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Bio-efficacy of newer insecticides against serpentine leaf miner, *Liriomyza trifolii* (Burgess) on watermelon

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Abstract

A field experiment was conducted to evaluate the efficacy of certain newer insecticides against serpentine leaf miner, *Liriomyza trifolii* (Burgess) during *summer* 2019. Among the different chemicals (Abamectin 1.9 EC, 0.00057%, Triazophos 40 EC, 0.05%, Deltamethrin 2.8 EC, 0.0025%, Emamectin benzoate 5 SC, 0.002%, Imidacloprid 17.8 SL, 0.004%, Cyantraniliprole 10.26 OD, 0.018%, Cartap hydrochloride 50 SP, 0.075%), the diamide insecticide cyantraniliprole registered the lowest number of leaf mines (4.34%) and per cent damage on leaves (13.01%) followed by abamectin and deltamethrin. This establishes the supremacy of diamide insecticides in the effective management of serpentine leaf miner on watermelon.

Keywords: Watermelon, serpentine leaf miner, insecticides, bioefficacy, *L. trifolii*

Introduction

Watermelon, *Citrullus lanatus* (Thunb.), is a native of Africa. It is an important dry season crop grown in India for its juicy fruits and its juice contains 92% water with ample amounts of carbohydrates, proteins and minerals (Anonymous, 2019a) [5]. Watermelon is a vining annual plant and it belongs to the family cucurbitaceae. China is the largest producer of watermelon in the world, followed by Turkey, Iran, Brazil and Egypt, while India occupies 25th position world-wide (Anonymous, 2016) [6]. In India, watermelon is mostly grown as a river-bed crop in the states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Karnataka, West Bengal and Tamil Nadu (Chadha, 2013) [7]. Although restricted to certain regions, it is also extensively cultivated in Gujarat as both *rabi* and summer crops. It is cultivated predominantly in the districts of Kheda, Vadodara, Chhota udepur, Sabarkantha and Banaskantha in Gujarat. Insect pests qualitatively and quantitatively affect the watermelon fruit production, which is otherwise a highly productive and remunerative crop. The major insect pests that infest watermelon include cucurbit fruit fly, *Bactrocera cucurbitae* (Coquilett), leaf miners, *Liriomyza trifolii* (Burgess) and *L. sativae* Blanchard, red pumpkin beetle, *Raphidopalpa foveicollis* Lucas, thrips, *Thrips tabaci* Lindeman, whitefly, *Bemisia tabaci* Gennadius, aphid, *Aphis gossypii* Glover and the red spider mite, *Tetranychus urticae* Koch. (Anonymous, 2012) [1]. Among these pests, the serpentine leaf miner, *L. trifolii* produces considerable loss in the crop yield. It is a native of Florida, USA (Spencer, 1973) [13] and it is supposed to have introduced along with chrysanthemum cutting s in the 1970s to California, USA and subsequently to other parts of the world. The first report of its occurrence in India was stated in the proceedings of the annual castor research workers group meeting held at Hyderabad in 1991 (Anonymous, 1991) [2]. *L. trifolii* is a polyphagous pest and is reported from all over India from several host plants (Viraktamath *et al*., 1993) [14]. The adult female of *L. trifolii* makes numerous punctures on the leaf mesophyll with its ovipositor for egg laying as well as for feeding on the exuding plant sap. The leaf puncturing results in stippled appearance of the leaves (Parella *et al*., 1985) [11]. The newly emerged larva remains concealed inside the leaf, feeds on the leaf mesophyll and produces conspicuous irregular mines on the upper surface of the leaves. Both the leaf stippling and mining processes cause considerable reduction in the effective photosynthetic area of the plant and which is reflected in the yield. In watermelon, a high leaf damage of about 37% has been reported due to the serpentine leaf miner (Patnaik, 2000) [12].

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Excessive mining may cause premature leaf drop (Ledieu and Bartlett, 1983) [8] and subsequent scalding of watermelon fruits. Apart from causing direct losses, it also produces wounds on the plant foliage and pre-disposes the plant to attack of bacterial and fungal pathogens. Also, transmission of viral diseases (Celery and watermelon mosaic virus) by the leaf miner adult has been demonstrated by Zitter and Tsai (1977) [15]. Considering the magnitude of damage *L. trifolii* causes in the watermelon crop, it is essential that investigations are to be made in order to prevent the pest from assuming a serious pest status.

Materials and Methods

This experiment was conducted during summer 2019 at College of Agriculture, Anand Agricultural University, Jabugam, Gujarat on Sugar queen variety to evaluate newer insecticides against serpentine leaf miner, *L. trifolii*. The experiments were carried out in completely randomized block design (RBD) with eight treatments including control, replicated thrice. The watermelon crop was raised according to the recommended agronomical practices. A selected set of insecticides against the leaf miner in different crops were tested for their efficacy in managing the pest in watermelon. The first spray of respective insecticides were made at 5 per cent leaf damage and subsequent second spray was applied after 15 days after the first spray by using high volume sprayer (knapsack) with required concentration. Five plants were selected randomly from each net plot area. The healthy and infested leaves by *L. trifolii* larvae were counted on randomly selected plants from each plot whereas mines were recorded on each plant. Observations of leaf mines were recorded before spray, as well as 5, 10 and 15 days after each spray. The yield of melon fruits was recorded at each picking. The effectiveness of the treatments was judged based on the efficacy of the insecticides against *L. trifolii*. The data were subjected to statistical analysis and are presented in Table 1 and 2.

Results and Discussion

Efficacy based on mines per leaf

Overall efficacy of seven insecticides showed that all the chemicals were significantly superior to control in reducing the *L. trifolii* population. The data on number of mines per leaf and per cent damaged leaves was obtained, which is represented in Table 1 and 2. Uniform population of the pest was observed on before the sprays. Among the various chemicals evaluated, the treatment of cyantraniliprole, 0.018% (2.20 mines/ leaf) and abamectin, 0.00057% (2.28 mines/ leaf) produced excellent results in the suppression of the leaf mines even at 15 days after their respective sprays. The treatments of deltamethrin, 0.0025% (2.85 mines/ leaf) also exhibited considerable suppression of leaf mines. Further, the chronological order of the efficacy of the remaining treatments was as follows: cartap hydrochloride, 0.075% (2.91 mines/ leaf) > imidacloprid, 0.004% (2.93 mines/ leaf) > emamectin benzoate, 0.002% (3.44 mines/ leaf) > triazophos, 0.05% (3.47 mines/ leaf). All treatments were found effective in reducing the leaf mines over the control plots (4.73 mines/ leaf). This is in close conformity with the report Anonymous (2019b) [4] where it was recorded that cyantraniliprole was the most effective insecticidal treatment against the leaf miner infesting watermelon, followed by deltamethrin and flonicamid. Mishra (2015) [10] from Bhubaneswar, Odisha observed similar trends in the management of leaf miner in gherkins, where it was documented that cyantraniliprole was found superior among the tested insecticides. Mandal (2012) [9] also reported that cyantraniliprole was found better over the standard checks of imidacloprid and fipronil, in controlling the leaf miner in tomato. The present findings are in concordance with the above reports.

Table 1: Leaf mines caused by *L. trifolii* in different insecticides evaluated on watermelon

S. No.	Treatments	No. of mines/leaf (days after spray)									Pooled over periods and sprays
		First spray					Second spray				
		Before spray	5	10	15	Pooled	5	10	15	Pooled	
1	Abamectin 1.9 EC, 0.00057%	4.54a (20.11)	*3.09cd (9.05)	2.35de (5.02)	2.45cd (5.50)	2.63d (6.42)	2.12e (3.99)	1.95d (3.30)	1.76d (2.60)	1.94d (3.26)	2.28d (4.70)
2	Triazophos 40 EC, 0.05%	4.62a (20.84)	4.20ab (17.14)	3.43b (11.26)	3.58b (12.32)	3.74b (13.49)	3.30b (10.39)	3.19b (9.68)	3.10b (9.11)	3.20b (9.74)	3.47b (11.54)
3	Deltamethrin 2.8 EC, 0.0025%	4.65a (21.12)	3.58bc (12.32)	2.85cd (7.62)	2.99bc (8.44)	3.14c (9.36)	2.68d (6.68)	2.56c (6.05)	2.42c (5.36)	2.55c (6.00)	2.85c (7.62)
4	Emamectin benzoate 5 SC, 0.002%	4.60a (20.66)	4.20ab (17.14)	3.43b (11.26)	3.58b (12.32)	3.73b (13.41)	3.26bc (10.13)	3.15b (9.42)	3.02b (8.62)	3.14b (9.36)	3.44b (11.33)
5	Imidacloprid 17.8 SL, 0.004%	4.51a (19.84)	3.63bc (12.68)	2.98bc (8.38)	3.06b (8.86)	3.22c (9.87)	2.79cd (7.28)	2.64c (6.47)	2.50c (5.75)	2.64c (6.47)	2.93c (8.08)
6	Cyantraniliprole 10.26 OD, 0.018%	4.56a (20.29)	2.97d (8.32)	2.27e (4.65)	2.39d (5.21)	2.54d (5.95)	2.05e (3.70)	1.88d (3.03)	1.68d (2.32)	1.87d (3.00)	2.20d (4.34)
7	Cartap hydrochloride 50 SP, 0.075%	4.43a (19.12)	3.62bc (12.60)	2.95bc (8.20)	3.04b (8.74)	3.21c (9.80)	2.77d (7.17)	2.62c (6.36)	2.49c (5.70)	2.62c (6.36)	2.91c (7.97)
8	Control	4.68a (21.40)	4.63a (20.94)	4.68a (21.40)	4.70a (21.59)	4.67a (21.31)	4.78a (22.35)	4.79a (22.44)	4.82a (22.73)	4.80a (22.54)	4.73a (21.87)
	S. Em. ± Treatment (T)	0.08	0.19	0.16	0.18	0.09	0.14	0.15	0.13	0.08	0.06
	C.V. (%)	2.93	8.69	8.95	9.63	8.71	8.20	9.41	8.35	8.31	8.51

*Figures in parentheses are retransformed values, those outside are $\sqrt{x + 0.5}$ transformed values.
Treatment means with letter(s) in common are not significant by DNMRT at 5% level of significance

Efficacy based on per cent leaf damage

The pre-count data on per cent damage of leaves recorded before insecticide sprays indicated uniform population of *L. trifolii*. The post-sprays data on per cent damage on leaves was found the lowest in case of cyantraniliprole, 0.018% (13.01%) followed by abamectin, 0.00057% (13.21%), which was on par with cyantraniliprole. Further, the ordinal rank of treatments in the decreasing order of per cent damage on leaves was observed as: deltamethrin, 0.0025% (19.15%) > cartap hydrochloride, 0.075% (20.44%) > imidacloprid, 0.004% (20.81%) > emamectin benzoate, 0.002% (27.91%) > triazophos, 0.05% (28.03%). All insecticidal treatments were found better over the control plots (41.95%) in managing the per cent damage on leaves. This is in affirmative with the report of Anonymous (2019b) [4] where cyantraniliprole was recorded the most effective insecticidal treatment against the leaf miner infesting watermelon, followed by deltamethrin and flonicamid. The present findings are in concordance with Mishra (2015) [10] from Bhubaneswar, Odisha observed similar trends in the management of leaf miner in gherkins, where it was documented that cyantraniliprole was tested superior among the various insecticides. Mandal (2012) [9] also reported that cyantraniliprole was found better over the standard checks of imidacloprid and fipronil, in controlling the leaf miner in tomato.

Table 2: Leaf damage due to *L. trifolii* in different insecticidal treatments evaluated on watermelon

S. No.	Treatments	No. of mines/leaf (days after spray)									Pooled over periods and sprays
		First spray					Second spray				
		Before spray	5	10	15	Pooled	5	10	15	Pooled	
1	Abamectin 1.9 EC, 0.00057%	37.97a (37.85)	*26.17c (19.45)	24.08d (16.65)	22.67d (14.86)	24.31d (16.95)	19.74e (11.41)	18.22d (9.78)	17.01d (8.56)	18.32d (9.88)	21.31d (13.21)
2	Triazophos 40 EC, 0.05%	37.49a (37.04)	35.47ab (33.67)	34.74b (32.47)	33.81b (30.96)	34.67b (32.36)	30.68b (26.03)	28.93b (23.40)	28.19b (22.32)	29.27b (23.90)	31.97b (28.03)
3	Deltamethrin 2.8 EC, 0.0025%	37.64a (37.30)	30.75bc (26.14)	28.85cd (23.28)	27.36cd (21.12)	28.99c (23.49)	24.19de (16.79)	22.69cd (14.88)	21.88cd (13.89)	22.92c (15.17)	25.95c (19.15)
4	Emamectin benzoate 5 SC, 0.002%	37.99a (37.89)	35.42ab (33.59)	34.68b (32.38)	33.77b (30.90)	34.63b (32.29)	30.41bc (25.62)	28.91b (23.37)	28.14b (22.24)	29.15b (23.73)	31.89b (27.91)
5	Imidacloprid 17.8 SL, 0.004%	38.26a (38.34)	30.28bc (25.42)	29.95bc (24.92)	29.29bc (23.93)	30.10c (25.15)	25.46cd (18.48)	23.96bc (16.49)	23.54bc (15.95)	24.32c (16.96)	27.18c (20.81)
6	Cyantraniliprole 10.26 OD, 0.018%	38.12a (38.11)	26.15c (19.42)	23.99d (16.53)	22.67d (14.86)	24.27d (16.90)	19.53e (11.18)	17.67d (9.21)	16.83d (8.38)	18.01d (9.56)	21.14d (13.01)
7	Cartap hydrochloride 50 SP, 0.075%	38.63a (38.97)	30.79bc (26.20)	29.86bc (24.79)	28.94bc (23.42)	29.86c (24.79)	25.29cd (18.25)	23.60bc (16.03)	22.79bc (15.00)	23.90c (16.41)	26.88c (20.44)
8	Control	37.93a (37.79)	40.07a (41.44)	40.14a (41.56)	40.27a (41.78)	40.16a (41.59)	40.35a (41.92)	40.63a (42.40)	40.75a (42.61)	40.58a (42.32)	40.37a (41.95)
	S. Em. ± Treatment (T)	0.49	1.48	1.57	1.53	0.84	1.53	1.63	1.65	0.89	0.60
	C.V. (%)	2.22	8.02	8.81	8.85	8.18	9.83	11.07	11.51	10.31	9.06

*Figures in parentheses are retransformed values, those outside are arc sine transformed values.
Treatment means with letter(s) in common are not significant by DNMRT at 5% level of significance

Conclusion

From the above results, it can be inferred that among the chemicals, the diamide insecticide cyantraniliprole, 0.018% registered the lowest number of leaf mines (4.34%) and per cent damage on leaves (13.01%) followed by abamectin, 0.00057% and deltamethrin, 0.0025%. This establishes the supremacy of diamide insecticides in the effective management of leaf miners.

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