ISSN 2277-9663
AGRES - An International e-Journal

Volume 1 Issue 1 January-March,2012

EFFICACY OF DIFFERENT CHEMICAL INSECTICIDES AGAINST MUSTARD APHID, *LIPAPHIS ERYSIMI* (KALTENBACH) INFESTING MUSTARD

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ABSTRACT

Investigations on evaluation of chemical insecticides for their efficacy against aphid, *Lipaphis erysimi* (Kaltenbach) infesting mustard was carried out at Anand Agricultural University, Anand (Gujarat) during 2010-11. Among the different synthetic insecticides evaluated for their bio-efficacy against *L. erysimi*, imidacloprid 17.8 SL (0.008%), acetamiprid 20 SP (0.01%) and thiamerthoxam 25 WG (0.0125%) proved to be more effective 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. The highest number of grain, test weight and seed yield was recorded from the plots treated with imidacloprid (0.008%) followed by thiamerthoxam (0.0125%), acetamiprid (0.01%) and acephate (0.075%) and recorded 55.60 to 52.59 per cent increase in yield over control. The mustard plots treated with the phosphamidon (0.03%) recorded the lowest number of grain, test weight and seed yield followed by thiacloprid (0.024%), clothianidin (0.025%), flonicamid (0.025%) and dimethoate (0.03%). Overall effectiveness of various insecticides on the basis of their effectiveness against aphid and their toxicity to natural enemies as well as yield and yield attributing characters, imidacloprid 17.8 SL 0.08% found most effective and economical insecticide than rest of the insecticidal treatments and occupied first rank followed by acetamiprid 20 SP 0.01%, acephate 75 SP 0.075% and thiamerthoxam 25 WG 0.0125%.

ISSN 2277-9663
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KEY WORDS: Mustard, Aphid, Chemical insecticides

INTRODUCTION

Mustard, *Brassica juncea* (Linnaeus) Czern and Coss belongs to family cruciferae and originated in China. Later on, it was introduced into North Eastern India. It is important oil seed crop of India which occupies an area of 6.30 million hectares with total production of 7.20 million tonnes and productivity of 1143 kg/ha during 2008-2009 (Anon., 2010a). It is also important *rabi* oil seed crop of Gujarat cultivated in about 0.29 million hectares of area with total production of about 0.33 million tonnes and average productivity of 1636 kg/ha (Anon., 2010_b). Among various biotic factors responsible for reducing the yield of mustard, insect pests are the major one. According to Bakhetia and Sekhon (1989), 38 insect pests are known to be associated with rapeseed-mustard crop in India. On the basis of their economic importance, the insect pests of mustard crop may be grouped into, key pest: aphid, *Lipaphis erysimi* (Kaltenbach), major pests: sawfly, *Athalia lugens proxima* (Klug); painted bug, *Bagrada cruciferarum* Kirkaldy and leaf miner, *Chromatomyia horticola* Goureau, minor pests: Bihar hairy caterpillar, *Diacrisia abliqua* Walker; cabbage butterfly, *Pieris brassicae* Linnaeus; flea beetle, *Phyllotreta cruciferae* Goeze and green aphid, *Myzus persicae* Seltzer, new pests: leaf webber, *Crocidolomia binotalis* Zeller; borer, *Hellula undalis* Fabricius and whitefly, *Bemisia tabaci* Gennadius. Among these, aphid, *L. erysimi* is the key pest in all the mustard growing regions of the country. The nymphs and adults of the aphid suck the cell sap from the inflorescence, terminal twig, siliqua (pod), leaves and branches. On severe infestation, plant gets poor pod formation, leaves get curled, shrivel and plants become completely dried. On the other hand, aphid produces a good amount of honeydew which facilitates the growth of the fungus that makes the leaves appear dirty black (Awasthi, 2002). *L. erysimi* causes 35.4 to 73.3 per cent yield loss, 30.09 per cent seed weight loss and 2.75 per cent oil loss as reported by Bakhetia and Sekhon (1989), Singh and Premchand (1995) and Sharma and Kashyap (1998). The present study was carried out to evaluate the

different chemical insecticides against aphid, *L. erysimi* to avoid the yield losses in mustard.

MATERIALS AND METHODS

In order to study the effect of different synthetic insecticides against aphid, *L. erysimi,* the experiment was laid out in a Randomized Block Design with three replications having plot size of 3.6 × 4.0 m during *rabi* 2010-11 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. Mustard variety GM-2 was sown at spacing of 45 x 15 cm with recommended agronomical practices except plant protection for raising the crop. First spray application of respective insecticides was given on ETL level (1.5 aphid index/plant) and subsequently sprays were given at 20 days interval using manually operated continuous Knapsack sprayer having duromist nozzle. Aphid population was recorded in terms of aphid index (0-5) from randomly selected 10 plants before first spray and 3, 5, 7 and 10 day(s) after first, second and third spray applications. Number of natural enemies *i.e*., coccinellids (grubs and adults), chrysopids (eggs) and syrphid fly (larvae) were recorded on the randomly selected five plants. The population of *Diaeretiella rapae* was recorded by observing number of live and mummified (parasitized) aphids on 10 cm terminal twig of randomly selected 10 plants. Number of grains/pod, weight of 1000 grains and grain yield was also recorded. The yield of seed from each net plot was weighed separately. ICBR for each treatment was calculated by dividing net gain over control by total cost of plant protection. Finally, Net Insecticidal Cost Benefit Ratio (NICBR) for each treatment was calculated by deducting one from gross ICBR.

RESULTS AND DISCUSSION

The data on aphid population over periods and sprays was also pooled and presented in Table 1. All chemicals recorded significantly lower aphid population than control. Imidacloprid (0.008%), thiamerthoxam (0.0125%) and acetamiprid (0.01%) found to be most effective chemicals against aphid than rest of the insecticidal treatments. The chronological

order of various insecticides based on aphid index (0-5) given in bracket was: imidacloprid 0.08 (0.54) > thiamerthoxam 0.0125 (0.60) > acetamiprid 0.01 (0.62) > dimethoate 0.03 (1.09) = acephate 0.075 (1.09) > thiacloprid 0.024 (1.22) > clothianidin 0.025 (1.66) > flonicamid 0.015 (1.69) > phosphamidon 0.03 per cent (1.90) > control (2.74). The next best group of chemicals was: acephate 0.075%, dimethoate 0.03% and thiacloprid 0.024% and were at par with each other. Whereas, Clothianidin 0.025%, flonicamid 0.015% and phosphamidon 0.03% found more or less equally effective as these treatments were statistically at par with each other. Overall, imidacloprid 0.08%, thiamethoxam 0.0125% and acetamiprid 0.01% were highly effective chemicals against mustard aphid, *L. erysimi*.

As per the report of Chinnabbai *et al.* (1999)**,** the highest mortality of mustard aphid was recorded in the plots treated with acetamiprid 0.02 (87.95%) followed by imidacloprid 0.017 % (66.25%) after 24 hours. Gour and Pareek (2003) also found imidacloprid 0.005 % as the most effective insecticide against aphid followed by dimethoate 0.03 % and acephate 0.05 %. Similarly, Rohilla *et al.* (2004) observed that imidacloprid 0.0178% and thiamethoxam 50 g a.i. /ha were highly effective insecticides against mustard aphid. According to Bapari *et al.* (2008), imidacloprid (17.8) SL 0.002 per cent showed the best knock-down effect *L. erysimi* on mustard and the longest persistency.

Natural enemies:

The data on coccinellids population pooled over periods and sprays (Table 1) showed that all insecticidal treatments recorded significantly lower coccinellids population than control. Phosphamidon recorded the highest (0.27/Plant) population of coccinellids and found to be the least toxic, however, it was at par with thiacloprid (0.24) followed by dimethoate (0.19) and flonicamid. Imidacloprid 0.008% recorded the lowest (0.11) population of coccinellids per plant and proved to be the most toxic chemicals although it was at par with thiamethoxam, acetamiprid, acephate and clothianidin.

Among the insecticides, plots treated with phosphamidon recorded the highest number of eggs of chrysopids, however, it was at par with

dimethoate, thiacloprid and clothianidin and found less toxic as compared to rest of the chemicals. While, lower number of eggs was observed in plots treated with imidacloprid 0.008% followed by flonicamid, acephate, thiamethoxam and acetamiprid and were found more or less equally toxic to chrysopids as they were at par with each other (Table 1).

The plots treated with phosphamidon recorded the highest larvae/plant and differed significantly from rest of treatments followed by flonicamid 0.015%, dimethoate 0.03% and thiacloprid 0.024%. While, Imidacloprid and thiamethoxam found toxic to syrphid fly larva and was at par with acephate and acetamiprid followed by clothianidin and thiacloprid (Table 1).

The data on number of parasitized aphids due to *D. rapae* phosphamidon 0.03% recorded significantly the highest (0.62/10 cm twig) number of parasitized aphids and found to be most safe insecticide. Imidacloprid, thiamethoxam, acetamiprid, flonicamid, acephate, thiacloprid, clothianidin and dimethoate were at par with each other and recorded lower (0.31 to 0.46 per 10 cm twig) number of parasitized aphids due to *D. rapae* (Table 1). Further, these insecticides found to be less safe to *D. rapae*, a parasite of aphid, *L. erysimi.*

The data on honey bees visits pooled over periods showed that, acetamiprid 0.01%, phosphamidon 0.03% and flonicamid 0.015% comparatively found safer as compared to dimethoate 0.03%, clothianidin 0.025%, thiamethoxam 0.0125%, acephate 0.075%, imidacloprid 0.008% and thiacloprid 0.024% (Table 1). As per the report of Gour and Pareek (2004), higher population of bee, *Apis cerana indica* was recorded from the mustard plots treated with cartap hydrochloride (0.04 and 0.08%), malathion (0.025 and 0.05%), dimethoate (0.015 and 0.03%). While, it was minimum in acephate (0.05%) followed by imidacloprid (0.05%), ethofenprox (0.004%) and cypermethrin (0.001 and 0.002%).

Impact of various botanicals on yield attributing characters:

The highest number of grain, test weight and seed yield was recorded from the plots treated with imidacloprid 0.008% followed by thiamethoxam 0.0125%, acetamiprid 0.01% and acephate 0.075% (Table

2). The mustard plots treated with the phosphamidon 0.03% recorded the lowest number of grain, test weight and seed yield followed by thiacloprid 0.024%, clothianidin 0.025%, flonicamid 0.025% and dimethoate 0.03%.

According to Gour and Pareek (2003), maximum seed yield was harvested by the spray application of imidacloprid 0.05% (14.9 q/ha) followed by dimethoate 0.03% (11.9 q/ha) and acephate 0.05% (11.1 q/ha). As per the report of Choudhary and Pal (2005), the highest yield of mustard was obtained in the plots treated with acephate 0.075% (12.31 q/ha) followed by thiamethoxam 0.0125% (12.24) and dimethoate 0.03% (11.03). Patel (2006) observed that the treatment imidacloprid gave the highest seed yield (1531 kg/ha) followed by thiamethoxam (1344) and acetamiprid (1225).

Economics

The economics of various synthetic insecticides (Table 3) revealed that the highest (22,125.00 Rs/ha) net realization was obtained from the treatment of imidacloprid 0.008% followed by thiamethoxam 0.0125% (20950.00 Rs/ ha), acetamiprid 0.01% (20,350.00 Rs/ ha), acephate 0.075% (19500.00 Rs/ ha) and flonicamid 0.015% (18025.00 Rs/ ha). The highest (1:20.72) Net Insecticidal Cost Benefit Ratio (NICBR) was registered from the plots treated with phosphamidon 0.03% followed by dimethoate 0.03% (1:19.16). Acephate 0.075% (1:14.25), acetamiprid 0.01% (1:11.15), flonicamid 0.015% (1:9.92) and imidacloprid 0.08% (1:9.05) also recorded higher NICBR.

CONCLUSION

Among the different synthetic insecticides evaluated for their bio-efficacy against aphid, *L. erysimi*, imidacloprid, acetamiprid and thiamerthoxam proved to be more effective. The highest seed yield was recorded from the plots treated with imidacloprid followed by thiamerthoxam, acetamiprid and acephate Overall effectiveness of various insecticides on the basis of their effectiveness against aphid and their toxicity to natural enemies as well as yield and yield attributing characters,

imidacloprid 17.8 SL 0.08% found most effective and economical insecticide than rest of the insecticidal treatments and occupied first rank followed by acetamiprid, acephate and thiamerthoxam.

REFERENCES

Anonymous (2010a). http://faostat.fao.org

Anonymous (2010b).http://http://dacnet.nic.in/eands/latest_2009.htm

Awasthi, V. B. (2002). Introduction to general and applied entomology. Scientific Publisher, Jodhpur (India) pp. 266-271.

Bakhetia, D. R. C. and Sekhon, B. S. (1989). Insect pests and their management rapeseed-mustard. *J. Oilseeds Res.,* **6**: 269-273.

Bapari, T., Bhattacharya, S. and Dhar, T. (2008). Screening of eco-friendly synthetic insecticides in different spray schedules against *Lipaphis erysimi* (Kalt.) (Aphididae: Hemiptera). *Environment and Ecology*, **26** (4B): 1945-1950.

Chinnabbai, C. H., Devi, C. H. R. and Venkataiah, M. (1999). Bio-efficacy of some new insecticides against the mustard aphid**,** *Lipaphis erysimi* (Kalt.) (Aphididae, Homoptera). *Pest Mgt. and Eco. Zoology,* **7** (1): 47-50.

Choudhary, S. and Pal, S. (2005). Efficacy of some newer insecticides against mustard aphid, *Lipaphis erysimi* Kalt. *Shashpa*, **12** (2): 125-126.

Gour, I. S. and Pareek, B. L. (2003). Field evaluation of insecticides against mustard aphid, *L. erysimi* (Kalt.) under semi-arid region of Rajasthan. *Indian J. Pl. Prot.*, **31** (2): 25-27.

Gour, I. S. and Pareek, B. L. (2004). Effect of insecticides on the incidence of honey bee, *Apis cerana indica* Fab. on mustard bloom under semi-arid region of Rajasthan. *Madras Agric. J.,* **91** (7-12): 430-432.

Patel, M. R. (2006). Population dynamics, varietal screening and bio-efficacy of insecticides against pest complex of mustard. *M. Sc. (Agri) thesis* submitted to N.A.U., Navsari. pp 40-43.

Rohilla, H. R., Bhatnagar P. and Yadav P. R. (2004). Chemical control of mustard aphid with newer and conventional insecticides. *Indian J. Ent.,* **66** (1): 30-32.

Sharma, P. K. and Kashyap, N. P. (1998). Estimation of losses in three different oil seed *Brassica* crops due to aphid complex in Himachal Pradesh (India). *J. Entom. Res.,* **22**: 22-25.

Singh, P. K. and Premchand (1995). Yield loss due to the mustard aphid *Lipaphis erysimi* (Kalt) in Eastern Bihar Plateau. *J. Appl. Zoological Res.,* **6**: 97-100.

ISSN 2277-9663
AGRES - An International e-Journal

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Table 1: Bio-efficacy of synthetic insecticides against *L. erysimi* in mustard

Treatments	Pooled over periods and sprays				Pooled over periods	
	Aphid index (0-5 scale)	No. of Predators / Plant		No. of chrysopids egg(s)/ plant	Parasitized aphids/10 cm twig due to *D. rapae*	Honey bees visits/plant/3 minutes
		Coccinellids (Grubs & Adults)	Syrphid fly (Larvae)			
1	2	3	4	5	6	7
Imidacloprid 17.8 SL @ 0.08%	1.02 (0.54)a	0.78a (0.11)	0.90a (0.31)	0.76a (0.08)	0.90a (0.31)	2.50ab (5.75)
Thiamethoxam 25 WG @ 0.0125%	1.05 (0.60)a	0.80ab (0.14)	0.92a (0.35)	0.78ab (0.11)	0.90a (0.31)	2.45ab (5.50)
Acetamiprid 20 SP @ 0.01%	1.06 (0.62)a	0.80ab (0.14)	0.95ab (0.40)	078ab (0.11)	0.91ab (0.33)	2.56b (6.05)
Clothianidin 50 WDG @ 0.025%	1.47 (1.66)c	0.81ab (0.16)	0.99bc (0.48)	0.80bc (0.14)	0.98b (0.46)	2.44ab (5.45)
Thiacloprid 48 SC @ 0.024%	1.31 (1.22)b	0.86cd (0.24)	1.03cd (0.56)	0.80bc (0.14)	0.96ab (0.42)	2.54ab (5.95)
Flonicamid 50 WG @ 0.015%	1.48 (1.69)c	0.83bc (0.19)	1.08de (0.67)	0.77ab (0.09)	0.93ab (0.36)	2.55b (6.00)
Acephate 75 SP @ 0.075%	1.26 (1.09)b	0.80ab (0.14)	0.93ab (0.36)	0.77ab (0.09)	0.93ab (0.36)	2.47ab (5.60)
Dimethoate 30 EC @ 0.03%	1.26 (1.09)b	0.83bc (0.19)	1.05cd (0.60)	0.83c (0.19)	0.98b (0.46)	2.39a (5.21)
Phosphamidon 40 SL @ 0.03%	1.55 (1.90)c	0.88d (0.27)	1.13e (0.78)	0.83c (0.19)	1.06c (0.62)	2.55b (6.00)
Control	1.80 (1.27)d	1.24e (1.04)	1.54f (1.87)	1.10d (0.71)	1.43d (1.54)	2.74c (7.01)
Mean	1.33 (1.27)	0.86 (0.24)	1.05 (0.60)	0.83 (0.19)	0.99 (0.48)	2.52 (5.85)

ISSN 2277-9663
AGRES - An International e-Journal

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ANOVA

S. Em. ±	0.03	0.01	0.02	0.01	0.02	0.06
Treatment (T)	0.01	0.01	0.01	0.01	0.01	0.04
Period (P)	0.01	0.01	0.01	0.01	0.01	-
Spray (S)	0.03	0.02	0.02	0.02	0.02	0.13
T x P	0.02	0.01	0.02	0.01	0.01	-
T x S	0.04	0.03	0.03	0.03	0.03	-
P x S	0.06	0.04	0.05	0.04	0.05	-
T x P x S						
C. D. at 5%	0.10	0.04	0.06	0.03	0.07	0.15
T	0.03	0.02	NS	0.03	0.03	0.12
P	0.02	0.02	0.02	0.02	0.02	-
S	NS	NS	NS	NS	0.06	NS
T x P	0.05	0.04	0.04	NS	0.04	-
T x S	0.11	0.08	NS	0.08	NS	-
P x S	NS	NS	NS	0.11	NS	-
T x P x S						
C. V. %	7.27	8.17	7.83	8.47	8.82	9.14

Notes:

1. Figures in parentheses are retransformed values; those outside are $\sqrt{X+0.5}$ value.

2. Treatment mean with letter(s) in common are not significant at 5 % level of significance within a column.

ISSN 2277-9663
AGRES - An International e-Journal

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Table 2: Impact of various botanical insecticides on yield attributing characters and seed yield of mustard.

Treatments	No. of grains/pod	Test weight (g) (wt. of 1000 seeds)	Seed yield (q/ha)	Increased in yield over control (%)
1	2	3	4	5
Imidacloprid 17.8 SL @ 0.08%	12.03a	6.08a	15.90a	55.66
Thiamethoxam 25 WG @ 0.0125%	11.98a	6.01a	15.43ab	54.31
Acetamiprid 20 SP @ 0.01%	11.86a	5.75ab	15.19abc	53.59
Clothianidin 50 WDG @ 0.025%	10.06c	5.58a	13.93c	49.39
Thiacloprid 48 SC @ 0.024%	10.72bc	5.55bc	13.79cd	48.87
Flonicamid 50 WG @ 0.015%	10.83b	5.17cd	14.26bc	50.56
Acephate 75 SP @ 0.075%	11.59a	5.91ab	14.87abc	52.59
Dimethoate 30 EC @ 0.03%	11.08ab	5.94ab	14.01bc	49.47
Phosphamidon 40 SL @ 0.03%	10.03c	5.15d	12.48d	43.51
Control (water spray)	7.48d	3.81e	7.05e	-
Mean	10.77	5.50	13.69	-
ANOVA				
S. Em. ± :	0.27	0.13	0.47	-
C. D. at 5%:	0.79	0.39	1.40	-
C. V. %	4.28	4.19	5.96	-

Notes:

1. Treatment mean with letter(s) in common are not significant at 5 % level of significance within a column

2. Percent Increase in yield over control = (Yield of treatment – Yield of control) / Yield of treatment X 100

ISSN 2277-9663
AGRES - An International e-Journal
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Table 3: Economic of various synthetic insecticides used for control of aphid *L. erysimi* infesting mustard

Insecticides	conc. (%)	Quantity of insecticides for two sprays (l or kg/ha)	Cost of insecticide (Rs/l or kg)	Total cost of plant protection for two sprays (Rs/ha)	Yield (q/ha)	Gross realization (Rs/ha)	Net realization over control (Rs/ha)	Net profit (Rs/ha)	ICBR	NICBR
Imidacloprid 17.8 SL	0.008	0.750 l	2400	2200.00	15.90	39,750	22,125	19925.00	1:10.05	1:9.05
Thiamethoxam 25 WG	0.0125	0.579 kg	3580	2472.82	15.43	38,575	20,950	18477.20	1:8.47	1:7.47
Acetamiprid 20 SP	0.01	0.579 kg	2200	1673.80	15.19	37,975	20,350	18676.20	1:12.15	1:11.15
Clothianidin 50 WDG	0.025	0.579 kg	10000	6190.00	13.93	34,825	17,200	11010.00	1:2.78	1:1.78
Thiacloprid 48 SC	0.024	0.579 kg	2300	1731.70	13.79	34,475	16,850	15118.50	1:9.73	1:8.73
Flonicamid 50 WG	0.015	0.347 kg	3600	1649.20	14.26	35,650	18,025	16376.80	1:10.92	1:9.92
Acephate 75 SP	0.075	1.00 kg	800	1200.00	14.87	37,175	19,500	18,300.00	1:15.25	1:14.25
Dimethoate 30 EC	0.03	1.157 l	400	862.80	14.01	35,025	17,400	16537.50	1:20.16	1:19.16
Phosphamidon 40 SL	0.03	0.750 l	300	625.00	12.48	31,200	13,575	12950.00	1:21.72	1:20.72
Control (water spray)	-	-	-	-	7.05	17,625	-	-	-	-