Research Article

MANAGEMENT OF *LIPAPHIS ERYSIMI* (KALT.) USING NEWER INSECTICIDES AND BIO-PESTICIDES IN RADISH

Megaladevi, P.[1*] and M. Manjunatha[2]
[1]*Department of Agricultural Entomology, AC&RI, TNAU, Coimbatore-641003. Tamil Nadu, INDIA*
[2]*College of Agriculture, UAHS, Shivamogga- 577225, Karnataka, INDIA*
**Corresponding author's E-mail: megaladevi27@gmail.com*

KEYWORDS:
Biopesticides, Insecticides, *Lipaphis erysimi*, Radish

ARTICLE INFO
Received on: 22.08.2019
Revised on: 11.11.2019
Accepted on: 12.11.2019

ABSTRACT

At present, there is a great deal of discussion on the resistance and resurgence of insects to commonly used insecticides which is of grave concern in crop protection. One of the solutions to the resistance problem is the rotation of newer insecticides with the conventional ones. Hence, an attempt has been made to evaluate newer insecticides and bio-pesticides to manage aphids *Lipaphis erysimi* (Kalt.) in radish. The field experiment was laid out in randomized block design (RBD) with three replications and 10 treatments with a plot size of 3 m x 2 m. In each plot, five plants were selected and tagged. The first spray was given after 18 days of sowing when sufficient buildup of aphid population was seen. Emamectin benzoate 5 SG @ 0.5 g/l was used as a blanket application for the management of defoliators. From each tagged plant, three leaves were selected from the upper, middle and lower part for counting the number of aphids per leaf with help of magnifying lens and the mean population of aphids per plant was worked out. Aphid population was recorded at one day before, three, seven and fourteen days after application of insecticides. The tuber yield per plant was recorded at each harvest separately for each treatment and the yield is converted to kg/plot. Obtained data were analyzed using ANOVA. Thiamethoxam, imidacloprid, and dimethoate were best and effective chemicals in reducing the population of aphids, whereas the two microbial pesticides were found to be less effective.

INTRODUCTION

Radish (*Raphanus sativus* L.) is grown for its tender tuberous roots which are eaten raw as salad or as cooked vegetable. The low yield of radish can be attributed to a wide variety of factors among which the range of insect pests is a predominant factor. Major insect pest of radish in India are aphids (*Brevicoryne brassicae* (L.), *Lipaphis erysimi* (Kalt.), *Myzus persicae* Sulz.and *Toxoptera aurantii* (Fon.)), the sawfly *Athalia lugens proxima* (Klug) [*A. lugens*] and flea-beetles (*Chaetocnema basalis* (Baly), *Monolepta signata* Olivier and *Phyllotreta chotanica* Duv.) and minor pests are *Thrips tabaci* Lind., *Crocidolomia pavonana* (F.), *Hellula undalis*Fab., *Spilosoma oblique* Walk. and *Spodoptera litura* Fab. Among which *Lipaphis erysimi* (Kalt.) is the predominant aphid species found in Shivamogga region. Many of its natural enemies can be used as biological control agents such as ladybirds (Coccinellidae) in radish crops and the wasp *Diaeretiella rapae* in broccoli. Regarding research on the role of natural enemies in the biological control of aphid, it has been mostly focused on the use of predacious insects *Coccinella septempunctata* L., *Menochilus sexmaculatus* (Fab.) and *Chrysoperla cornea* Stephens (Singh and Lal, 2011).

As it is very difficult to mass produce the predators for their release, emphasis has been given towards utilizing entomopathogens which are the potential bio-pesticides. Virtually very little work has been carried out on the role of the entomopathogenic fungi in the management of *Lipaphis erysimi* (Kalt.) in radish but the fungal pathogens are always commonly found infecting significant proportion of the aphid population and also they fit very well in a viable, sustainable, economical and eco- friendly integrated pest management strategy against this pest.

The fungus *Fusarium semitectum* Berk. and Rav. is known to effectively control aphids infesting cowpea, sugarcane and tobacco. Efforts have been made in the present study for detailed evaluation of the fungus *F. semitectum* against *Lipaphis erysimi* (Kalt.) infesting radish.

Vegetable growers largely depend on chemical pesticides to counter the problem of insect pests. Indiscriminate use of pesticides has led to severe ecological consequences like destruction of natural enemies' fauna, effect on non-target organisms, residues in consumable products and resistance to the pesticides, to which we solely rely. At present there is a great deal of discussion on the resistance and resurgence of insects to commonly used insecticides which is of a grave concern in crop protection. One of the solutions to the resistance problem is the rotation of newer insecticides with the conventional ones. Hence, an attempt has been made to evaluate newer insecticidal molecules to manage *Lipaphis erysimi* (Kalt.). Accordingly, toxicity of two newer molecules *viz*., imidacloprid and thiamethoxam were compared with most commonly used conventional insecticides like dimethoate in radish. Bio-intensive pest management (BIPM) is the recent trend in Indian farming and attracting the farmers for higher income to their produce on vegetables. Keeping these points in mind the present study was planned with the objective for management of aphids using newer insecticides and bio-pesticides.

MATERIALS AND METHODS

The variety used in this study is an Asiatic (tropical) variety type namely Arka Nishant, whose roots are medium-sized, 25 cm long, 3-4 cm in diameter, marble – white with crisp texture and mild pungency and it is resistant to pithiness, premature bolting, root branching and forking.

A field experiment was carried out at College of Agriculture, Shivamogga in order to find out the efficacy of newer insecticides and biopesticides against aphids on radish. The field experiment was laid out in randomized block design (RBD) with three replications and 10 treatments with a plot size of 3 m x 2 m. In each plot five plants were selected and tagged. First spray was given after 18 days of sowing when sufficient buildup of aphid population was seen. Emamectin benzoate 5 SG @ 0.5 g/l was used as blanket application for the management of defoliators. The treatment details of the experiment are presented in Table 1.

Table 1. Details of the newer insecticides and bio-pesticides evaluated against Lipaphis erysimi (Kalt.) in radish

SL. No.	Treatments	Trade name	Dose/ l
T_1	Imidacloprid 17.8 SL	Confidor	0.3 ml
T_2	Malathion 50 EC	Malathion	2.0 ml
T_3	Dichlorvos 76 EC	G - Vos	1.5 ml
T_4	NSKE 4%	-	-
T_5	Thiamethoxam 25 WG	Actara	0.5 g
T_6	Dinotefuron 20SG	Token	0.3 g
T_7	Dimethoate 30 EC	Tafgor	1.7 ml
T_8	*Fusarium semitectum*	Dept. of Microbiology, COA, Navile, UAHS, Shivamogga.	4.20 X 10^9 spores/ml
T_9	*Verticillium lecanii*	Dept. of Microbiology, COA, Navile, UAHS, Shivamogga.	5.90 X 10^8 spores/ml
T_{10}	Untreated control	-	-

Mass multiplication of *Fusarium semitectum* and *Verticillium lecanii*

The Sabouraud Maltose Agar Yeast (SMAY- Peptone – 5g, Dextrose- 20g and distilled water 500ml) broth for ***Fusarium semitectum*** **and** potato dextrose broth (PDA-Potatoes (sliced, washed and unpeeled) – 200g, Dextrose-20g and distilled water 1000ml) for *Verticillium lecanii* was used for mass production of the fungi. 250 ml of culture broth was taken in a 1000 ml conical flask, autoclaved at 121 ºC (15 lbs) for 20 minutes. Then the broth was cooled and inoculated with the culture of the fungi grown on sorghum grains. The inoculated flask was incubated at room temperature (25 º C) for a week period for the development of the fungus, which developed as fluffy mass. The fungal spores were harvested with the help of a small sterile metal spatula from the culture grown in broth. The spore suspension was prepared using distilled water and filtered through a double layered muslin cloth. The number of spores per ml was calculated by pouring one ml of spore suspension to haemocytometer and fungal spores were counted using phase contrast microscope.

The number of spores per ml was calculated using the following formula.

$$\text{Number of spores per ml} = D \times {}^{X}/_{N} \times K$$

Where, D = dilution factor

X = total number of spores counted

N = number of small squares counted

K = volume above one small square in cm

Area of Small Square is 1/400 mm^2 = 0.0025 mm^2

Depth of liquid above one small square is equal to 0.0025 mm^2 x 0.1 mm = 0.00025 mm^3.

Preparation of Neem Seed Kernel Extract (NSKE)

To prepare one liter of 4% NSKE solution the materials required are as follows: 40 g of well dried neem seed kernels, water (reasonably good quality)- 1 liter, detergent- 1g and muslin cloth for filtering.

40 g of well dried neem seed kernels were powdered using pestle and mortar and soaked for overnight in 500 ml of water. In next day morning the solution was stirred well with wooden plank till solution becomes milky white. Then the solution was filtered through double layer of muslin cloth and volume was made to one liter. One percent of detergent (1 g of detergent was mixed with 100 ml of water) was added with this solution, mixed thoroughly and used for spraying.

From each tagged plant, three leaves were selected from upper, middle and lower part for counting the number of aphids per leaf with help of magnifying lens. In order to obtain the average number of aphids per plant, the following formula was applied:

$$n = \frac{1}{N} \left(r_1 \sum x_1 + r_2 \sum x_2 + r_3 \sum x_3\right)$$

Where, n = average number of counted aphids per plant

N = number of plants sampled (10 in each case in the present work)

r_1 = average number of upper leaves per plant

r_2 = average number of middle leaves per plant

r_3 = average number of lower leaves per plant

x_1 = number of counted aphid per upper leaf

x_2= number of counted aphid per middle leaf

x_3= number of counted aphid per lower leaf

Aphid population was recorded at one day before, three, seven and fourteen days after application of insecticides. The tuber yield per plant was recorded at each harvest separately for each treatment and the yield is converted to kg/plot. Obtained data were analysed using ANOVA.

RESULTS AND DISCUSSION

After three days of treatment imposition, the results showed significant differences among the treatments, whereas the lowest aphid population per plant was recorded with thiomethoxam (15.00), followed by imidacloprid (16.00). Significantly higher aphid population per plant was recorded with *Fusarium semitectum*(36.67) followed by NSKE 4 per cent (34.00), malathion (31.67), *Verticillium lecanii* (29.67), dichlorvos (25.00), dinotefuron (19.67) and dimethoate (17.67). In untreated control, aphid population was 53.33 per plant which was significantly higher compared to other treatments (Table 2).

Table 2. Evaluation of newer insecticide and bio-pesticide molecules against aphids on radish under field condition

Treatments	Mean number of aphids per plant				Mean	Root yield (q/ha)
	DBS	3DAS	7DAS	14DAS		
T_1-Imidacloprid 17.8 SL @ 0.3 ml/l	34.67 (5.89)	16.00 (3.98)^{ef}	7.00 (2.61)^{f}	19.00 (4.24)^{de}	14.00 (3.71)^{de}	62.50^{a}
T_2-Malathion 50 EC @ 2 ml/l	33.67 (5.80)	31.67 (5.60)^{bc}	24.67 (4.93)^{bcd}	30.00 (5.48)^{b}	28.78 (5.35)^{b}	57.67^{d}
T_3- Dichlorvos 76 EC @ 1.5 ml/l	34.67 (5.88)	25.00 (5.00)^{cde}	17.33 (4.13)^{cde}	35.00 (5.92)^{b}	25.78 (5.08)^{bc}	59.17^{cd}
T_4- NSKE 4% @ 5ml/l	35.00 (5.92)	34.00 (5.83)^{bc}	30.33 (5.50)^{b}	27.67 (5.25)^{bc}	30.67 (5.54)^{b}	62.17^{ab}
T_5- Thiamethoxam 25 WG @ 0.5 g/l	40.67 (6.38)	15.00 (3.83)^{f}	6.33 (2.51)^{f}	15.33 (3.89)^{e}	12.22 (3.48)^{e}	62.50^{a}
T_6- Dinutefuron 20 SG @ 0.3 g/l	33.67 (5.80)	19.67 (4.43)^{def}	13.67 (3.65)^{ef}	25.33 (5.03)^{bcd}	19.56 (4.42)^{cd}	60.50^{bc}
T7- Dimethoate 30 EC @ 1.7 ml/l- Standard Check	37.33 (6.11)	17.67 (4.20)^{def}	14.00 (3.71)^{def}	20.00 (4.47)^{cde}	17.22 (4.15)^{de}	61.67^{ab}
T8- *Fusarium semitectum* @ 4.20 x 10^9 spores/ml	40.00 (6.32)	36.67 (6.26)^{ab}	26.67 (5.11)^{bc}	29.67 (5.39)^{bc}	31.00 (5.53)^{b}	58.00^{d}
T9- *Verticillium lecanii* @ 5.90 X 10^8 spores/ml	38.67 (6.22)	29.67 (5.25)^{bcd}	31.00 (5.48)^{b}	31.67 (5.60)^{b}	30.78 (5.49)^{b}	59.17^{cd}
T10- Untreated control	38.67 (6.21)	53.33 (7.176)^{a}	83.67 (9.05)^{a}	104.67 (10.21)^{a}	80.56 (8.92)^{a}	48.67^{e}
SEm ±	0.23	0.53	0.60	0.45	0.38	0.05
CD @ P= 0.05	-	1.11	1.24	0.95	0.67	0.10
CV %	4.66	12.57	15.49	9.99	7.2	1.67

DBS- Day before spraying, DAS- Days after spraying; Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values.

Figures with same alphabets are statistically on par with each other.

Seven days of treatment imposition, the results showed significant differences among the treatments, where the lowest aphid population per plant was recorded with thiomethoxam (6.33), followed by imidacloprid (7.00). Significantly higher aphid population per plant was recorded with *Verticillium lecanii* (31.00) followed by NSKE 4% (30.33), *Fusarium semitectum*(26.67), malathion (24.67), dichlorvos (17.33), dimethoate (14.00) and dinutefuron (13.67). In untreated control, aphid population was significantly higher (83.67 per plant) compared to other treatments (Table 2).

Fourteen days after treatment imposition, the lowest aphid population per plant was recorded with thiomethoxam (15.33), followed by imidacloprid (19.00). Significantly higher aphid population per plant was recorded with dichlorvos (35.00) followed by *Verticillium lecanii* (31.67), malathion (30.00), *Fusarium semitectum*(29.67), NSKE 4 per cent (27.67), dinutefuron (25.33) and dimethoate (20.00). In untreated control, aphid population was 104.67 per plant which was significantly higher compared to other treatments (Table 2).

The overall mean population of aphids per plant was lowest with thiomethoxam (12.22), which was followed by imidacloprid (14.00). Significantly higher mean aphid population per plant was recorded with *Fusarium semitectum*(31.00)followed by *Verticillium lecanii* (30.78), NSKE 4 per cent (30.67), malathion (28.78), dichlorvos (25.78) dinutefuron (19.56) and dimethoate (17.22). In untreated control, mean aphid population was 80.56 per plant which was significantly higher compared to other treatments.

The descending order of toxicity for aphids on radish were thiomethoxam>imidacloprid>dimethoate>dinutefuron>dichlorvos>malathion>NSKE>*Verticillium lecanii*>*Fusarium semitectum*(Table 2).

The root yield of radish in different treatments ranged from 3.28 to 3.75. Highest root yield of 62.50qha^{-1} was recorded in T1 (Imidacloprid 17.8 SL) and T5 (Thiomethoxam 25 WG) being on par with T4 (NSKE 4%) and T7 (Dimethoate 30 EC).

Among the insecticidal and bio-pesticidal treatments lowest root yield of 3.46 kg/plot was observed in T2 (Malathion 50 EC) being on par with T9 (*Verticillium lecanii*), T3 (Dichlorvos 76 EC) and T8 (*Fusarium semitectum*). The untreated control recorded significantly lowest root yield of 48.67 q ha^{-1}(Table 2). Jaydeep *et al.*, 2011 reported that the descending order of toxicity for cabbage aphid *Brevicoryne brassicae* were imidacloprid> thiomethoxam> dimethoate> diafenthiuron> acephate which is also in conformity with Schroeder *et al.* (2001) (against rapeseed and mustard aphid *Brevicoryne brassicae*) and Jehan *et al.* (2013) (against cotton aphid *Aphis gossypii*).

Moreover, thiamethoxam have shown a great potential against different aphid species such as pomegranate aphid, *Aphis punicae* P. (Rouhani *et al.*, 2013); *A. craccivora* Koch (Abdu-Allah, 2012); *B. brassicae* L. (Schroeder *et al.*, 2001); cotton aphid (Dhawan et al., 2008) and Misra (2002).

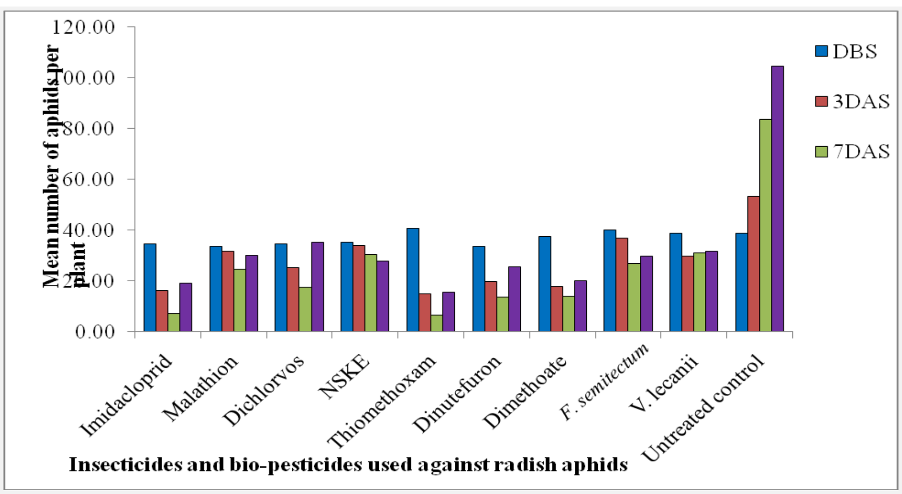

Fig. 1. Evaluation of insecticide and bio-pesticide molecules against aphids on radish

Similarly, imidacloprid have shown a great potential against different aphid species such as *Myzus persicae* in tobacco, *Brevicoryne brassicae* in cabbage (Aslam and Ahmad *et al.,* 2004), chilli aphid (Gopaldas, 2013), El-Dewy (2006) and Gour and Pareek (2003).

Dimethoate was found to be most effective insecticide in reducing aphid population as well as registering the optimum yield was reported by Gami *et al*. (1980); Sekhon *et al*. (2008); Singh and Lal (2011) and Sahoo (2012).

All the insecticides reduced the aphid population compared to untreated control. Thiomethoxam, imidacloprid and dimethoate proved very effective in recording lowest aphid population. The next best treatments were dinutefuron, dichlorvos. Further the biopesticides *viz., Fusarium* *semitectum* and *Verticillium lecanii* and a botanical NSKE proved inferior in reducing aphid population under field condition.

The efficacy of thiomethoxam, imidacloprid and dimethoate has reflected in higher root yield of radish in the present study. The relevant literature on the efficacy of these three insecticides in increasing root yield of radish is wanting. Hence it forms a new report on the efficiency of above three insecticides in increasing the root yield.

REFERENCES

Abdu-Allah, G. 2012. Aphicidal activity of imidacloprid and primicarb compared with certain plant extracts on *Brevicoryne brassicae* L. and *Aphis craccivora* Koch. *Assiut J. Agric. Sci.,* **43:**104–114.

Aslam, M. and M. Ahmad. 2004. Effectiveness of some insecticides against cabbage aphid, *Brevicoryne brassicae* (Linnaeus) (Aphididae: Homoptera). *J. Res.* (Science), Bahauddin Zakariya University, Multan, Pakistan, **13(2)**:145-150.

Dhawan, A.K., S. Sarika and A. Anan. 2008. Relative toxicity of different insecticides against cotton aphid, *Aphis gossypii* Glover. *Environ. Ecol*., **26(4B)**: 2067–2069.

El-dewy, M.H.E., 2006. Toxicological studies on some pests attacking cotton. *Ph.D. Thesis*, Fac. Agric., Kafr El-Sheikh Univ., Egypt, pp. 101.

Gami, J.M., J.G. Bapodra and R.R. Rathod. 1980. Chemical control of mustard aphid, *Lipaphis erysimi* Kaltenbach. *Indian J. Pl. Prot.,* **8(2)**:151-53.

Das, G. 2013. Efficacy of imidacloprid, a nicotinoid group of insecticide against the infestation of chilli aphid, *Myzus persicae* (Hemiptera: Aphididae).*Int. J. Biol. Sci*., **2(11)**:154-159.

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

Halder, J., M.H. Kodandaram and A.B. Rai. 2011. Differential responses of major vegetable aphids to newer insecticide molecules. *Vegetable Sciences*, ***38*(2)**:191-193.

El-Naggar., J.B. and N.E.H.A. Zidan. 2013. Field evaluation of imidacloprid and thiamethoxam against sucking insects and their side effects on soil fauna. *J. Pl. Prot. Res.,* **53(4):**375-388.

Misra, H.P. 2002. Field evaluation of some newer insecticides against aphids (*Aphis gossypii*) and jassids (*Amrasca biguttula*) on okra. *Indian J. Entomol*., 64(1): 80–84.

Rouhani, M., M.A. Samih, H. Izadi and E. Mohammadi. 2013. Toxicity of new insecticides against pomegranate aphid, Aphis punicae. *International Research Journal of Applied and Basic Sciences*, **4(3):** 496-501.

Schroeder, N.C., A.J Dumbleton and S.M. Zydenbos. 2001. Thiamethoxam seed coating on rapeseed for the control of cabbage aphid, *Brevicoryne brassicae*(L.). *N.Z. Pl. Prot.* **54**:240-243.

Sekhon, S.S., S.S. Sajjan and U. Kanta. 2008. Chemical control of mustard aphid, *Lipaphis erysimi*on seed crop of radish. *J. Entomol. Res.* **32(1)**:41-43.

Singh, A. and M.N. Lal. 2011. Ecofriendly approaches for management of mustard aphid, *Lipaphis erysimi* (Kalt.). *M.Sc. (Ag.) Thesis*, NDUA&T, Faizabad, India.

How to cite this article?

Megaladevi, P. and M. Manjunatha. 2019. Management of *Lipaphis erysimi* (Kalt.) using newer insecticides and bio-pesticides in radish. *Innovative Farming*, **4**(4): 196-200.