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RF Chaudhary

Agroforestry Research Station,
S.D. Agricultural University,
Sardarkrushinagar,
Banaskantha, Gujarat, India

JR Patel

Agroforestry Research Station,
S.D. Agricultural University,
Sardarkrushinagar,
Banaskantha, Gujarat, India

Mahesh Chaudhary

Agroforestry Research Station,
S.D. Agricultural University,
Sardarkrushinagar,
Banaskantha, Gujarat, India

Evaluation of new and conventional insecticides for the management of mustard aphid (*Lipaphis erysimi* kalt)

RF Chaudhary, JR Patel and Mahesh Chaudhary

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Abstract

Field experiment was conducted during rabi season of 2016-17 and 2018-19 at Maize Research Station, Sardarkrushinagar Dantiwada Agricultural University, Khedbrahma to study the effect of new insecticides against mustard aphid, *Lipaphis erysimi* K. on mustard. Experiment was laid out in Randomized Block Design with nine treatments. The least aphid population was registered in plots treated with seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 liter of water (0.01%) during two years. It was followed by seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 liter of water (0.01%).

Keywords: mustard, aphid, insecticide

Introduction

Mustard crop plants belong to the *Brassicaceae* family. Members of this genus are informally known as cruciferous plants. Most common species of this crop are *B. campestris*, *B. napus* and *B. juncea*. This crop is grown in *Rabi* growing season in both irrigated and rain fed areas of India (Ahmed *et al.*, 2018)^[1]. Mustard occupies a supreme position as a source of edible oil for human. The production of mustard is low in India as compared to other countries mainly due to damage caused by insect pest and diseases including other factors. More than 43 species of insect pests infest mustard crop in India, out of which about a dozen of species are considered as major pest (Mandal *et al.*, 2012)^[4]. Mustard crop is highly vulnerable to insect pests at different stages of growth, of which mustard aphid (*Lipaphis erysimi* kalt) is the key pest followed by whitefly, mustard saw fly, painted bug and pea leaf miner (Sahito *et al.*, 2016)^[9]. These are responsible for reducing yield. These pests could be controlled to some extent by chemical pesticides. New molecules for seed treatment and for spraying are available in market but information on these molecules is scanty. Considering yield losses due to this pest, chemical control measures are suggested and in many cases seed yield loss have been minimized. The present investigation was carried out with the objective to find out the effective insecticides against aphid of mustard.

Material and methods

The experiment was conducted at Maize Research Station, Sardarkrushinagar Dantiwada Agricultural University, Khedbrahma, Gujarat (India), during *rabi* season of 2016-17 and 2018-19. GDM 4; a cultivar extensively sown in the field area was used as test crop. The experiment was laid out in Randomized Block Design with three replications. Individual size of the plot was 5.0 m x 2.7 m along with spacing of 45 cm X 15 cm and fertilizer was used at ratio of 50:50:00 NPK (kg/ha). Respective seed treatment of insecticides was given to the seed at the time of sowing. Spray of insecticides were applied when ETL of aphid cross 1.5 A. I. and observation recorded. Five plants were selected randomly from each plot and aphid index per plant were recorded. Observation of mustard aphid was recorded before spray and 1, 3 and 7 days after spray. Agronomic practices for growing of the crop were followed as per recommendations of the region.

The average aphid index was worked out by using following formula,

$$\text{Average aphid index} = \frac{0N + 1N + 2N + 3N + 4N + 5N}{\text{Total number of plants observed}}$$

Corresponding Author:**RF Chaudhary**

Agroforestry Research Station,
S.D. Agricultural University,
Sardarkrushinagar,
Banaskantha, Gujarat, India

Experimental details	
Treatments	
T1	Seed treatment with imidacloprid 600 FS @ 5 ml/kg seed
T2	Seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed
T3	T1 + spray of flonicamid 50 WG @ 2.0 g/10 lit. Water (0.01%)
T4	T1 + spray of dimethoate 30 EC @ 10 ml /10 lit. Water (0.03%)
T5	T2 + spray of flonicamid 50 WG @ 2.0 g/10 lit. Water (0.01%)
T6	Spray of imidacloprid 17.8 SL @ 20 g a.i./ha
T7	Spray of thiamethoxam 25 WG @ 25 g a.i./ha
T8	Spray of fipronil 5 SC @ 50 g a.i./ha
T9	Control (untreated water spray)

Aphid index

Index	Description
0	Plant free from aphids
1	Aphids present but colonies not built up. No injury due to pest appearance on plant.
2	Small colonies of aphids present on leaves of plant. Such leaves exhibit slight curling due to aphid feeding.
3	Large colonies of aphids present on leaves and others parts, damage symptoms visible due to aphid feeding.
4	Most of the leaves covered with aphid colonies and the plant shows more damage symptoms due to aphid feeding.
5	The plant completely covered with aphid colonies, plant growth hindered due to feeding (stunting).

Where,

0, 1, 2, 3, 4, and 5 are aphid index

N = Number of plants showing respective aphid index.

Results and Discussion

During the 2016-17 and 2018-19 later stage aphid population was initiated so spray was applied. The result in table 1 revealed that the aphid index was not significantly differed at before spray.

The result (table 2) at one day after spray revealed that the minimum aphid population recorded in the plot seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. Water (0.01%) during both years as well as in pooled. It was at par with seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. water (0.01%), spray of imidacloprid 17.8 SL @ 20 g a.i./ha, spray of thiamethoxam 25 WG @ 25 g a.i./ha and seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of dimethoate 30 EC @ 10 ml /10 lit. water (0.03%) during 2016-17. While during 2018-19 it was non significant, where as it was at par with the seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. water (0.01%) in pooled result.

The results presented in table 3 indicated that the minimum aphid population (1.37 A.I.) recorded at three days after spray in the seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. Water (0.01%) and was at par with seed treatment with

thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. water (0.01%) during both the years and pooled. Moreover it was at par with the seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of dimethoate 30 EC @ 10 ml /10 lit. water (0.03%), spray of imidacloprid 17.8 SL @ 20 g a.i./ha and spray of thiamethoxam 25 WG @ 25 g a.i./ha.

At seven days after spray, result presented in table 4. It can be revealed from the data that the seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit found least aphid index during both the years and pooled. It was at par with the seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. Water (0.01%). So these both the treatment seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10lit.water (0.01%) and seed treatment with thiamethoxam 35 FS @ 6 ml/kg seed + spray of flonicamid 50 WG @ 2.0 g/10 lit. water (0.01%) exhibited significantly superior as compared to the rest of the treatments at seven days after sprays for aphid control.

Singh and Verma (2008) [7] reported that imidacloprid 70 WS @ 5 g and 10 g a.i/kg seed controlled the aphid population on mustard when used as seed treatment. Sahoo (2012) [6] reported that dimethoate 30 EC and oxydemeton-methyl 25 EC were proved to be more effective against mustard aphid (*L. erysimi*). Kalasariya (2016) [2] revealed that schedule 4 consisting of flonicamid 0.02 per cent at seedling stage, flubendamide 0.014 per cent at pre-flowering stage, azadirachtin 0.15 per cent at 50% flowering stage and acephate + fenvalerate 0.028 per cent at 50% pod formation stage was significantly found most effective treatment which recorded lowest aphid index (1.1) over stage of the crop and year, whereas the schedule S3 (1.4 aphid index) proved next better effective in comparison to control schedule S6. Maurya *et al.* (2018) [5] revealed that thiamethoxam 25% WG @ 100 g/ha was found most effective treatment in reducing the aphids population followed by acephate 75 SP @ 500g/ha. The pymetrozine 50 WG @ 250 g/ha was recorded less effective. Among conventional insecticides imidacloprid 17.8 SL @ 150 ml/ha was found more effective than dimethoate 30% EC @ 1000 ml/ha and fipronil 5 SC @ 1000 ml/ha. Khedkar *et al.* (2012) [3] reported that the imidacloprid 17.8 SL (0.008%), acetamiprid 20 SP (0.01%) and thiamethoxam 25 WG (0.0125%) proved to be more effective against *L. erysimi* followed by acephate (0.075%), dimethoate (0.03%) and thiacloprid (0.024%). Clothianidin (0.025%), flonicamid (0.015%) and phosphamidon (0.03%) found less effective. Sohial *et al.* (2011) [8] showed that Fastkil (Methomyl) was more toxic to the mustard aphid (*L. erysimi*) population followed by Actara (Thiamethoxam) (high), Actara (medium) and Actara (low), respectively. Fastkil was found most lethal for the ladybird beetle population followed by Confidor (Imidacloprid) (high), Actara (low), Confidor (low), Confidor (medium), and Actara (medium) respectively.

Table 1: Effect of new insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard

Treatment No.	Treatments	Aphid Index		
		Before spray		
		2016-17	2018-19	Pooled
1	Seed treatment with Imidacloprid 600 FS @ 5 ml/kg seed	1.54* ^a (2.37)	1.54* ^a (2.36)	1.54* ^a (2.37)
2	Seed treatment with Thiamethoxam 35 FS @ 6 ml/kg seed	1.53 ^a (2.34)	1.56 ^a (2.43)	1.54 ^a (2.38)
3	T1 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.48 ^a (2.19)	1.57 ^a (2.46)	1.52 ^a (2.33)
4	T1 + spray of Dimethoate 30 EC @ 10 ml /10 lit. Water (0.03%)	1.53 ^a (2.34)	1.57 ^a (2.46)	1.55 ^a (2.39)
5	T2 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.52 ^a (2.31)	1.53 ^a (2.35)	1.52 ^a (2.33)
6	Spray of Imidacloprid 17.8 SL @ 20 g a.i./ha	1.54 ^a (2.37)	1.60 ^a (2.56)	1.57 ^a (2.46)

7	Spray of Thiamethoxam 25 WG @ 25 g a.i/ha	1.54 ^a (2.37)	1.54 ^a (2.36)	1.54 ^a (2.37)
8	Spray of Fipronil 5 SC @ 50 g a.i/ha	1.55 ^a (2.40)	1.52 ^a (2.33)	1.54 ^a (2.36)
9	Control (untreated water spray)	1.55 ^a (2.40)	1.56 ^a (2.43)	1.56 ^a (2.42)
	S.Em.±	0.06	0.05	0.038
	C.D. at 5 %	NS	NS	NS
	C.V. %	7.20	5.83	6.54
	Y x T			NS

Notes: 1.*Figures are $\sqrt{x+0.5}$ transformed values, whereas figures in parentheses are retransformed values.

2. Treatment means with the letter/letters in common are not significant by DNMRT at 5% level of significance within a column.

Table 2: Effect of new insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard

Treatment No.	Treatments	Aphid Index		
		1 Days After spray		
		2016-17	2018-19	Pooled
1	Seed treatment with Imidacloprid 600 FS @ 5 ml/kg seed	1.58 ^a (2.50)	1.54 ^a (2.36)	1.56 ^{ab} (2.42)
2	Seed treatment with Thiamethoxam 35 FS @ 6 ml/kg seed	1.53 ^{ab} (2.34)	1.52 ^{ab} (2.50)	1.55 ^{ab} (2.41)
3	T1 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.30 ^c (1.69)	1.36 ^b (1.86)	1.33 ^d (1.78)
4	T1 + spray of Dimethoate 30 EC @ 10 ml /10 lit. Water (0.03%)	1.46 ^{abc} (2.13)	1.46 ^{ab} (2.13)	1.46 ^{bc} (2.13)
5	T2 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.39 ^{bc} (1.93)	1.39 ^{ab} (1.93)	1.39 ^{cd} (1.93)
6	Spray of Imidacloprid 17.8 SL @ 20 g a.i/ha	1.45 ^{abc} (2.10)	1.48 ^{ab} (2.20)	1.47 ^{abc} (2.15)
7	Spray of Thiamethoxam 25 WG @ 25 g a.i/ha	1.43 ^{abc} (2.04)	1.46 ^{ab} (2.13)	1.44 ^c (2.08)
8	Spray of Fipronil 5 SC @ 50 g a.i/ha	1.47 ^{ab} (2.16)	1.48 ^{ab} (2.19)	1.48 ^{abc} (2.18)
9	Control (untreated water spray)	1.59 ^a (2.53)	1.55 ^a (2.40)	1.57 ^a (2.46)
	S.Em.±	0.05	0.05	0.032
	C.D. at 5 %	0.16	NS	0.09
	C.V. %	6.17	5.29	5.74
	Y x T			NS

Notes: 1.*Figures are $\sqrt{x+0.5}$ transformed values, whereas figures in parentheses are retransformed values.

2. Treatment means with the letter/letters in common are not significant by DNMRT at 5% level of significance within a column.

Table 3: Effect of new insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard

Treatment No.	Treatments	Aphid Index		
		3 Days After spray		
		2016-17	2018-19	Pooled
1	Seed treatment with Imidacloprid 600 FS @ 5 ml/kg seed	1.59 ^a (2.53)	1.64 ^a (2.69)	1.61 ^a (2.60)
2	Seed treatment with Thiamethoxam 35 FS @ 6 ml/kg seed	1.60 ^a (2.56)	1.64 ^a (2.70)	1.62 ^a (2.63)
3	T1 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.08 ^c (1.17)	1.26 ^d (1.59)	1.17 ^f (1.37)
4	T1 + spray of Dimethoate 30 EC @ 10 ml /10 lit. Water (0.03%)	1.31 ^b (1.72)	1.39 ^{cd} (1.93)	1.35 ^{bcd} (1.83)
5	T2 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.20 ^{bc} (1.44)	1.30 ^{cd} (1.70)	1.25 ^{ef} (1.56)
6	Spray of Imidacloprid 17.8 SL @ 20 g a.i/ha	1.28 ^b (1.64)	1.41 ^{cd} (2.00)	1.35 ^{bcd} (1.81)
7	Spray of Thiamethoxam 25 WG @ 25 g a.i/ha	1.25 ^b (1.56)	1.41 ^{cd} (2.00)	1.33 ^{bcd} (1.77)
8	Spray of Fipronil 5 SC @ 50 g a.i/ha	1.32 ^b (1.74)	1.46 ^{bc} (2.13)	1.39 ^b (1.93)
9	Control (untreated water spray)	1.61 ^a (2.59)	1.62 ^{ab} (2.63)	1.62 ^a (2.61)
	S.Em.±	0.04	0.05	0.032
	C.D. at 5 %	0.13	0.14	0.09
	C.V. %	5.54	5.59	5.57
	Y x T			NS

Notes: 1.*Figures are $\sqrt{x+0.5}$ transformed values, whereas figures in parentheses are retransformed values.

2. Treatment means with the letter/letters in common are not significant by DNMRT at 5% level of significance within a column.

Table 4: Effect of new insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard

Treatment No.	Treatments	Aphid Index		
		7 Days After spray		
		2016-17	2018-19	Pooled
1	Seed treatment with Imidacloprid 600 FS @ 5 ml/kg seed	1.71 ^a (2.92)	1.74 ^a (3.02)	1.72 ^a (2.97)
2	Seed treatment with Thiamethoxam 35 FS @ 6 ml/kg seed	1.74 ^a (3.03)	1.79 ^a (3.19)	1.74 ^a (3.11)
3	T1 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	0.93 ^e (0.86)	1.11 ^d (1.23)	1.02 ^c (1.04)
4	T1 + spray of Dimethoate 30 EC @ 10 ml /10 lit. Water (0.03%)	1.16 ^b (1.35)	1.34 ^{bc} (1.80)	1.25 ^b (1.57)
5	T2 + spray of Flonicamid 50 WG @2.0 g/10 lit. Water (0.01%)	1.00 ^{bcd} (1.00)	1.20 ^{cd} (1.43)	1.10 ^c (1.21)
6	Spray of Imidacloprid 17.8 SL @ 20 g a.i/ha	1.16 ^b (1.35)	1.35 ^{bc} (1.83)	1.25 ^b (1.57)
7	Spray of Thiamethoxam 25 WG @ 25 g a.i/ha	1.14 ^{bcd} (1.30)	1.38 ^b (1.90)	1.26 ^b (1.58)
8	Spray of Fipronil 5 SC @ 50 g a.i/ha	1.18 ^b (1.39)	1.41 ^b (2.00)	1.29 ^b (1.68)
9	Control (untreated water spray)	1.71 ^b (2.92)	1.80 ^a (3.23)	1.75 ^a (3.07)
	S.Em.±	0.05	0.05	0.035
	C.D. at 5 %	0.15	0.14	0.10
	C.V. %	6.61	5.55	6.06
	Y x T			NS

Notes: 1.*Figures are $\sqrt{x+0.5}$ transformed values, whereas figures in parentheses are retransformed values.

2. Treatment means with the letter/letters in common are not significant by DNMRT at 5% level of significance within a column.

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