by lefnuron, lambda cyhalothrin, buprofazin, emamectin benzoate and trichlorfon, respectively after 72 h post treatment (Table 4).

Discussion

In Pakistan Brassica crop is attacked by a number of aphid species including *M. persicae*, which inflict heavy loses to yield and reduce the quality of oil. Aphids' population is greatly influenced by the environmental factors such as temperature, relative humidity and rainfall (Kisimoto & Dyck, 1976). In the present experiment influence of environmental factors on population dynamics was observed along with the use of chemical insecticides for the suppression of *M. persicae*.

Favorable environmental factors greatly enhance the population of *M. persicae* in the field. Other reasons for the population explosion of aphids are the wide use of chemical insecticides (Dittrich & Ernst, 1990).

In present investigation incidence of *M. persicae* started in the month of February which was also previously reported by Muhammad *et al.,* 2013; Parvez & Ali, 2000). The population of *M. persicae* acquired its highest level in the month of March during the infestation season. March being the most active period has also been previously reported (Abbas et al., 2014; Muhammad et al., 2013; Akhtar et al., 2010; Wains et al., 2010). The drop in aphid population was seen in the third week of March. Earlier researchers have reported decline of the aphid population in the second week of March (Muhammad et al., 2013; Khan et al., 2012; Tabassum et al., 2012). The slight difference in the timings may be due to the climate change year by year.

Chlorpyriphos remained highly effective to green peach aphids both in recommended dose and two fold serially diluted dose. Effectiveness and absence of resistance to organophosphate insecticide, chlorpyriphos was earlier reported in *M. persicae* population with high carboxylesterase activities (O'Hara, 1992), and no evidence of resistance was detected to chlorpyriphos (Unruh, 1996).

It was concluded from the results of the studies that insecticides such as chlorpyriphos belonging to organophosphate group of insecticides proved highly effective both in recommended as well as in 2 fold dilutions.

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Received: August, 27, 2019; *Accepted:* September, 25, 2019; *Published:* June, 30, 2020