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Effect of Spot Application of Imidacloprid 17.8 SL on Mustard Aphid (*Lipaphis erysimi*) under Conservation Agricultural Practices, West Bengal, India

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A B S T R A C T

An experiment was conducted at Balindi Research Complex Farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal during*Rabi* season of 2018-2019 to evaluate the impact of spot application of Imidacloprid 17.8 SL @ 0.3 ml per litre of water to suppress the initial population of the mustard aphid (*Lipaphis erysimi*) to check build up of destructive form. The pesticide was applied as spot application in three different tillage with five different fertilizers regimes in five mustard cultivars (B- 54, ADV- 414, B- 9, Bullet, TBM- 204). Among the tillage, the best performance of imidacloprid was noted in zero tillage, recorded 4.95 aphid/twig followed by the reduced tillage and conventional tillage. Again, among the nutrient residue combinations, the best result of the pesticide was obtained against the aphid in 100% paddy straw residue + 75% N. P. K treated plots (5.83 aphid/twig) at10th days after spraying. The pesticide treated in mustard variety ADV-414 recorded lowest aphid population (1.33 aphid/twig) with highest yield (1.5t/ha).

Introduction

Rapeseed and mustard (*Brassica* spp.) is the third most important oilseed crop in the world in terms of production and area and second most important of the country after groundnut contributing nearly 25-28% of total oil seeds production (Krishna Murthy and Bhatnagar, 1998; Mandal *et al.*, 2018). It is mainly cultivated in Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, Assam, Gujarat, Maharashtra, Haryana and West Bengal (Das *et al.*, 2019).Rape seed mustard oil is used primarily for edible purpose and as well as cooking oil. Besides, seeds are used as condiments, preparation of salad, juice curries and pickles. The meal cake left after oil extraction considered as important cattle feed and organic manure (Chand *et al.*, 2017). Thirty eight insect pests species are known to be associated with mustard crop in India and among them aphid (*Lipaphis erysimi*), sawfly (*Athalia lugens proxima*), painted bug (*Bagrada hilaris*), leaf miner (*Chromatomyia*

horticola) are important and mustard aphid has gained the attention of key pest status due to its havoc damage potentiality (Bakhetia and Sekhon, 1989; Das, 2002).It is a cosmopolitan insect and colonizesin the leaf surfaces and in leaf folds of the developing heads, on leaf stalks and on leaf axles. They are found on the growing points of the host plants, including tips, flowers and developing pods and cover the entire plant with high population density (Nelson and Rosenheim, 2006). All the stages of the population suck the plant sap continuously leads to stunting, distorting, and yellowing of the host plant (Khan *et al.,* 2015). The substantial yield losses due to aphid infestation have been estimated as 20 to 50%, and it could be as high as 78% if proper management strategy has not been taken (Prasad and Phadke, 1983). In order to suppress the aphid problem, farmers are mainly depend on the extensive use of chemical insecticides which leads to death of natural enemies, honey bees and create imbalance in the agro ecosystem (Ahlawat *et al.,* 2015). Considering the management aspect spot application of insecticide has been taken into our major consideration on the infested plants observing the initial damage symptoms caused by the insect pest with the aim of complete destruction of invading pest population to disrupt the scope of the pest to attain in destructive form and to minimize the use of the pesticide for the safety of the natural enemies and the ecosystem.

Materials and Methods

Location of Experimental field and statistical analysis

The research was conducted at Balindi Research Complex Farm (22°57'49" N 88°32'10"E 10 m above mean sea level), Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India during *Rabi* season of 2018-2019.Statistical analysis has been done by using SPSS version 20 by following split-split plot design where tillage in main plots, nutrient-residue combinations in the sub plots and the cultivars were allotted in the sub-sub plots.

Field preparation

The entire field was divided into three different tillage systems as conventional tillage (CT), reduced tillage (RT) and zero tillage (ZT) based on the tillage intensity. To prepare the conventionally tilled mustard field, two passes of cultivator and one pass of rotavator were assigned. Similarly, for the proper tilth of RT field one pass each of cultivator and rotavator were used. In case of zero tillage no tillage was given. Effective field capacity of cultivator was recorded 0.35ha/h in both the tillage systems and the very for rotavator was 0.32ha/h and 0.35 ha/h respectively in CT and RT.

Sowing of crop and fertilizer management

Five cultivar of Mustard crop i.e. B- 54, ADV- 414, B- 9, Bullet, TBM- 204 were shown on 9th November, 2018 with the seed rate 6 kg / ha and spacing 30 cm x 10 cm. The fertilizer dose was given as per recommendation i.e. 80:40:40 NPK kg/ha. Seeding and fertilizer application was done mechanically by multi-crop seed cum fertilizer drillhaving inclined plate metric mechanism for conventional practiced and reduced tillage practiced and the similar seeding machine attached with inverted 'T'-type furrow opener was used for zero tillage practice for mustard cultivation.

Application of Insecticide and impact study

Imidacloprid 17.8 SL, a neonicotinoid group of insecticide was given @ 0.3 ml / liter of water as spot application at 30 days after crop

sowing by using Knapsack sprayer. Before application, pre-treatment count was taken (aphid population / 10 cm of plant twig) and post treatment count was taken after 1 day after spraying, 3 days after spraying, 7 days after spraying and 10 days after spraying from five different varieties in three tillage plots with five different nutrient-residue combinations.

Results and Discussion

Effect of Imidacloprid on *Lipaphis erysimi* in different tillage treatment

The data on pest population (aphid population/plant twig) recorded during the experimental period reveals that highest population of mustard aphid was noticed in conventional tillage (169.56) followed by reduced tillage (154.46) and zero tillage (147.52) at pre-treatment condition. At 1 day after treatment, maximum mean population was observed in the conventional tillage (167.68) and the lowest population was recorded in the zero tillage (127.58) (Fig. 1).

The impact of spot application drastically reduced the aphid population 3 days after spraying and subsequent days. The lowest population (111.99) was recorded 3 days after spraying in zero tillage plot while the maximum (140.89) was observed in conventional tillage it. At 10 days after spraying performance of zero tillage condition was superior to other tillage showing very less number of aphid population (4.95) (Table 3).

Effect of Imidacloprid on *Lipaphis erysimi* in different nutrient-residue combinations

In the present experiment, each tillage plot was subdivided with five different nutrient-residue combinations. During pre-treatment count, maximum pest infestation (245.09) was recorded at 5th nutrient-residue combination i.e. 50% paddy straw residue + 75% N.P.K which was followed by (177.79) in 3rd nutrient-residue combination (100% paddy straw residue + 75% N.P.K), 155.09 in 1st nutrient-residue combination (0% paddy straw residue + 100% N.P.K), 152.36 in 4th nutrient-residue combination (50% paddy straw residue + 100% N.P.K) and 132.25 in 2nd nutrient-residue combination (100% paddy straw residue + 50% N.P.K) (Fig. 2).

At one day after spray, lowest pest population (75.81) was occurred in 100% paddy straw residue+ 50% N.P.K and highest (147.06) was recorded from 100% paddy straw residue + 75% N.P.Kand 3rd days after spraying there was a significantly reduction in pest population (30.68) in 100% paddy straw residue + 50% N.P.K and 50% paddy straw residue + 100% N.P.K. At 7th days after spraying and onwards the pest population was significantly reduced from the field and lowest population was occurred in 100% paddy straw residue + 75% N.P.K combination (Table. 4).

Effect of Imidacloprid on *Lipaphis erysimi* in different mustard cultivars

Five different mustard cultivars were taken for this study. From the experimental study it was observed that before insecticide application, cultivar ADV 414 showed superiority by harbouring less insect population (141.85) among all others varieties. At 1st day after spraying, ADV 414 performed best showing very less population (80.06) and rest varieties remaining susceptible to pest attack (Fig. 3).

Spot application of Imidacloprid significantly abridged the aphid population form 7 days after spraying. At 10 days after spraying less aphid population (1.33) was recorded from ADV 414 cultivar among all other cultivars (Table. 5).

Table.1 Field Layout of the experimental design at Balindi Research Complex Farm of Bidhan Chandra Krishi Viswavidyalaya

Conventional tillage					Zero tillage					Reduced tillage				
1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.	1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.	1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.
B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54	B-54
ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414	ADV-414
B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9	B-9
Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet	Bullet
TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204	TBM-204

Table.2 Experimental treatment details

Name of the crop	Cultivar	Tillage	Nutreint-residue combination
Mustard	B-54	Conventional tillage (CT)	N-R 1: 0% paddy straw residue+ 100% N.P.K
	ADV-414		N-R 2: 100% paddy straw residue+ 50% N.P.K
	B-9		N-R 3: 100% paddy straw residue+ 75% N.P.K
	Bullet		N-R 4: 50% paddy straw residue+ 100% N.P.K
	TBM-204		N-R 5: 50% paddy straw residue+ 75% N.P.K
	B-54	Zero tillage (ZT)	N-R 1: 0% paddy straw residue+ 100% N.P.K
	ADV-414		N-R 2: 100% paddy straw residue+ 50% N.P.K
	B-9		N-R 3: 100% paddy straw residue+ 75% N.P.K
	Bullet		N-R 4: 50% paddy straw residue+ 100% N.P.K
	TBM-204		N-R 5: 50% paddy straw residue+ 75% N.P.K
	B-54	Reduced tillage (RT)	N-R 1: 0% paddy straw residue+ 100% N.P.K
	ADV-414		N-R 2: 100% paddy straw residue+ 50% N.P.K
	B-9		N-R 3: 100% paddy straw residue+ 75% N.P.K
	Bullet		N-R 4: 50% paddy straw residue+ 100% N.P.K
	TBM-204		N-R 5: 50% paddy straw residue+ 75% N.P.K

Table.3 Mean population of mustard aphid at different tillage at different days after spraying

TILLAGE	PRE. TRT COUNT	1 DAT	3 DAT	7 DAT	10 DAT
CT	169.56	167.68	140.89	64.74	24.38
ZT	147.52	127.58	111.99	27.57	4.95
RT	154.46	135.00	121.14	31.04	5.95
MSE	220.06	962.87	349.01	2.59	0.19
SE(d)	**2.42**	**5.07**	**3.05**	**0.26**	**0.07**
CD(0.05)	**6.72582**	**14.06881**	**NS**	**0.730254**	**0.198977**
Mean	**157.18**	**143.42**	**124.67**	**41.12**	**11.76**
CV(%)	**9.437806**	**21.63559**	**14.98479**	**3.917363**	**3.732384**

Table.4 Mean population of mustard aphid at different nutrient residue combinations at different days after spraying

N-R Comb.	Pre. Trt Count	1 DAT	3 DAT	7 DAT	10 DAT
N-R 1	155.09	147.06	77.23	45.66	21.65
N-R 2	132.25	75.81	30.68	26.30	20.48
N-R 3	177.79	87.22	49.54	17.40	5.83
N-R 4	152.36	102.89	47.45	18.08	10.70
N-R 5	245.09	144.86	73.46	20.47	8.14
MSE	1775.64	896.82	133.37	5.02	0.51
SE(d)	**8.883548**	**6.313372**	**2.43463**	**0.472279**	**0.150255**
CD(0.05)	**18.33474**	**13.03016**	**5.024829**	**0.974737**	**0.310111**
Mean	172.51	111.57	55.67	25.58	13.36
CV(%)	**24.42598**	**26.84146**	**20.74361**	**8.756916**	**5.335438**

Table.5 Mean population of mustard aphid at different cultivars at different days after spraying

VAR.	Pre. Trt Count	1 DAT	3 DAT	7 DAT	10 DAT
B-54	171.41	106.09	42.33	7.28	1.84
ADV 414	141.85	80.06	31.06	4.95	1.33
B 9	144.12	98.69	42.42	6.76	2.01
Bullet	180.18	104.39	44.21	7.34	1.52
TBM 204	185.01	118.63	48.36	7.59	2.09
MSE	2830.48	1180.29	162.57	4.46	0.62
SE(d)	**11.21602**	**7.242732**	**2.687986**	**0.445181**	**0.165411**
CD(0.05)	**22.20694**	**14.3401**	**5.322024**	**0.881428**	**0.327503**
Mean	164.51	101.57	41.67	6.78	1.76
CV(%)	**32.33893**	**33.82433**	**30.59635**	**31.13532**	**44.62429**

Fig1 Graphical representation of mean population of *Lipaphis erysimi* in different tillage at different days after spraying

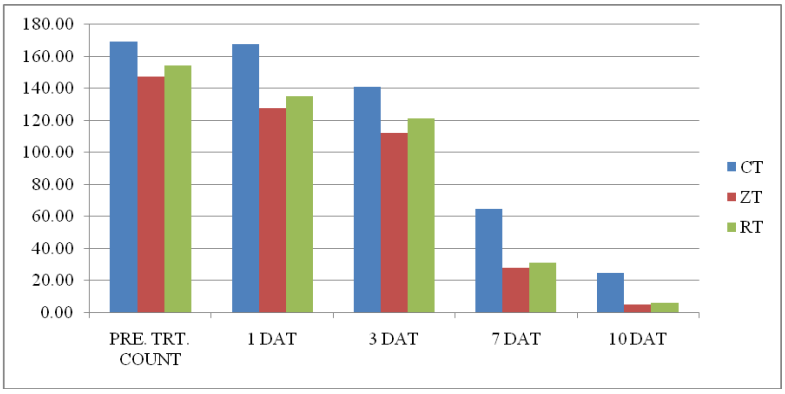


Fig.2 Graphical representation of mean population of *Lipaphis erysimi* in different nutrient residue combinations at different days after spraying

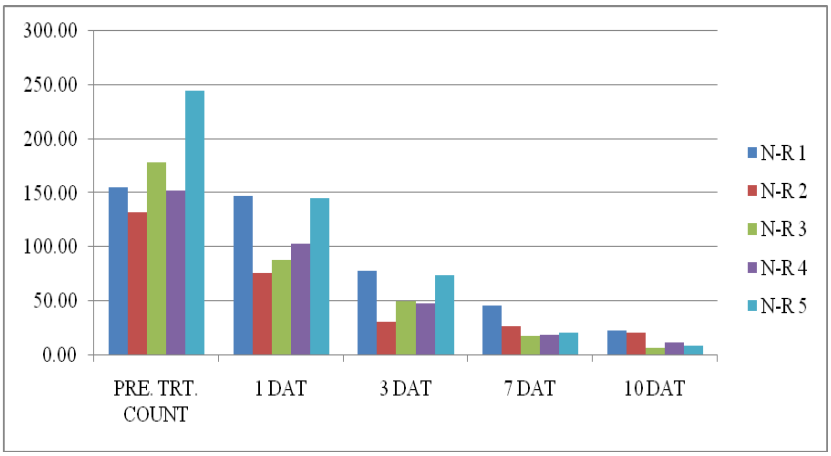
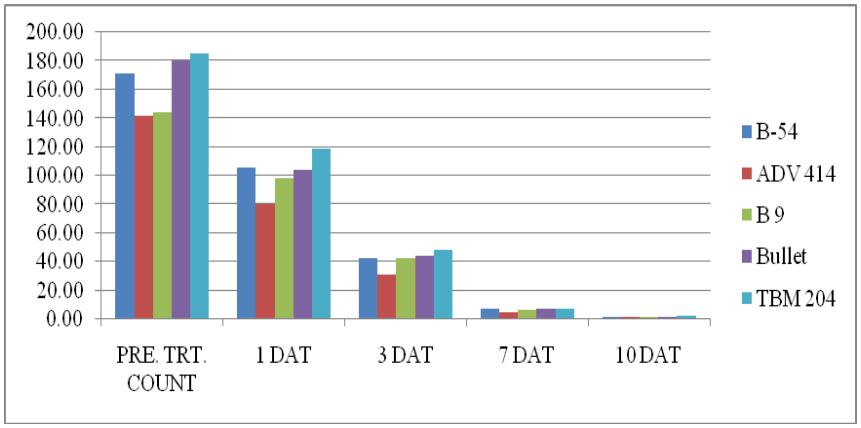


Fig.3 Graphical representation of mean population of *Lipaphis erysimi* in different cultivars at different days after spraying



Mustard aphid (*Lipaphis erysimi*) is the major biotic threat to late sown mustard cultivation which leads to 100 % yield loss in severe attack (Bakhetia and Arora, 1986). In order to management of this insect pest many insecticides are taken for trial experiment and among them Imidacloprid has been found very promising by reducing the pest population in significant level and yield maximum benefit cost ratio (Konar *et al.*, 2011; Deeve and Baruah, 2012). Both Imidacloprid and Thiomethoxam were found as effective against the aphid population (Rohilla *et al.*, 2004). Other than Imidacloprid, dimethoate was reported toxic to mustard aphid in field condition and increasing the yield of mustard (Sinha *et al.*, 2001). Khurana & Batra (1989) reported that cypermethrin was most effective against mustard aphid infesting on mustard under late sown condition. Imidacloprid 17.8% SL + NSKE 5%combination was found to be effective in suppressing the aphid population in a significant level (Lal *et al.*, 2018). Considering the perusal of available of literatures, the present study was focussed on the use of spot application of Imidacloprid 17.8 SL in mustard crop to avoid the primary invading pest population from the field. From our experimental result it has been shown that, spot application technique has successfully suppressed the entire aphid population from the field. So far, various experiments had been carried out emphasizing on the management aspect of mustard aphid by using different insecticides having diverse mode of action. In the present experiment we have tried to manage this destructive pest in a different way with the aim of suppression of the pest problem, minimize the toxicity of insecticides on natural enemies and to reduce the chance of toxic deposition of pesticides in soil and environment.

In conclusion the considering of the various management practices adopted against aphid management in the mustard crop, the spot application of Imidacloprid 17.8 SL @ 0.3 ml per litre of water is better option towards achieving highest yield and suppressing the pest with less disturbance to the crop ecosystem.

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